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**OAKLAND COMMUNITY COLLEGE**  
SOUTHFIELD CAMPUS  
DRIVING PAD

22322 RUTLAND DRIVE  
SOUTHFIELD, MICHIGAN

Project Manual

OCC Project No. SF25-003  
IDS Project No. 24140-1000

April 3, 2025  
Bids

# Project Manual

**Oakland Community College  
Southfield Campus  
Driving Pad  
Southfield, Michigan**

**OCC Project No. SF25-003**

## **INTEGRATED design SOLUTIONS**

architecture engineering interiors & technology

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IDS Project No. 24140-1000

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## **SECTION 01 1000 - SUMMARY**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Project Information.
  - 2. Work Performed by Owner.
  - 3. Owner-furnished/Contractor-installed (OFCI) products.
  - 4. Owner-furnished/Owner-installed (OFOI) products.
  - 5. Contractor's use of site and premises.
  - 6. Coordination with occupants
  - 7. Work restrictions.
  - 8. Specification and Drawing conventions.

#### **1.3 PROJECT INFORMATION**

- A. Project Identification: Oakland Community College, Southfield Campus, Driving Pad, OCC Project No. SF25-003, IDS Project No. 24140-1000
  - 1. Project Location: 22322 Rutland Drive, Southfield, Michigan.
- B. Owner: Oakland Community College, 22322 Rutland Drive, Southfield, Michigan.
- C. Architect: Integrated Design Solutions.
  - 1. Offices:
    - a. 1441 West Long Lake Road, Suite 200, Troy, Michigan.
    - b. 5211 Cascade Road SE, Suite 300, Grand Rapids, Michigan.

#### **1.4 WORK PERFORMED BY OWNER (If any)**

- A. Cooperate fully with Owner, so work may be carried out smoothly, without interfering with or delaying Work under this Contract or work by Owner. Coordinate the Work of this Contract with work performed by Owner.

#### **1.5 OWNER-FURNISHED/CONTRACTOR-INSTALLED (OFCI) PRODUCTS (If any)**

- A. Owner's Responsibilities: Owner will furnish products indicated and perform the following, as applicable:
  - 1. Provide to Contractor Owner-reviewed Product Data, Shop Drawings, and Samples.
  - 2. Provide for delivery of Owner-furnished products to Project site.

3. Upon delivery, inspect, with Contractor present, delivered items.
    - a. If Owner-furnished products are damaged, defective, or missing, arrange for replacement.
  4. Obtain manufacturer's inspections, service, and warranties.
  5. Inform Contractor of earliest available delivery date for Owner-furnished products.
- B. Contractor's Responsibilities: The Work includes the following, as applicable:
1. Designate delivery dates of Owner-furnished products in Contractor's construction schedule, utilizing Owner-furnished earliest available delivery dates.
  2. Review Owner-reviewed Product Data, Shop Drawings, and Samples, noting discrepancies and other issues in providing for Owner-furnished products in the Work.
  3. Receive, unload, handle, store, protect, and install Owner-furnished products.
  4. Make building services connections for Owner-furnished products.
  5. Protect Owner-furnished products from damage during storage, handling, and installation and prior to Substantial Completion.
  6. Repair or replace Owner-furnished products damaged following receipt.
- C. Owner-Furnished/Contractor-Installed (OFCI) Products: (If any)
1. As indicated on Drawings and in Specification Sections.

#### **1.6 OWNER-FURNISHED/OWNER-INSTALLED (OFOI) PRODUCTS (If any)**

- A. The Owner will furnish and install products indicated.
- B. Owner-Furnished/Owner-Installed (OFOI) Products: (If any)
1. As indicated on Drawings and in Specification Sections.

#### **1.7 CONTRACTOR'S USE OF SITE AND PREMISES**

- A. Restricted Use of Site: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.
- B. Limits on Use of Site: Limit use of Project site to Work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
1. Driveways, Walkways and Entrances: Keep driveways, loading areas, and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or for storage of materials.
    - a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
    - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- C. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.
- D. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

## **1.8 COORDINATION WITH OCCUPANTS**

- A. Partial Owner Occupancy: Owner will occupy the premises during entire construction period, with the exception of areas under construction. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's operations. Maintain existing exits unless otherwise indicated.
  - 1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and authorities having jurisdiction.
  - 2. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.

## **1.9 WORK RESTRICTIONS**

- A. Comply with restrictions on construction operations.
  - 1. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.
- B. On-Site Work Hours: Limit work to between 7:00 a.m. to 7:00 p.m., Monday through Friday, unless otherwise indicated or required by Owner. Work hours may be modified to meet Project requirements if approved by Owner and authorities having jurisdiction.
  - 1. Weekend Hours: 7:00 a.m. to 7:00 p.m; subject to Owner approval.
- C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging for temporary utility services according to requirements indicated:
  - 1. Notify Architect, Construction Manager, and Owner not less than two days in advance of proposed utility interruptions.
  - 2. Obtain Owner's written permission before proceeding with utility interruptions.
- D. Noise, Vibration, Dust, and Odors: Coordinate operations that may result in high levels of noise and vibration, dust, odors, or other disruption to Owner occupancy with Owner.
  - 1. Notify Architect, Construction Manager, and Owner not less than two days in advance of proposed disruptive operations.
  - 2. Obtain Owner's written permission before proceeding with disruptive operations.
- E. Smoking and Controlled Substance Restrictions: Use of tobacco products, alcoholic beverages, and other controlled substances on Project site on Owner's property is not permitted.
- F. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.

## **1.10 SPECIFICATION AND DRAWING CONVENTIONS**

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
  2. Text Color: Text used in the Specifications, including units of measure, manufacturer and product names, and other text may appear in multiple colors or underlined as part of a hyperlink; no emphasis is implied by text with these characteristics.
  3. Hypertext: Text used in the Specifications may contain hyperlinks. Hyperlinks may allow for access to linked information that is not residing in the Specifications. Unless otherwise indicated, linked information is not part of the Contract Documents.
  4. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 00 Contracting Requirements: General provisions of the Contract, including General and Supplementary Conditions, apply to all Sections of the Specifications.
1. Conflicting Requirements within Division 00: Division 00 Sections contained within this volume, listed in this volume's Table of Contents, and authored by the Architect, take precedence over other Division 00 Sections including, but not limited to, sections authored by the Construction Manager; regardless of any language stating otherwise.
- C. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
1. Conflicting Requirements within Division 01: Division 01 Sections contained within this volume, listed in this volume's Table of Contents, and authored by the Architect, take precedence over other Division 01 Sections including, but not limited to, sections authored by the Construction Manager; regardless of any language stating otherwise.
- D. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
  2. Abbreviations: Materials and products are identified by abbreviations scheduled on Drawings.
  3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

### **PART 2 - PRODUCTS (Not Used)**

### **PART 3 - EXECUTION (Not Used)**

**END OF SECTION 01 1000**

## **SECTION 01 2500 – SUBSTITUTION PROCEDURES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section includes administrative and procedural requirements for substitutions.

#### **1.3 DEFINITIONS**

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents.
  - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
  - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required to meet other Project requirements but may offer advantage to Contractor or Owner.

#### **1.4 ACTION SUBMITTALS**

- A. Substitution Requests: Submit documentation identifying product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
  - 1. Substitution Request Form: Use 01 2500.01 – Substitution Request Form, provided in Project Manual.
  - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
    - a. Provide the following with all Substitution Requests. Substitution Requests without the following information will be rejected.
      - 1) Product Data, including drawings and descriptions of products and fabrication and installation procedures.
      - 2) Point-by-point, Comparative Data: Provide detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
    - a) Provide detailed comparison on a single page. Include side-by-side, itemized, comparative data of specified product and proposed Substitution comparing essential attributes specified. Alternatively provide annotated copy of applicable Specification Section indicating differences.
  - b. Statement indicating why specified product or fabrication, or installation method cannot be provided, if applicable.
  - c. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.

- d. Samples, where applicable or requested.
  - e. Certificates and qualification data, where applicable or requested.
  - f. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
  - g. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
  - h. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
  - i. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
  - j. Cost information, including a proposal of change, if any, in the Contract Sum.
  - k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
  - l. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor through Construction Manager of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
- a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
  - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

## **1.5 QUALITY ASSURANCE**

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

## **1.6 PROCEDURES**

- A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

## **1.7 SUBSTITUTIONS**

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.
1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
- a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
  - b. Substitution request is fully documented and properly submitted.
  - c. Requested substitution will not adversely affect Contractor's construction schedule.



- d. Requested substitution has received necessary approvals of authorities having jurisdiction.
  - e. Requested substitution is compatible with other portions of the Work.
  - f. Requested substitution has been coordinated with other portions of the Work.
  - g. Requested substitution provides specified warranty.
  - h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
- B. Substitutions for Convenience: Architect will consider requests for substitution if received within 60 days after commencement of the Work. Requests received after that time may be considered or rejected at discretion of Architect.
1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
- a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
  - b. Requested substitution does not require extensive revisions to the Contract Documents.
  - c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
  - d. Substitution request is fully documented and properly submitted.
  - e. Requested substitution will not adversely affect Contractor's construction schedule.
  - f. Requested substitution has received necessary approvals of authorities having jurisdiction.
  - g. Requested substitution is compatible with other portions of the Work.
  - h. Requested substitution has been coordinated with other portions of the Work.
  - i. Requested substitution provides specified warranty.
  - j. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION (Not Used)**

**END OF SECTION 01 2500**

## SUBSTITUTION REQUEST FORM

Substitution Request Number: \_\_\_\_\_ Date Submitted: \_\_\_\_\_

IDS Project Number: \_\_\_\_\_

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

### SPECIFIED ITEM

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

Specification Section No.: \_\_\_\_\_ Specification Article / Paragraph: \_\_\_\_\_

Specified Item / Description: \_\_\_\_\_

Specified Manufacturer: \_\_\_\_\_ Specified Item / Model: \_\_\_\_\_

Reason for not providing specified item (*If after Bidding*): \_\_\_\_\_

\_\_\_\_\_

### PROPOSED SUBSTITUTION

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

Proposed Manufacturer: \_\_\_\_\_ Proposed Item / Model: \_\_\_\_\_

Manufacturer's Website: \_\_\_\_\_

Manufacturer's Address: \_\_\_\_\_

Years manufacturer has been in business: \_\_\_\_\_ Years item / model has been manufactured: \_\_\_\_\_

Differences between proposed Substitution and specified item: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Will proposed Substitution affect other parts of work? ☐ No ☐ Yes

If Yes, provide explanation: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Benefit of proposed Substitution (*If after Bidding*): ☐ Cost savings ☐ Time savings ☐ Other

Provide explanation of Benefit: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

IDS Project Number: \_\_\_\_\_

Provide the following information. Check box to indicate information has been attached. **Substitution Requests without the following information will be rejected.**

☐ Product data sheets.

☐ Point-by-point, comparative data.

Provide side-by-side, itemized, comparative data of specified product and proposed Substitution comparing essential attributes specified (gages, sizes, performance requirements, finishes, etc.). Alternatively provide annotated copy of applicable Specification Section indicating differences.

Indicate if any additional information is attached:

☐ Applicable certificates and test reports. ☐ List of References where proposed product is installed.

☐ Drawings. ☐ Samples. ☐ Other Items: \_\_\_\_\_

### **SUBMITTED BY**

The Undersigned certifies, except as otherwise indicated in Substitution Request:

- Substitution is equal or superior in all respects to specified product.
- Substitution complies with requirements in the Contract Documents, is compatible with related materials, and is appropriate for applications indicated.
- Same warranty will be provided for the Substitution as for the specified product.
- Same or equivalent maintenance service and source of replacement parts, as applicable, shall be available.
- Substitution will have no adverse effect on other trades and will not affect or delay project schedule.
- Substitution will not affect dimensions and functional clearances.
- Undersigned agrees to coordinate installation of the Substitution and any changes in the Work as necessary for installation of the Substitution.
- Costs for changes to the Work and any other costs caused by the Substitution; including, but not limited to, A/E design changes, detailing, and dimensioning, shall be paid by the undersigned.
- Undersigned waives claims for additional costs and time extensions that may subsequently become apparent after Substitution is approved.

Contractor / Company: \_\_\_\_\_

Signed By: \_\_\_\_\_ Printed Name: \_\_\_\_\_

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

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

Email: \_\_\_\_\_ Phone: \_\_\_\_\_

### **ARCHITECT'S RESPONSE**

- During bidding, Architect will approve Substitution by issuing an Addendum, Substitutions not approved by addendum are rejected.
- During construction, Architect will notify Contractor in writing (see below) of decision to accept or reject a Substitution. Accepted Substitutions shall be incorporated into the Work by Change Order, Construction Change Directive, Architectural Supplementary Instructions, or similar instruments as provided for in the Conditions of the Contract.

☐ Substitution Approved - Provide submittals in accordance with Specification Section 01 3000 – Submittal Procedures, as noted by Architect in Substitution Request, and in accordance with respective section for which substitution was made.

☐ Substitution Rejected - Provide specified materials.

Signed By: \_\_\_\_\_ Printed Name: \_\_\_\_\_

Architect's Comments: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_ Date: \_\_\_\_\_

## **SECTION 01 3300 - SUBMITTAL PROCEDURES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Submittal schedule requirements.
  - 2. Administrative and procedural requirements for submittals.
  - 3. Submittal Form.
  - 4. CAD/BIM File Release Form.

#### **1.3 DEFINITIONS**

- A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."
- C. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

#### **1.4 SUBMITTAL SCHEDULE**

- A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.
  - 1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
  - 2. Submit revised submittal schedule as required to reflect changes in current status and timing for submittals.
  - 3. Format: Arrange the following information in a tabular format:
    - a. Scheduled date for first submittal.
    - b. Specification Section number and title.
    - c. Submittal Category: Action; informational.
    - d. Name of subcontractor.

- e. Description of the Work covered.
- f. Scheduled date for Architect's final release or approval.

## **1.5 SUBMITTAL FORMATS**

- A. Submittals shall be electronic, unless otherwise indicated.
  - 1. Prepare submittals as a single PDF package, incorporating complete information into PDF file.
    - a. Name PDF file with submittal number.
- B. Submittal Information: Include the following information in each submittal:
  - 1. Project name.
  - 2. Date.
  - 3. Name of Architect.
  - 4. Name of Construction Manager.
  - 5. Name of Contractor.
  - 6. Name of firm or entity that prepared submittal.
  - 7. Names of subcontractor, manufacturer, and supplier.
  - 8. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier and alphanumeric suffix for resubmittals.
  - 9. Category and type of submittal.
  - 10. Submittal purpose and description.
  - 11. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
  - 12. Drawing number and detail references, as appropriate.
  - 13. Indication of full or partial submittal.
  - 14. Location(s) where product is to be installed, as appropriate.
  - 15. Other necessary identification.
  - 16. Remarks.
  - 17. Signature of transmitter.
- C. Options: Identify options requiring selection by Architect.
- D. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.

## **1.6 SUBMITTAL PROCEDURES**

- A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
  - 1. Email: Prepare each submittal as a single PDF package and transmit to Architect, through Construction Manager, by sending via email.
    - a. Send submittals to the following email address:
      - 1) shop\_drawings@ids-michigan.com
    - b. Subject Line: The Subject line of email should indicate the IDS project number, the project name, and specification section number (In this order).

- c. IDS submittal form must be completed and included at the beginning of, and in the same PDF, as the submittal.
    - d. Submit only one specification section in each e-mail.
    - e. Architect, through Construction Manager, will return review comments in a PDF file.
  2. Web-Based Project Management Software: When used for a Project, prepare submittals in PDF form, and upload to web-based Project management software website instead of using email.
    - a. Enter required data in web-based software site to fully identify submittal.
    - b. IDS submittal form must be completed and included at the beginning of, and in the same PDF, as the submittal.
    - c. Submit only one specification section in each e-mail.
- B. Submittal Form:
  1. Refer to copy of form at the end of this Section.
    - a. Additionally, at construction kick-off meeting the Architect will transmit the Submittal Form to the Contractor in both Word and PDF format.
  2. Complete and fill out the following information on the submittal form.
    - a. Item (1) – Project Title/Location: Refer to Title Page of specifications. Include Bid Package number, if applicable.
    - b. Item (2) – From/Return to: Contractor's/Construction Manager's name and address to whom submittal is to be returned
    - c. Item (3) - IDS Project No.: Integrated Design Solutions' project number.
    - d. Item (4) - Submittal Date:
    - e. Item (5) - Submittal Number: Use 1, 2, 3, etc. for easy reference of each separate submittal.
    - f. Item (6) - If this is a Partial Submittal of this item, check the box and use "1.1", "1.2", etc. in the submittal number space. If this is a complete submittal, do not check box.
    - g. Item (7) - If this is a resubmittal (revision to a previous submittal), check the box and use the original submittal number and number the submittal "1A", "1B", etc in the submittal number space. If this is a new submittal, do not check box.
    - h. Item (8) – Project Manual Section No.: Indicate the Project Manual Specification Section number relating to the submittal
    - i. Item (9) – Product Manufacturer: Insert name of product manufacturer.
    - j. Item (10) - Item Description (specific information, not just "drawings", i.e. Curtainwall Shop Drawings.
    - k. Item (11) – Number of copies. Indicate the number of copies, product data, samples, etc. of each item being submitted.
    - l. Item (12) – Contractor's/Construction Manager's Remarks & Deviations (if any): Indicate appropriate remarks and note any deviations from the requirements of the Contract Documents, as required, and sign the certification that all submittals have been reviewed.
    - m. Item (13) – Addendum or Bulletin (if any): Indicate if submittal information is based on an addendum or bulletin. Indicate number of issue.
    - n. Item (14) – Substitution (if any): Indicate whether the submittal was approved under a separate Substitution
- C. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
  1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
  2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
  3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.

4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections, so processing will not be delayed because of need to review submittals concurrently for coordination.
  - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- D. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
  1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect, through Construction Manager, will advise Contractor when a submittal being processed must be delayed for coordination.
  2. Resubmittal Review: Allow 15 days for review of each resubmittal.
  3. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is required, allow 21 days for initial review of each submittal.
- E. Resubmittals: Make resubmittals in same format as initial submittal.
  1. Note date and content of previous submittal.
  2. Note date and content of revision in label or title block, and clearly indicate extent of revision.
  3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.
- F. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- G. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

## 1.7 SUBMITTAL REQUIREMENTS

- A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
  1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
  2. Mark each copy of each submittal to show which products and options are applicable.
  3. Include the following information, as applicable:
    - a. Manufacturer's catalog cuts.
    - b. Manufacturer's product specifications.
    - c. Standard color charts.
    - d. Statement of compliance with specified referenced standards.
    - e. Testing by recognized testing agency.
    - f. Application of testing agency labels and seals.
    - g. Notation of coordination requirements.
    - h. Availability and delivery time information.
  4. For equipment, include the following in addition to the above, as applicable:
    - a. Wiring diagrams that show factory-installed wiring.
    - b. Printed performance curves.
    - c. Operational range diagrams.

- d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
  5. Submit Product Data before Shop Drawings, and before or concurrently with Samples.
- B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
  1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
    - a. Identification of products.
    - b. Schedules.
    - c. Compliance with specified standards.
    - d. Notation of coordination requirements.
    - e. Notation of dimensions established by field measurement.
    - f. Relationship and attachment to adjoining construction clearly indicated.
    - g. Seal and signature of professional engineer if specified.
- C. Samples: Submit Samples for review of type, color, pattern, and texture for a check of these characteristics with other materials.
  1. Transmit Samples that contain multiple, related components, such as accessories together in one submittal package.
  2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
    - a. Project name and submittal number.
    - b. Generic description of Sample.
    - c. Product name and name of manufacturer.
    - d. Sample source.
    - e. Number and title of applicable Specification Section.
    - f. Specification paragraph number and generic name of each item.
  3. Email or Web-Based Transmittal: Provide PDF transmittal. Include digital image illustrating Sample characteristics and identification information for record.
    - a. In addition to electronic submittal, submit actual physical samples.
  4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
    - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
    - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
  5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units, showing the full range of colors, textures, and patterns available.
    - a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect, through Construction Manager, will return submittal with options selected.



6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
  - a. Number of Samples: Submit three sets of Samples. Architect and Construction Manager will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record Sample.
    - 1) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
  1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
  2. Manufacturer and product name, and model number if applicable.
  3. Number and name of room or space.
  4. Location within room or space.
- E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.
- G. Certificates:
  1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
  2. Installer Certificates: Submit written statements on manufacturer's letterhead, certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
  3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead, certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
  4. Material Certificates: Submit written statements on manufacturer's letterhead, certifying that material complies with requirements in the Contract Documents.
  5. Product Certificates: Submit written statements on manufacturer's letterhead, certifying that product complies with requirements in the Contract Documents.
  6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of AWS B2.1/B2.1M on AWS forms. Include names of firms and personnel certified.

H. Test and Research Reports:

1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for substrate preparation and primers required.
2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
  - a. Name of evaluation organization.
  - b. Date of evaluation.
  - c. Time period when report is in effect.
  - d. Product and manufacturers' names.
  - e. Description of product.
  - f. Test procedures and results.
  - g. Limitations of use.

**1.8 DELEGATED-DESIGN SERVICES**

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.
  2. When requested by Architect, provide three paper copies of certificate, signed and sealed by the responsible design professional

**1.9 CONTRACTOR'S REVIEW**

- A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.

- B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.
1. Architect will not review submittals received from Contractor that do not have Contractor's review and approval.

#### **1.10 ARCHITECT'S REVIEW**

- A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, and return.
1. Architect will indicate, via markup on each submittal, the appropriate action, as follows:
- a. No Exceptions Taken: Work covered by the submittal may proceed provided it complies with requirements of the Contract Documents. Final payment depends on that compliance.
  - b. Exceptions As Noted: Work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and requirements of the Contract Documents. Final payment depends on that compliance.
  - c. Revise and Resubmit: Do not proceed with Work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise submittal according to the notations or corrections; resubmit without delay. Repeat as necessary, until "No Exceptions Taken" or "Exceptions As Noted" review mark is obtained.
    - 1) Do not use, or allow others to use, submittals marked "Revise and Resubmit" at the Project Site or elsewhere where Work is in progress.
  - d. Rejected: Do not proceed with Work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare a new submittal according to the notations; resubmit without delay. Repeat as necessary, until "No Exceptions Taken" or "Exceptions As Noted" review mark is obtained.
    - 1) Do not use, or allow others to use, submittals marked "Rejected" at the Project Site or elsewhere where Work is in progress.
  - e. Action Not Required: Indicates that no action is required. Submittal has been received for record only.
- B. Informational Submittals: Architect will review each submittal and will not return it or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect and Construction Manager.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Architect will return without review submittals received from sources other than Contractor.
- F. Submittals not required by the Contract Documents will be returned by Architect without action.

**1.11 CAD/BIM FILE RELEASE FORM**

- A. Contractor's use of architect's computer-aided drafting (CAD) or building information modeling (BIM) files.
1. At Contractor's written request, copies of Architect's Computer-Aided Drafting (CAD) or Building Information Modeling (BIM) files will be provided to Contractor for Contractor's use in connection with Project, subject to the following conditions:
    - a. Contractor shall submit a fully executed "Request for Integrated Design Solutions, LLC (IDS) from Contractor For Transfer of Computer-Aided Drafting (CAD) or Building Information Modeling (BIM) Files on Electronic Media" form indicating acceptance of the terms and conditions therein.
      - 1) Refer to copy of form at the end of this Section.

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION (Not Used)**

**END OF SECTION 01 3300**

# SUBMITTAL FORM

Project Title <sup>(1)</sup> :	
IDS Project No. <sup>(3)</sup> :	
Submittal Date <sup>(4)</sup> :	

From/Return To <sup>(2)</sup> :

Submittal No. <sup>(5)</sup> :		<input type="checkbox"/> Partial <sup>(6)</sup> <input type="checkbox"/> Resubmittal <sup>(7)</sup>	IDS Submittal No.:	
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Project Manual Section No. <sup>(8)</sup> :		Manufacturer(s) <sup>(9)</sup> :	
---	--	----------------------------------	--

Item Description <sup>(10)</sup>	Print <sup>(11)</sup>	Product Data	Sample	Other	<input type="checkbox"/> A	<input type="checkbox"/> M	<input type="checkbox"/> E	<input type="checkbox"/> EN	<input type="checkbox"/> S	<input type="checkbox"/> C	<input type="checkbox"/> DN	<input type="checkbox"/> FS	<input type="checkbox"/> IN	<input type="checkbox"/> TE

Contractor's/Construction Manager's Remarks and Deviations <sup>(12)</sup> :
Addendum or Bulletin: <sup>(13)</sup>
Substitution: <sup>(14)</sup>
<p>The undersigned certifies that the above submitted items have been reviewed in detail, including materials, quantities, dimensions, specified performance criteria, installation requirements, catalog numbers and field conditions and are correct and in strict compliance with the Contract Documents, except as the undersigned has noted otherwise. Approval of items does not relieve the Contractor/Construction Manager from complying with all requirements of the Contract Documents. IDS review does not relieve the contractor from responsibility for errors or omissions in this submittal.</p> <p>Contractor/Construction Manager: _____</p> <p>Signature _____</p>

IDS Remarks:
IDS Construction Administration Approval:
Date: _____
<b>ACTION CODES:</b> <div> 1. NO EXCEPTIONS TAKEN  2. EXCEPTIONS AS NOTED  3. REVISE AND RESUBMIT  4. REJECTED  5. ACTION NOT REQUIRED </div>
IDS Received Stamp

# INSTRUCTIONS

- A. Use this form for all submittals. Integrated Design Solutions, will furnish the Contractor/Construction Manager with forms.
- B. Organize submittals by Specification Section. Use a separate form for submittals of each Specification Section. **DO NOT SUBMIT ITEMS SPECIFIED IN DIFFERENT SPECIFICATION SECTIONS ON ONE SUBMITTAL FORM.**
- C. Fill in submittal form as follows:
- (1) Project Title and Location. (Refer to Title Page of specifications. Include Bid Package number, if applicable.)
  - (2) Contractor's/Construction Manager's name and address to whom submittal is to be returned.
  - (3) Integrated Design Solutions' project number.
  - (4) Submittal Date.
  - (5) Submittal Number: Use 1, 2, 3, etc. for easy reference of each separate submittal.
  - (6) If this is a Partial Submittal of this item, check the box and use "1.1", "1.2", etc. in the submittal number space. If this is a complete submittal, do not check box.
  - (7) If this is a resubmittal (revision to a previous submittal), check the box and use the original submittal number and number the submittal "1A", "1B", etc in the submittal number space. If this is a new submittal, do not check box.
  - (8) Indicate the Project Manual Specification Section number relating to the submittal.
  - (9) Manufacturer: Insert name of product manufacturer, (e.g., Liebert).
  - (10) Item Description: Insert a brief statement describing the submitted item in generic terms (e.g. Ceramic Mosaic Tile, etc.) with a list of all drawings or identifying numbers.
  - (11) No. of Copies: Indicate the number of copies, product data, samples, etc. of each item being submitted (e.g. prints-2, reproducible-1, etc.).
  - (12) Indicate appropriate remarks and note any deviations from the requirements of the Contract Documents, as required, and sign the certification that all submittals have been reviewed.
  - (13) Indicate if submittal information is based on an addendum or bulletin. Indicate number of issue.
  - (14) Indicate whether the submittal was approved under a separate Substitution Request.
- D. The balance of this form will be filled in by Integrated Design Solutions, and returned to the Contractor along with the submittal.

**Request for Integrated Design Solutions, LLC (IDS) from Contractor For Transfer of  
Computer-Aided Drafting (CAD) or Building Information Modeling (BIM) Files on Electronic Media**

Project Administrator:	_____	Contractors:	_____
IDS Project Number:	_____	Construction Manager:	_____
Project Name:	_____		_____
Location:	_____		_____
Bid Package Number	_____	Date:	_____

IDS is requested to provide the following CAD/BIM files, as listed, for the named project, for the convenience of the contractor in preparing shop fabrication drawings:

<u>Drawing No./BIM File Discipline</u>	<u>Drawing Title</u>	<u>Issue Date of Drawing/BIM File</u>
_____	_____	_____
_____	_____	_____
_____	_____	_____

Drawings were prepared on the following:

Software: \_\_\_\_\_ Operating System: \_\_\_\_\_

Check appropriate format for requested files.

DWG \_\_\_\_\_ DXF \_\_\_\_\_ IGES \_\_\_\_\_ NWD \_\_\_\_\_ RVT \_\_\_\_\_ DGN \_\_\_\_\_

**TERMS AND CONDITIONS**

- IDS makes no representation as to the compatibility of the CAD/BIM files with any hardware or software.
- Since the information set forth on the CAD/BIM files can be modified unintentionally or otherwise, IDS reserves the right to remove all indicia of its ownership and/or involvement from each electronic display.
- Contractor will use figured dimensions only and will not "pull" dimensions from the CAD/BIM files.
- All information on the CAD/BIM files is considered instruments of service of IDS and shall not be used for other projects, for additions to this project, or completion of this project by others. CAD/BIM files shall remain the property of IDS, and in no case shall the transfer of these files be considered a sale.
- IDS makes no representation regarding the accuracy, completeness, or permanence of CAD/BIM files, nor for their merchantability or fitness for a particular purpose. Addenda information or revisions made after the date indicated on the CAD/BIM files may not have been incorporated. In the event of a conflict between IDS' sealed contract drawings and CAD/BIM files, the sealed contract drawings shall govern. It is the Contractor's responsibility to determine if any conflict exists. The CAD/BIM files shall not be considered to be Contract Documents as defined by the General Conditions of the Contract for Construction.
- The use of CAD/BIM files prepared by IDS shall not in any way obviate the Contractor's responsibility for the proper checking and coordination of dimensions, details, member sizes and gage, and quantities of materials as required to facilitate complete and accurate construction of the project.

5211 cascade road se, ste. 300  
grand rapids, mi 49546

1441 w. long lake road, ste. 200  
troy, mi 48098

248-823-2100 [www.ids-michigan.com](http://www.ids-michigan.com)

7. The Contractor/Construction Manager shall, to the fullest extent permitted by law, indemnify, defend and hold harmless IDS and its subconsultants from all claims, damages, losses, expenses, penalties and liabilities of any kind, including attorney's fees, arising out of or resulting from the use of CAD/BIM files by the Contractor, or by third party recipients of the CAD/BIM files from the Contractor.
8. IDS believes that no licensing or copyright fees are due to others on account of the transfer of the CAD/BIM files, but to the extent any are, the Contractor will pay the appropriate fees and hold IDS harmless from such claims.
9. Any purchase order number provided by the Contractor is for the Contractor's accounting purposes only. Purchase order terms and conditions are void and are not a part of this agreement.
10. This agreement shall be governed by the laws of the State of Michigan.

### **3D TERMS OF USE**

1. The 3D Computer Model(s), including but not limited to related calculation modeling and material, for the Project is provided by IDS as defined above to the User/Recipient as defined above (individually, a "User", or collectively, "Users") at the User's request subject to the terms and conditions stated below (the "Terms of Use"). User hereby acknowledges and agrees to the following terms and conditions.
2. The 3D Model is made available to User solely as a convenience to the User and for informational purposes only. The User is not to rely upon the 3D Computer Model and the data and/or information contained therein in preparing any of its documents for the Project. The User acknowledges that the 3D Computer Model is not a part of the Construction or Contract Documents for the Project and that IDS makes no representations or warranties, expressed or implied, regarding the 3D Computer Model, the accuracy or completeness of the 3D Computer Model or the data and/or information contained therein. It is agreed that the 3D Computer Model is generated for the purposes of assisting in the construction of the Project, the sealed construction drawings/instruments of service ultimately govern the design and the construction of the Project. The construction drawings/instruments of service trump the 3D Computer Model as the ultimate authority for the design and construction of the Project and are the Project's governing documents.
3. The User agrees that these terms apply to the 3D Model in its entirety, together with all of its component parts and data. The User acknowledges that the requirements of these Terms of Use apply to all of User's principals, employees, agents, consultants, and trade contractors, including all subcontractors.
4. The User agrees that the use of the 3D Computer Model is solely at the User's risk and that the User assumes full responsibility and liability in connection with the User's use of the 3D Computer Model and the information and/or data contained therein. The User agrees that IDS has no responsibility for any deficiencies, inaccuracies, errors and/or omissions contained in the 3D Computer Model or the data and/or information contained therein. IDS has no responsibility for any deficiencies or defects in the User's documents, work and/or services resulting from the User's use of the 3D Computer Model in lieu of the Construction and/or Contract Documents for the Project.
5. The User acknowledges and agrees a) that the use of the 3D Computer Model is not a substitute for professional judgment, b) that the use of the 3D Computer Model does not relieve the User from applying the appropriate standard of care and skill relevant to the use of the 3D Computer Model and its contents; c) that the 3D Computer Model is only to be used as a tool to assist the User in connection with the Project; d) that the User is solely responsible for verifying the accuracy of all results created with the use of the 3D Computer Model; and e) IDS is not responsible or liable for the means and methods of construction and the User's use of the 3D Computer Model shall in no way give rise to such duty or liability by IDS or its consultants.
6. IDS AND ITS CONSULTANTS SPECIFICALLY DISCLAIM ALL WARRANTIES WHETHER EXPRESSED, IMPLIED OR STATUTORY, INCLUDING, WITHOUT LIMITATION, ALL WARRANTIES OF MERCHANTABILITY, TITLE, FITNESS FOR A PARTICULAR PURPOSE, CONSTRUCTABILITY, NON-INFRINGEMENT, COMPATIBILITY, SECURITY OR ACCURACY. USERS' USE OF THE 3D COMPUTER MODEL IS AT ITS OWN RISK. USER ASSUMES FULL RESPONSIBILITY AND RISK OF LOSS RESULTING FROM USE OR INABILITY TO USE THE 3D COMPUTER MODEL OR ITS CONTENT AND WAIVES ANY AND ALL CLAIMS AGAINST IDS IN ANY WAY RELATED TO THE 3D COMPUTER MODEL.



7. The User further agrees that the 3D Computer Model contains information that is confidential and proprietary to IDS, and that IDS retains the ownership and all other reserved rights in the work product reflected in the 3D Computer Model that was prepared by IDS or its consultants for the Project. IDS grants the User a non-exclusive, non-transferable royalty-free license to use the 3D Computer Model for information purposes only in connection with the Project [or defined other specific task] in strict accordance with these Terms of Use. The User agrees that the 3D Computer Model will be used solely and exclusively for the Project and that it will not use the 3D Computer Model and the data and/or information contained therein, in whole or in part, for any purpose or project other than the Project. The User further agrees that the 3D Computer Model will continue to be kept confidential by the User, and that it shall not be disclosed in any manner, transferred or exchanged to any third parties by the User without the expressed, written consent of IDS.
8. Upon completion of the User's involvement with the Project or at any time upon written request of IDS, the User shall upon request promptly deliver to IDS the 3D Computer Model and any other material containing or reflecting any information or data in the 3D Computer Model (whether prepared by IDS, the User or otherwise) and will not retain copies, extracts or other reproductions, tangible or intangible, in whole or in part of the 3D Computer Model. The User's non-disclosure and non-use obligations set forth herein shall survive the return, destruction or deletion of the 3D Computer Model. If the User becomes legally compelled, by subpoena or court order to disclose the 3D Model, or any information contained therein, the User shall provide IDS with prompt notice so that a protective order or other appropriate remedy may be sought by and/or compliance with the provisions of the Terms of Use may be waived.
9. User hereby agrees that IDS shall be entitled to equitable relief, including injunction, in the event of any breach of the Terms of Use, including without limitation its obligations to maintain the confidentiality of the 3D Model, that the granting of such relief will not be opposed and that such relief shall not be the exclusive remedy for such breach. IDS's failure to insist upon strict adherence to any term of these Terms of Use shall not be considered a waiver thereof or deprive IDS of the right subsequently to insist upon strict adherence to that term or any other term of this Terms of Use.
10. The User hereby agrees, to the fullest extent permitted by law, that in no event shall IDS be liable to User for any damages or losses of any kind including, but not limited to, damages by death or bodily injury to persons, injury to property, and direct, indirect, consequential, special, or incidental damages, resulting from any error, omission, inaccuracy, deficiency or defect in or problem with, the 3D Computer Model or the data and/or information contained therein. Without limiting the foregoing, the User acknowledges that the 3D Computer Model and the data and/or information contained therein may be inaccurate and/or incomplete and that IDS will have no obligation to update or modify the 3D Computer Model or any of the data and/or information contained in it because the 3D Computer Model was prepared solely for informational purposes and is not part of the Construction or Contract Documents for the Project.
11. The User its officers, directors, shareholders, partners, agents, employees, consultants, trade contractors, subcontractors or independent contractors shall, to the fullest extent permitted by law, defend, indemnify and hold IDS and its officers, directors, shareholders, partners, principals, consultants, agents and employees harmless from and against any and all actions, damages, demands, claims, suits, losses, liability, judgments, recoveries, costs and expenses including, but not limited to, reasonable attorney's fees related in any way to the 3D Computer model and/or to any use of the 3D Computer Model or the data and/or the information contained therein by the User or any third party who receives the 3D Computer Model from the User. Such claims may include, but are not limited to, any claim which may arise due to deletions, omissions or variations of data due to mechanical or technical failure in connection with the transmission of the 3D Computer Model.
12. The User acknowledges and agrees that it is not in privity of contract with IDS as of result of these Terms of Use with respect to any claims or causes of action related to or arising out of the Project. The User further agrees to obligate any contractor, consultant or other party who uses the 3D Computer Model to be bound in writing by the terms and conditions contained herein and to provide a copy of such acceptance of the Terms of Use to IDS. Any User's use of the 3D Computer Model and the information and/or data contained therein constitutes such User's acceptance of all the terms here specified.
13. The signatory of these Terms of Use on User's behalf warrants to IDS that he/she is duly authorized to sign these Terms of Use on User's behalf and that these Terms of Use are a binding obligation assumed by the User.
14. These Terms of Use shall control and supersede all prior or simultaneous negotiations, representations and agreements, either written or oral including separate agreements between the User and IDS. Signing these Terms of Use indicates the User's agreement to the terms stated above. However in the event that these Terms of Use are not fully executed, they shall nonetheless be effective and controlling to the parties so long as IDS has provided same to the User and it has utilized the 3D Computer Model subsequent to receiving this document without registering its written objections/modifications to these terms.

AUTHORIZED ACCEPTANCE

by Integrated Design Solutions, LLC

by Contractor

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Print Name and Title

\_\_\_\_\_  
Print Name and Title

\_\_\_\_\_  
Date

\_\_\_\_\_  
Date

Document1

## **SECTION 01 4000 - QUALITY REQUIREMENTS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
  - 1. Specific quality-assurance and quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.
  - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
  - 3. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, Construction Manager, or authorities having jurisdiction are not limited by provisions of this Section.

#### **1.3 DEFINITIONS**

- A. Experienced: When used with an entity or individual, "experienced," unless otherwise further described, means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.
- B. Field Quality-Control Tests and Inspections: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, subcontractor, or sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.
  - 1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).
- D. Mockups: Physical assemblies of portions of the Work constructed to establish the standard by which the Work will be judged. Mockups are not Samples.
  - 1. Mockups are used for one or more of the following:
    - a. Verify selections made under Sample submittals.
    - b. Demonstrate aesthetic effects.
    - c. Demonstrate the qualities of products and workmanship.
    - d. Demonstrate successful installation of interfaces between components and systems.
    - e. Perform preconstruction testing to determine system performance.
  - 2. Product Mockups: Mockups that may include multiple products, materials, or systems specified in a single Section.

- 3. In-Place Mockups: Mockups constructed on-site in their actual final location as part of permanent construction.
- E. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.
- F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- G. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source (e.g., plant, mill, factory, or shop).
- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. The term "testing laboratory" has the same meaning as the term "testing agency."
- I. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work, to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- J. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work, to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Architect or Construction Manager.

#### **1.4 DELEGATED DESIGN SERVICES**

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
  - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated Design Services Statement: Submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

#### **1.5 CONFLICTING REQUIREMENTS**

- A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Architect regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Architect for clarification before proceeding.

- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified is the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

## **1.6 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Contractor's quality-control personnel.
- B. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- C. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
  - 1. Specification Section number and title.
  - 2. Entity responsible for performing tests and inspections.
  - 3. Description of test and inspection.
  - 4. Identification of applicable standards.
  - 5. Identification of test and inspection methods.
  - 6. Number of tests and inspections required.
  - 7. Time schedule or time span for tests and inspections.
  - 8. Requirements for obtaining samples.
  - 9. Unique characteristics of each quality-control service.
- D. Reports: Prepare and submit certified written reports and documents as specified.
- E. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.

## **1.7 REPORTS AND DOCUMENTS**

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
  - 1. Date of issue.
  - 2. Project title and number.
  - 3. Name, address, telephone number, and email address of testing agency.
  - 4. Dates and locations of samples and tests or inspections.
  - 5. Names of individuals making tests and inspections.
  - 6. Description of the Work and test and inspection method.
  - 7. Identification of product and Specification Section.
  - 8. Complete test or inspection data.
  - 9. Test and inspection results and an interpretation of test results.
  - 10. Record of temperature and weather conditions at time of sample-taking and testing and inspection.
  - 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
  - 12. Name and signature of laboratory inspector.
  - 13. Recommendations on retesting and reinspecting.

- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
  - 1. Name, address, telephone number, and email address of technical representative making report.
  - 2. Statement on condition of substrates and their acceptability for installation of product.
  - 3. Statement that products at Project site comply with requirements.
  - 4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
  - 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
  - 6. Statement of whether conditions, products, and installation will affect warranty.
  - 7. Other required items indicated in individual Specification Sections.
- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
  - 1. Name, address, telephone number, and email address of factory-authorized service representative making report.
  - 2. Statement that equipment complies with requirements.
  - 3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
  - 4. Statement of whether conditions, products, and installation will affect warranty.
  - 5. Other required items indicated in individual Specification Sections.

## **1.8 QUALITY ASSURANCE**

- A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that is similar in material, design, and extent to those indicated for this Project.
- F. Testing and Inspecting Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented in accordance with ASTM E329, and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

- G. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- H. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect, demonstrate, repair, and perform service on installations of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following Contractor's responsibilities, including the following:
  - 1. Provide test specimens representative of proposed products and construction.
  - 2. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
  - 3. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
  - 4. Build site-assembled test assemblies and mockups, using installers who will perform same tasks for Project.
  - 5. When testing is complete, remove test specimens and test assemblies, and mockups; do not reuse products on Project.
  - 6. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, through Construction Manager, with copy to Contractor. Interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from the Contract Documents.
- J. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
  - 1. Build mockups of size indicated.
  - 2. Build mockups in location indicated or, if not indicated, as directed by Architect or Construction Manager.
  - 3. Notify Architect and Construction Manager seven days in advance of dates and times when mockups will be constructed.
  - 4. Employ supervisory personnel who will oversee mockup construction. Employ workers who will be employed to perform same tasks during the construction at Project.
  - 5. Demonstrate the proposed range of aesthetic effects and workmanship.
  - 6. Obtain Architect's approval of mockups before starting corresponding Work, fabrication, or construction.
    - a. Allow seven days for initial review and each re-review of each mockup.
  - 7. Promptly correct unsatisfactory conditions noted by Architect's preliminary review, to the satisfaction of the Architect, before completion of final mockup.
  - 8. Approval of mockups by the Architect does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 9. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
  - 10. Demolish and remove mockups when directed unless otherwise indicated.

## 1.9 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspection they are engaged to perform.
  2. Costs for retesting and reinspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.
1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
  2. Engage a qualified testing agency to perform quality-control services.
    - a. Contractor will not employ same entity engaged by Owner, unless agreed to in writing by Owner.
  3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.
  4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
  5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
  6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- D. Testing Agency Responsibilities: Cooperate with Architect, Construction Manager, and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect, Construction Manager, and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
  2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
  3. Conduct and interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from requirements.
  4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
  5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
  6. Do not perform duties of Contractor.
- E. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 01 3300 "Submittal Procedures."



- F. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- G. Contractor's Associated Requirements and Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
  - 1. Access to the Work.
  - 2. Incidental labor and facilities necessary to facilitate tests and inspections.
  - 3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
  - 4. Facilities for storage and field curing of test samples.
  - 5. Delivery of samples to testing agencies.
  - 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
  - 7. Security and protection for samples and for testing and inspection equipment at Project site.
- H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.
  - 1. Schedule times for tests, inspections, obtaining samples, and similar activities.

#### **1.10 SPECIAL TESTS AND INSPECTIONS**

- A. Special Tests and Inspections: Owner will coordinate with Construction Manager to engage a qualified testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, and as follows:
  - 1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.
  - 2. Notifying Architect, Commissioning Authority, Construction Manager, and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
  - 3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect and Commissioning Authority, through Construction Manager, with copy to Contractor and to authorities having jurisdiction.
  - 4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
  - 5. Interpreting tests and inspections, and stating in each report whether tested and inspected Work complies with or deviates from the Contract Documents.
  - 6. Retesting and reinspecting corrected Work.

### **PART 2 - PRODUCTS (Not Used)**

### **PART 3 - EXECUTION**

#### **3.1 TEST AND INSPECTION LOG**

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
  - 1. Date test or inspection was conducted.
  - 2. Description of the Work tested or inspected.
  - 3. Date test or inspection results were transmitted to Architect.

4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's, Commissioning Authority's, Construction Manager's and authorities' having jurisdiction reference during normal working hours.
  1. Submit log at Project closeout as part of Project Record Documents.

### **3.2 REPAIR AND PROTECTION**

- A. General: On completion of testing, inspection, sample-taking, and similar services, repair damaged construction and restore substrates and finishes.
  1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 01 7300 - Execution.
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

**END OF SECTION 01 4000**

## **SECTION 01 4200 - REFERENCES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 DEFINITIONS**

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

#### **1.3 INDUSTRY STANDARDS**

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
  - 1. For standards referenced by applicable building codes, comply with dates of standards as listed in building codes.

- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
  - 1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

#### **1.4 ABBREVIATIONS AND ACRONYMS**

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."
- B. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list.
  - 1. EPA - Environmental Protection Agency; [www.epa.gov](http://www.epa.gov).
  - 2. OSHA - Occupational Safety & Health Administration; [www.osha.gov](http://www.osha.gov).
  - 3. USDA - Department of Agriculture; [www.usda.gov](http://www.usda.gov).

#### **1.5 CODES AND REGULATORY REQUIREMENTS**

- A. Regulatory requirements applicable to this project: Refer to Drawings.
- B. Where Drawings and specification sections reference more current standards or codes, comply with the more restrictive requirements.

#### **PART 2 - PRODUCTS (Not Used)**

#### **PART 3 - EXECUTION (Not Used)**

**END OF SECTION 01 4200**

## **SECTION 01 5700 – TEMPORARY CONTROLS**

### **1.1 GENERAL**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Work shall comply with the 2020 MDOT Standard Specifications for Construction, Section 208, except as otherwise indicated in the Special Provisions specified in this section.

**END OF SECTION 01 5700**

## **SECTION 01 6000 - PRODUCT REQUIREMENTS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

#### **1.3 DEFINITIONS**

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
  - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
  - 2. New Products: Items that have not previously been incorporated into another project or facility. Salvaged items or items reused from other projects are not considered new products. Items that are manufactured or fabricated to include recycled content materials are considered new products, unless indicated otherwise.
  - 3. Comparable Product: Product by named manufacturer that is demonstrated and approved through the comparable product submittal process described in Part 2 "Comparable Products" Article, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. Published attributes and characteristics of basis-of-design product establish salient characteristics of products.
  - 1. Evaluation of Comparable Products: In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification.
- C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications; submit a comparable product request or substitution request, if applicable.
- D. Comparable Product Request Submittal: An action submittal requesting consideration of a comparable product, including the following information:
  - 1. Identification of basis-of-design product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.

2. Data indicating compliance with the requirements specified in Part 2 "Comparable Products" Article.
- E. Basis-of-Design Product Specification Submittal: An action submittal complying with requirements in Section 013300 "Submittal Procedures."
- F. Substitution: Refer to Section 01 2500 - Substitution Procedures, for definition and limitations on substitutions.

#### **1.4 QUALITY ASSURANCE**

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
- B. Identification of Products: Except for required labels and operating data, do not attach or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.
  1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is not conspicuous.
  2. Equipment Nameplates: Provide a permanent nameplate on each item of service- or power-operated equipment. Locate on a visually accessible but inconspicuous surface. Include information essential for operation, including the following:
    - a. Name of product and manufacturer.
    - b. Model and serial number.
    - c. Capacity.
    - d. Speed.
    - e. Ratings.
  3. See individual identification Sections in Divisions 21, 22, 23, and 26 for additional equipment identification requirements.

#### **1.5 COORDINATION**

- A. Modify or adjust affected work as necessary to integrate work of approved comparable products and approved substitutions.

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

- A. Deliver, store, and handle products, using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
  1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
  2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
  3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.

4. Inspect products on delivery to determine compliance with the Contract Documents and that products are undamaged and properly protected.

C. Storage:

1. Provide a secure location and enclosure at Project site for storage of materials and equipment.
2. Store products to allow for inspection and measurement of quantity or counting of units.
3. Store materials in a manner that will not endanger Project structure.
4. Store products that are subject to damage by the elements under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation and with adequate protection from wind.
5. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
7. Protect stored products from damage and liquids from freezing.

## 1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
1. Manufacturer's Warranty: Written standard warranty form furnished by individual manufacturer for a particular product and issued in the name of the Owner or endorsed by manufacturer to Owner.
  2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of the Owner or endorsed by manufacturer to Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
  2. Specified Form: When specified forms are included in the Project Manual, prepare a written document, using indicated form properly executed.
  3. See other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 01 7700 - Closeout Procedures.

## PART 2 - PRODUCTS

### 2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
  2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
  3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
  4. Where products are accompanied by the term "as selected," Architect will make selection.



5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
6. Or Equal: For products specified by name and accompanied by the term "or equal," "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.
  - a. Submit additional documentation required by Architect in order to establish equivalency of proposed products. Unless otherwise indicated, evaluation of "or equal" product status is by the Architect, whose determination is final.

B. Product Selection Procedures:

1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
  - a. Sole product may be indicated by the phrase "Subject to compliance with requirements, provide the following."
2. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
  - a. Sole manufacturer/source may be indicated by the phrase "Subject to compliance with requirements, provide products by the following."
3. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.
  - a. Limited list of products may be indicated by the phrase "Subject to compliance with requirements, provide one of the following."
4. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed or an unnamed product that complies with requirements.
  - a. Non-limited list of products is indicated by the phrase "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following."
  - b. Provision of an unnamed product is not considered a substitution, if the product complies with requirements.
5. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.
  - a. Limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, provide products by one of the following."
6. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed or a product by an unnamed manufacturer that complies with requirements.
  - a. Non-limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following."

- b. Provision of products of an unnamed manufacturer is not considered a substitution, if the product complies with requirements.
- 7. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications may additionally indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
  - a. For approval of products by unnamed manufacturers, comply with requirements in Section 01 2500 "Substitution Procedures" for substitutions for convenience.
- C. Visual Matching Specification: Where Specifications require the phrase "match Architect's sample," provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or a similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

## **2.2 COMPARABLE PRODUCTS**

- A. Conditions for Consideration of Comparable Products: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with the following requirements:
  - 1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work.
  - 2. Detailed comparison of significant qualities of proposed product with those of the named basis-of-design product. Significant product qualities include attributes, such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
  - 3. Evidence that proposed product provides specified warranty.
  - 4. List of similar installations for completed projects, with project names and addresses and names and addresses of architects and owners, if requested.
  - 5. Samples, if requested.
- B. Architect's Action on Comparable Products Submittal: If necessary, Architect will request additional information or documentation for evaluation, as specified in Section 01 3300 "Submittal Procedures."
  - 1. Form of Approval of Submittal: As specified in Section 01 3300 "Submittal Procedures."
  - 2. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
- C. Submittal Requirements, Two-Step Process: Approval by the Architect of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.

## **PART 3 - EXECUTION (Not Used)**

**END OF SECTION 01 6000**

## **SECTION 01 7300 - EXECUTION**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section includes general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:
  - 1. Installation of the Work.
  - 2. RFIs.
  - 3. Cutting and patching.
  - 4. General coordination procedures.
  - 5. Coordination of Owner's portion of the Work.
  - 6. Progress cleaning.
  - 7. Starting and adjusting.
  - 8. Protection of installed construction.

#### **1.3 DEFINITIONS**

- A. RFI: Request for Information. Request from Construction Manager seeking information required by or clarifications of the Contract Documents.
- B. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.
- C. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

#### **1.4 PREINSTALLATION MEETINGS**

- A. Cutting and Patching Conference: Conduct conference at Project site.
  - 1. Prior to commencing work requiring cutting and patching, review extent of cutting and patching anticipated and examine procedures for ensuring satisfactory result from cutting and patching work. Inform Architect and Construction Manager of scheduled meeting. Require representatives of each entity directly concerned with cutting and patching to attend, including the following:
    - a. Contractor's superintendent.
    - b. Trade supervisor responsible for cutting operations.
    - c. Trade supervisor(s) responsible for patching of each type of substrate.
    - d. Mechanical, electrical, and utilities subcontractors' supervisors, to the extent each trade is affected by cutting and patching operations.
  - 2. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

## 1.5 REQUEST FOR INFORMATION (RFI)

- A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Construction Manager shall prepare and submit an RFI in the form specified.
1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Construction Manager.
  2. Coordinate and submit RFIs in a prompt manner to avoid delays in work.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
1. Project name.
  2. Architect's Project number.
  3. Date.
  4. Name of Contractor.
  5. RFI number, numbered sequentially.
  6. RFI subject.
  7. Specification Section number and title and related paragraphs, as appropriate.
  8. Drawing number and detail references, as appropriate.
  9. Field dimensions and conditions, as appropriate.
  10. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
  11. Contractor's signature.
  12. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
    - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: AIA Document G716 or similar form.
1. Attachments shall be electronic files in PDF format.
- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
1. The following RFIs will be returned without action:
    - a. Requests for approval of submittals.
    - b. Requests for approval of substitutions.
    - c. Requests for approval of Contractor's means and methods.
    - d. Requests for coordination information already indicated in the Contract Documents.
    - e. Requests for adjustments in the Contract Time or the Contract Sum.
    - f. Requests for interpretation of Architect's actions on submittals.
    - g. Incomplete RFIs or inaccurately prepared RFIs.
  2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architect of additional information.
  3. If Construction Manager believes the RFI response from Architect warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 5 days of receipt of the RFI response.

- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly unless other arrangement is agreed upon with Architect. Include the following:
1. Project name.
  2. Name and address of Construction Manager.
  3. Name and address of Architect.
  4. RFI number, including RFIs that were returned without action or withdrawn.
  5. RFI description.
  6. Date the RFI was submitted.
  7. Date Architect's response was received.
  8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
- F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within three days if Construction Manager disagrees with response.

## **1.6 CLOSEOUT SUBMITTALS**

- A. Certified statements from existing manufacturers stating that existing warranties have not been affected by cutting and patching work performed under this Section.

## **1.7 QUALITY ASSURANCE**

- A. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.
- B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
1. Structural Elements: When cutting and patching structural elements, or when encountering the need for cutting and patching of elements whose structural function is not known, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
  2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include but are not limited to the following:
    - a. Primary operational systems and equipment.
    - b. Fire separation assemblies.
    - c. Air or smoke barriers.
    - d. Fire-suppression systems.
    - e. Plumbing piping systems.
    - f. Mechanical systems piping and ducts.
    - g. Control systems.
    - h. Communication systems.
    - i. Fire-detection and -alarm systems.
    - j. Conveying systems.
    - k. Electrical wiring systems.
    - l. Operating systems of special construction.

3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:
  - a. Water, moisture, or vapor barriers.
  - b. Membranes and flashings.
  - c. Exterior curtain-wall construction.
  - d. Sprayed fire-resistive material.
  - e. Equipment supports.
  - f. Piping, ductwork, vessels, and equipment.
  - g. Noise- and vibration-control elements and systems.
4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

## **1.8 WARRANTY**

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Comply with requirements specified in other Sections.
  1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
  1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials. Use materials that are not considered hazardous.
- C. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Cutting and Patching: Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
  1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with in-place finishes or primers.
  2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

- B. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.
  - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, gas service piping, and water-service piping; underground electrical services; and other utilities.
  - 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- C. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
  - 1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
  - 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
  - 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- D. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
  - 1. Description of the Work, including Specification Section number and paragraph, and Drawing sheet number and detail, where applicable.
  - 2. List of detrimental conditions, including substrates.
  - 3. List of unacceptable installation tolerances.
  - 4. Recommended corrections.
- E. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

### **3.2 PREPARATION**

- A. Cutting and Patching:
  - 1. Temporary Support: Provide temporary support of Work to be cut.
  - 2. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
  - 3. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
  - 4. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize or prevent interruption to occupied areas.
- B. Existing Utility Information: Furnish information to local utility and Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- C. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

- D. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- E. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect through Construction Manager.

### **3.3 CUTTING AND PATCHING**

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
  - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Temporary Support: Provide temporary support of Work to be cut.
- C. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- D. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching in accordance with requirements in Section 01 1000 "Summary."
- E. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize or prevent interruption to occupied areas.
- F. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
  - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
  - 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
  - 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
  - 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
  - 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
  - 6. Proceed with patching after construction operations requiring cutting are complete.
- G. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as practicable, as judged by Architect. Provide materials and comply with installation requirements specified in other Sections, where applicable.
  - 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.



2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
    - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    - b. Restore damaged pipe covering to its original condition.
  3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
    - a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch, corner to corner of wall and edge to edge of ceiling. Provide additional coats until patch blends with adjacent surfaces.
  4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
  5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- H. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

### **3.4 INSTALLATION**

- A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
  1. Make vertical work plumb and make horizontal work level.
  2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
  3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
  4. Maintain minimum headroom clearance of 96 inches (2440 mm) in occupied spaces and 90 inches (2300 mm) in unoccupied spaces, unless otherwise indicated on Drawings.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure satisfactory results as judged by Architect. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations, so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on-site and placement in permanent locations.
- F. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.
  - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
  - 2. Allow for building movement, including thermal expansion and contraction.
  - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Architect. Fit exposed connections together to form hairline joints.
- J. Repair or remove and replace damaged, defective, or nonconforming Work.
  - 1. Comply with Section 01 7700 "Closeout Procedures" for repairing or removing and replacing defective Work.

### **3.5 GENERAL COORDINATION PROCEDURES**

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.
  - 1. Schedule construction operations in sequence required to obtain the best results, where installation of one part of the Work depends on installation of other components, before or after its own installation.
  - 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
  - 3. Make adequate provisions to accommodate items scheduled for later installation.

### **3.6 COORDINATION OF OWNER'S PORTION OF THE WORK**

- A. Site Access: Provide access to Project site for Owner's construction personnel and Owner's separate contractors.
  - 1. Provide temporary facilities required for Owner-furnished, Contractor-installed products.
  - 2. Refer to Section 01 1000 "Summary" for other requirements for Owner-furnished, Contractor-installed and Owner-furnished, Owner-installed products
- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel and Owner's separate contractors.
  - 1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
  - 2. Preinstallation Conferences: Include Owner's construction personnel and Owner's separate contractors at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

### **3.7        PROGRESS CLEANING**

- A.    Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
  - 1.    Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
  - 2.    Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F (27 deg C).
  - 3.    Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
    - a.    Use containers intended for holding waste materials of type to be stored.
- B.    Site: Maintain Project site free of waste materials and debris.
- C.    Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.
  - 1.    Remove liquid spills promptly.
  - 2.    Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D.    Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E.    Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F.    Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G.    Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Division 01.
- H.    During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I.    Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J.    Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

### **3.8        STARTING AND ADJUSTING**

- A.    Coordinate startup and adjusting of equipment and operating components with requirements in Division 01.
- B.    Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- C.    Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

- D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Manufacturer's Field Service: Comply with qualification requirements in Section 01 4000 "Quality Requirements."

**3.9 PROTECTION AND REPAIR OF INSTALLED CONSTRUCTION**

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.
- C. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.
- D. Comply with manufacturer's written instructions for temperature and relative humidity.

**END OF SECTION 01 7300**

## **SECTION 01 7700 - CLOSEOUT PROCEDURES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section includes administrative and procedural requirements for Contract closeout, including, but not limited to, the following:
  - 1. Substantial Completion procedures.
  - 2. Final completion procedures.
  - 3. Warranties.
  - 4. Final cleaning.

#### **1.3 DEFINITIONS**

- A. List of Incomplete Items (Contractor's "punch list"): Contractor-prepared list of items to be completed or corrected, prepared for the Architect's use prior to Architect's inspection, to determine if the Work is substantially complete.

#### **1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of cleaning agent.
- B. Contractor's List of Incomplete Items (Contractor's "punch list"): Initial submittal at Substantial Completion.
- C. Certified List of Incomplete Items (Contractor's "punch list"): Final submittal at Final Completion.

#### **1.5 CLOSEOUT SUBMITTALS**

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.

#### **1.6 MAINTENANCE MATERIAL SUBMITTALS**

- A. Schedule of Maintenance Material Items: For maintenance material submittal items required by other Sections.

#### **1.7 SUBSTANTIAL COMPLETION PROCEDURES**

- A. Contractor's List of Incomplete Items (Contractor's "punch list"): Prepare and submit a list of items to be completed and corrected, indicating the value of each item on the list and reasons why the Work is incomplete.

- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction, permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
  2. Submit closeout submittals specified in other Division 01 Sections, including Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
  3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
  4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number.
    - a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Owner's signature for receipt of submittals.
  5. Submit testing, adjusting, and balancing records.
  6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Advise Owner of pending insurance changeover requirements.
  2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
  3. Complete startup and testing of systems and equipment.
  4. Perform preventive maintenance on equipment used prior to Substantial Completion.
  5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
  6. Advise Owner of changeover in utility services.
  7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
  8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
  9. Complete final cleaning requirements.
  10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
  2. Results of completed inspection will form the basis of requirements for Final Completion.

## **1.8 FINAL COMPLETION PROCEDURES**

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:
  - 1. Submit a final Application for Payment in accordance with Division 01.
  - 2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
  - 3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
  - 4. Submit Final Completion photographic documentation.
- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
  - 1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

## **1.9 LIST OF INCOMPLETE ITEMS (CONTRACTOR'S "PUNCH LIST")**

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
  - 1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor, listed by room or space number.
  - 2. Organize items applying to each space by major element, including categories for ceilings, individual walls, floors, equipment, and building systems.
  - 3. Include the following information at the top of each page:
    - a. Project name.
    - b. Date.
    - c. Page number.
  - 4. Submit list of incomplete items in one of the following formats as directed by Architect:
    - a. PDF Electronic File: Architect, through Construction Manager, will return annotated file.
    - b. Web-Based Project Software Upload: Utilize software feature for creating and updating list of incomplete items (punch list).

## **1.10 SUBMITTAL OF PROJECT WARRANTIES**

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.

- B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
- D. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
  - 1. Submit on digital media acceptable to Architect or by uploading to web-based project software site.
- E. Warranties in Paper Form: In addition to the Warranty Electronic File, provide one copy in paper form.
  - 1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch (215-by-280-mm) paper.
  - 2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
  - 3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
- F. Provide additional copies of each warranty to include in operation and maintenance manuals.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

## **PART 3 - EXECUTION**

### **3.1 FINAL CLEANING**

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
  - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
    - a. Clean Project site of rubbish, waste material, litter, and other foreign substances.
    - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
    - c. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.
    - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
    - e. Remove snow and ice to provide safe access to building.



- f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
- g. Remove debris and surface dust from limited-access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
- h. Clean flooring, removing debris, dirt, and staining; clean according to manufacturer's recommendations.
- i. Vacuum and mop concrete.
- j. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
- k. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
- l. Remove labels that are not permanent.
- m. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
- n. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
- o. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
- p. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
- q. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
- r. Clean strainers.
- s. Leave Project clean and ready for occupancy.

- C. Construction Waste Disposal: Comply with waste-disposal requirements in Division 01.

### **3.2 REPAIR OF THE WORK**

- A. Complete repair and restoration operations required by Section 01 7300 "Execution" before requesting inspection for determination of Substantial Completion.

**END OF SECTION 01 7700**

## **SECTION 01 7823 - OPERATION AND MAINTENANCE DATA**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
  - 1. Operation and maintenance documentation directory manuals.
  - 2. Emergency manuals.
  - 3. Systems and equipment operation manuals.
  - 4. Systems and equipment maintenance manuals.
  - 5. Product maintenance manuals.

#### **1.3 DEFINITIONS**

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

#### **1.4 CLOSEOUT SUBMITTALS**

- A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
  - 1. Architect and Commissioning Authority (if any) will comment on whether content of operation and maintenance submittals is acceptable.
  - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operation and maintenance manuals in the following format:
  - 1. Submit on digital media acceptable to Architect or by uploading to web-based project software site as directed by Architect. Enable reviewer comments on draft submittals.
  - 2. Submit two paper copies. Architect, through Construction Manager, will return one copies.
    - a. Paper copies may be omitted with written approval of Architect.
- C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect and Commissioning Authority (if any) will comment on whether general scope and content of manual are acceptable.

- D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect and Commissioning Authority (if any) will return copy with comments.
  - 1. Correct or revise each manual to comply with Architect's and Commissioning Authority (if any) comments. Submit copies of each corrected manual within 15 days of receipt of Architect's and Commissioning Authority's (if any) comments and prior to commencing demonstration and training.
- E. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

## **1.5 FORMAT OF OPERATION AND MAINTENANCE MANUALS**

- A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
  - 1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
  - 2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.
- B. Manuals, Paper Copy: Submit manuals in the form of hard-copy, bound and labeled volumes.
  - 1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch (215-by-280-mm) paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
    - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
    - b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
  - 2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
  - 3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment. Enclose title pages and directories in clear plastic sleeves.
  - 4. Supplementary Text: Prepared on 8-1/2-by-11-inch (215-by-280-mm) white bond paper.
  - 5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
    - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
    - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

## **1.6 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS**

- A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
  - 1. Title page.
  - 2. Table of contents.
  - 3. Manual contents.
- B. Title Page: Include the following information:
  - 1. Subject matter included in manual.
  - 2. Name and address of Project.
  - 3. Name and address of Owner.
  - 4. Date of submittal.
  - 5. Name and contact information for Contractor.
  - 6. Name and contact information for Construction Manager (if any).
  - 7. Name and contact information for Architect.
  - 8. Name and contact information for Commissioning Authority (if any).
  - 9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
  - 10. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
  - 1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

## **1.7 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY MANUAL**

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals. List items and their location to facilitate ready access to desired information. Include the following:
  - 1. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
  - 2. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
  - 3. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

## **1.8 EMERGENCY MANUALS**

- A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- B. Content: Organize manual into a separate section for each of the following:
  - 1. Type of emergency.
  - 2. Emergency instructions.
  - 3. Emergency procedures.
- C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
  - 1. Fire.
  - 2. Flood.
  - 3. Gas leak.
  - 4. Water leak.
  - 5. Power failure.
  - 6. Water outage.
  - 7. System, subsystem, or equipment failure.
  - 8. Chemical release or spill.
- D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- E. Emergency Procedures: Include the following, as applicable:
  - 1. Instructions on stopping.
  - 2. Shutdown instructions for each type of emergency.
  - 3. Operating instructions for conditions outside normal operating limits.
  - 4. Required sequences for electric or electronic systems.
  - 5. Special operating instructions and procedures.

## **1.9 SYSTEMS AND EQUIPMENT OPERATION MANUALS**

- A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.
  - 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
  - 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
  - 1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
  - 2. Performance and design criteria if Contractor has delegated design responsibility.
  - 3. Operating standards.
  - 4. Operating procedures.
  - 5. Operating logs.
  - 6. Wiring diagrams.

7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

C. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

D. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

F. Piped Systems: Diagram piping as installed and identify color coding where required for identification.

## **1.10 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS**

A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds as described below.

C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

- D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:
1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
    - a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
  2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
  3. Identification and nomenclature of parts and components.
  4. List of items recommended to be stocked as spare parts.
- E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
1. Test and inspection instructions.
  2. Troubleshooting guide.
  3. Precautions against improper maintenance.
  4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
  5. Aligning, adjusting, and checking instructions.
  6. Demonstration and training video recording, if available.
- F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
  2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.
- J. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
1. Do not use original project record documents as part of maintenance manuals.

## **1.11 PRODUCT MAINTENANCE MANUALS**

- A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- C. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. Product Information: Include the following, as applicable:
  - 1. Product name and model number.
  - 2. Manufacturer's name.
  - 3. Color, pattern, and texture.
  - 4. Material and chemical composition.
  - 5. Reordering information for specially manufactured products.
- E. Maintenance Procedures: Include manufacturer's written recommendations and the following:
  - 1. Inspection procedures.
  - 2. Types of cleaning agents to be used and methods of cleaning.
  - 3. List of cleaning agents and methods of cleaning detrimental to product.
  - 4. Schedule for routine cleaning and maintenance.
  - 5. Repair instructions.
- F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
  - 1. Include procedures to follow and required notifications for warranty claims.

## **PART 2 - PRODUCTS (Not Used)**

## **PART 3 - EXECUTION (Not Used)**

**END OF SECTION 01 7823**



## **SECTION 01 7839 - PROJECT RECORD DOCUMENTS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section includes administrative and procedural requirements for Project Record Documents, including the following:
  - 1. Record Drawings.
  - 2. Record specifications.
  - 3. Record Product Data.
  - 4. Miscellaneous record submittals.

#### **1.3 CLOSEOUT SUBMITTALS**

- A. Record Drawings: Submit annotated PDF electronic files and one paper copies of Record Drawings, including addenda and Contract modifications
  - 1. Paper copies may be omitted with written approval of Architect.
- B. Record Specifications: Submit annotated PDF electronic files and one paper copies of Project's Specifications, including addenda and Contract modifications.
  - 1. Paper copies may be omitted with written approval of Architect.
- C. Record Product Data: Submit annotated PDF electronic files and directories and one paper copies of each submittal.
  - 1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.
  - 2. Paper copies may be omitted with written approval of Architect.
- D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories and one paper copies of each submittal.
  - 1. Paper copies may be omitted with written approval of Architect.

#### 1.4 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
1. Preparation: Mark record prints to show the actual installation, where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
    - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
    - b. Accurately record information in an acceptable drawing technique.
    - c. Record data as soon as possible after obtaining it.
    - d. Record and check the markup before enclosing concealed installations.
    - e. Cross-reference record prints to corresponding photographic documentation.
  2. Content: Types of items requiring marking include, but are not limited to, the following:
    - a. Dimensional changes to Drawings.
    - b. Revisions to details shown on Drawings.
    - c. Depths of foundations.
    - d. Locations and depths of underground utilities.
    - e. Revisions to routing of piping and conduits.
    - f. Revisions to electrical circuitry.
    - g. Actual equipment locations.
    - h. Duct size and routing.
    - i. Locations of concealed internal utilities.
    - j. Changes made by Change Order or Construction Change Directive.
    - k. Changes made following Architect's written orders.
    - l. Details not on the original Contract Drawings.
    - m. Field records for variable and concealed conditions.
    - n. Record information on the Work that is shown only schematically.
  3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
  4. Mark record prints with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
  5. Mark important additional information that was either shown schematically or omitted from original Drawings.
  6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect and Construction Manager. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
1. Formats: Provide both of the following formats unless otherwise directed by Architect.
    - a. Same digital data software program, version, and operating system as for the original Contract Drawings.
    - b. Annotated PDF electronic file with comment function enabled.
  2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.

3. Refer instances of uncertainty to Architect for resolution.
  4. Architect will furnish Contractor with one set of digital data files of the Contract Drawings for use in recording information.
- C. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
  2. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
  3. Identification: As follows:
    - a. Project name.
    - b. Date.
    - c. Designation "PROJECT RECORD DRAWINGS."
    - d. Name of Architect and Construction Manager.
    - e. Name of Contractor.

## **1.5 RECORD SPECIFICATIONS**

- A. Preparation: Mark Specifications to indicate the actual product installation, where installation varies from that indicated in Specifications, addenda, and Contract modifications.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
  2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
  3. Record the name of manufacturer, supplier, installer, and other information necessary to provide a record of selections made.
  4. Note related Change Orders, Record Product Data, and Record Drawings where applicable.
- B. Format: Submit record specifications in the following two formats.
1. Annotated PDF electronic file or scanned PDF electronic file(s) of marked-up paper copy of Specifications
  2. Paper copy.

## **1.6 RECORD PRODUCT DATA**

- A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and revisions to Project Record Documents as they occur; do not wait until end of Project.
- B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
  2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
  3. Note related Change Orders, Record Specifications, and Record Drawings where applicable.

C. Format:

1. Submit record product data in the following two formats.
  - a. Annotated PDF electronic file or scanned PDF electronic file(s) of marked-up paper copy of Product Data
  - b. Paper copy.
2. Include Record Product Data directory organized by Specification Section number and title, electronically linked to each item of Record Product Data.

**1.7 MISCELLANEOUS RECORD SUBMITTALS**

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.
- B. Format:
  1. Submit miscellaneous record submittals in the following two formats.
    - a. Annotated PDF electronic file or scanned PDF electronic file(s) of marked-up miscellaneous record submittals
    - b. Paper copy.
  2. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

**1.8 MAINTENANCE OF RECORD DOCUMENTS**

- A. Maintenance of Record Documents: Store Record Documents in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION (Not Used)**

**END OF SECTION 01 7839**

## **SECTION 01 7900 – DEMONSTRATION AND TRAINING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
  - 1. Instruction in operation and maintenance of systems, subsystems, and equipment.

#### **1.3 INFORMATIONAL SUBMITTALS**

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
- B. Qualification Data: For instructor and facilitator.

#### **1.4 QUALITY ASSURANCE**

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 01 4000 "Quality Requirements," experienced in operation and maintenance procedures and training.

#### **1.5 COORDINATION**

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Architect.

#### **1.6 INSTRUCTION PROGRAM**

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.

- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
    - a. System, subsystem, and equipment descriptions.
    - b. Performance and design criteria if Contractor is delegated design responsibility.
    - c. Operating standards.
    - d. Regulatory requirements.
    - e. Equipment function.
    - f. Operating characteristics.
    - g. Limiting conditions.
    - h. Performance curves.
  2. Documentation: Review the following items in detail:
    - a. Emergency manuals.
    - b. Systems and equipment operation manuals.
    - c. Systems and equipment maintenance manuals.
    - d. Product maintenance manuals.
    - e. Project Record Documents.
    - f. Identification systems.
    - g. Warranties and bonds.
    - h. Maintenance service agreements and similar continuing commitments.
  3. Emergencies: Include the following, as applicable:
    - a. Instructions on meaning of warnings, trouble indications, and error messages.
    - b. Instructions on stopping.
    - c. Shutdown instructions for each type of emergency.
    - d. Operating instructions for conditions outside of normal operating limits.
    - e. Sequences for electric or electronic systems.
    - f. Special operating instructions and procedures.
  4. Operations: Include the following, as applicable:
    - a. Startup procedures.
    - b. Equipment or system break-in procedures.
    - c. Routine and normal operating instructions.
    - d. Regulation and control procedures.
    - e. Control sequences.
    - f. Safety procedures.
    - g. Instructions on stopping.
    - h. Normal shutdown instructions.
    - i. Operating procedures for emergencies.
    - j. Operating procedures for system, subsystem, or equipment failure.
    - k. Seasonal and weekend operating instructions.
    - l. Required sequences for electric or electronic systems.
    - m. Special operating instructions and procedures.
  5. Adjustments: Include the following:
    - a. Alignments.
    - b. Checking adjustments.
    - c. Noise and vibration adjustments.
    - d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:
  - a. Diagnostic instructions.
  - b. Test and inspection procedures.
7. Maintenance: Include the following:
  - a. Inspection procedures.
  - b. Types of cleaning agents to be used and methods of cleaning.
  - c. List of cleaning agents and methods of cleaning detrimental to product.
  - d. Procedures for routine cleaning.
  - e. Procedures for preventive maintenance.
  - f. Procedures for routine maintenance.
  - g. Instruction on use of special tools.
8. Repairs: Include the following:
  - a. Diagnosis instructions.
  - b. Repair instructions.
  - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
  - d. Instructions for identifying parts and components.
  - e. Review of spare parts needed for operation and maintenance.

## **1.7 PREPARATION**

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 01 7823 "Operation and Maintenance Data."
- B. Set up instructional equipment at instruction location.

## **1.8 INSTRUCTION**

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
  1. Owner, through Construction Manager, will furnish Contractor with names and positions of participants.
- C. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
  1. Schedule training with Owner, through Construction Manager, with at least seven days' advance notice.
- D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.

- E. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION (Not Used)**

**END OF SECTION 01 7900**



## **SECTION 02 4119.23 – UTILITY REMOVAL**

### **1.1 GENERAL**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Work shall comply with the 2020 MDOT Standard Specifications for Construction, except as otherwise indicated in the Special Provisions specified in this section.

### **1.2 SPECIAL PROVISIONS**

- A. **ITEM A - GATE WELL WELL, REM, GATE WELL COVER, REM, SALV**

- 1. **Description.**

- a. This work consists of removing water main gate valve from the water main, and removal of the structure (well), in it's entirety, that the valve is in. This work includes furnishing all labor, equipment, and materials required for excavation and backfilling as shown on the plans and specified herein.
  - b. Where existing valve and structure casting is in good condition, they are to be salvaged and reused.

- 2. **Materials.**

- a. All materials must be in accordance with sections 902, 923 and other applicable sections of the Standard Specifications for Construction.

- 3. **Construction.**

- a. Construction shall be in accordance with sections 823 of the 2020 MDOT Standard Specifications for Construction, the City of Farmington Hills Water Main Standard Details, and the applicable Special Provisions. If any conflict arises between the 2020 MDOT Standard Specifications, the City of Farmington Hills Standard Details, and/or Project Special Provisions, then the City of Farmington Hills Standard Water Main Details shall take precedent.

- 4. **Gate Valve, Rem** includes excavating, backfilling and removal and disposal of the gate valve.

- B. **ITEM C - WATER MAIN, 12 INCH OR LESS, REM**

- 1. **Description.**

- a. During the installation of the proposed underground improvements, certain existing water main may be encountered which may be in conflict with the lines and grades of the proposed work.
  - b. The work would include the cutting away and removal of pipe in order to provide room for the proposed items of work.
  - c. The water mains are cast or ductile iron, except as noted on plans, and shall be neatly cut a minimum of twenty-four (24) inches each way beyond the outside edge of any proposed item of work.
  - d. Asbestos Cement Water Main are to be cut and disposed of in accordance with all local, state, and federal requirements as well as industry standards, whichever is more stringent.
  - e. The open ends of all cut pipe shall be sealed with permanent watertight mechanical joint caps.
  - f. Any additional excavation and trench backfill required beyond that necessary to construct the proposed items of work shall also be included in the bid for this item of work.

**2. NOTE:**

- a. The furnishing and placing of permanent bulkheads or mechanical end caps where sections of the existing water mains are removed, as well as all necessary excavation and backfill, shall be included in this item of work.

**C. ITEM C – SEWER, REM**

**1. Description.**

- a. During the installation of the proposed underground improvements, certain existing storm and sanitary sewers may be encountered which may be in conflict with the lines and grades of the proposed work.
- b. The work would include the cutting away and removal of pipe in order to provide room for the proposed items of work.
- c. The material of storm and sanitary sewers is uncertain. The sewers all be neatly cut a minimum of twenty-four (24) inches each way beyond the outside edge of any proposed item of work.
- d. The open ends of all cut pipe shall be sealed with permanent watertight mechanical joint caps.
- e. Any additional excavation and trench backfill required beyond that necessary to construct the proposed items of work shall also be included in the bid for this item of work.
- f. The work includes removal of all associated structures, i.e. manholes, catch basins, cleanouts, etc. shown to be removed.
- g. Contractor is responsible for management of stormwater runoff and sewage diversions as necessary until permanent stormwater and sanitary sewers are installed.

**2. NOTE:**

- a. The furnishing and placing of permanent bulkheads or mechanical end caps where sections of the existing water mains are removed, as well as all necessary excavation and backfill, shall be included in this item of work.

**END OF SECTION 02 4119.23**

## **SECTION 02 4119.13 – MISCELLANEOUS SITE DEMOLITION**

### **1.1 GENERAL**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Work shall comply with the 2020 MDOT Standard Specifications for Construction, except as otherwise indicated in the Special Provisions specified in this section.

### **1.2 SPECIAL PROVISIONS**

#### **A. ITEM A - BLEACHER, REM, SALV (IF APPLICABLE)**

##### **1. Description.**

- a. This work consists of providing labor, equipment and materials to provide proper removal and salvage of the bleacher.

##### **2. Materials.**

- a. The contractor is responsible for providing the necessary labor, equipment and materials to complete proper removal and salvage of the bleacher.

##### **3. Construction.**

- a. Contractor shall remove and salvage bleacher as indicated on the plans. Bleacher shall be safely removed from the existing location while taking precautions not to damage the bleacher. Bleacher shall then be moved to a proposed location within the property determined by the Owner.

#### **B. ITEM B - BOLLARD, REM**

##### **1. Description.**

- a. This work consists of removing and disposing of bollard and its foundation as located and indicated on the plans.

##### **2. Materials.**

- a. All materials shall be in accordance with Section 902 of the MDOT 2020 Standard Specifications for Construction.

##### **3. Construction.**

- a. Remove the bollard entirely, including any concrete footings, to a depth which will not interfere with the proposed construction. The bollard and footing shall be disposed of in accordance with Section 204 of the MDOT 2020 Standard Specifications for Construction.
- b. Backfill all excavated areas with 21AA limestone as described in Section 204 of the MDOT 2020 Standard Specifications for Construction

C. **ITEM C - EXERCISE STATION, REM, SALV (IF APPLICABLE)**

1. **Description.**

- a. This item of work consists of providing all materials, labor and equipment necessary to complete exercise station removal and salvage as shown on the plans, or as directed by the Engineer.

2. **Materials.**

- a. The contractor is responsible for providing the necessary labor, equipment and materials to complete proper removal and salvage of the exercise station.

3. **Construction.**

- a. The work shall be performed in accordance with Section 205 of the 2020 Standard Specifications for Construction except as described herein. This item of work includes the removal and salvaging of all exercise station equipment including any foundations as noted in the plans regardless of type or size. It is the Contractors responsibility to evaluate the site conditions prior to submitting a bid price. No price adjustments will be made for variations due to undiscovered sizes or types of material. All exercise station equipment salvaged shall then be moved to a proposed location within the property determined by the Owner.

D. **ITEM D - GATE, SECURITY LIFT, REM**

1. **Description.**

- a. This work consists of removing and disposing of a security lift gate and its foundation as located and indicated on the plans.

2. **Materials.**

- a. All materials shall be in accordance with Section 902 of the MDOT 2020 Standard Specifications for Construction.

3. **Construction.**

- a. Remove the security left gate entirely, including any concrete footings, to a depth which will not interfere with the proposed construction. The gate, arm and footing shall be disposed of in accordance with Section 204 of the MDOT 2020 Standard Specifications for Construction. Any associated electrical connections and wiring shall be cut and capped within the footing excavated area.
- b. Backfill all excavated areas with 21AA limestone as described in Section 204 of the MDOT 2020 Standard Specifications for Construction.

E. **ITEM E - LANDSCAPE BOULDER, REM, SALV**

1. **Description.**

- a. This item of work consists of removing landscape boulders as indicated on the construction plans. The contractor should remove and salvage these boulders as part of the work for this project.

2. **Materials.**

- a. None.

3. **Construction.**

- a. Contractor shall remove and salvage landscape boulders as indicated on the plans. Landscape Boulders shall be safely removed from the existing location while taking precautions not to damage the boulders. Boulders shall then be moved to a proposed location within the property determined by the Owner.

F. **ITEM F - LANDSCAPE STONE, REM**

1. **Description.**

- a. This item of work consists of providing all materials, labor and equipment necessary to complete landscape stone removal as shown on the plans, or as directed by the Engineer.

2. **Materials.**

- a. None.

3. **Construction.**

- a. The work shall be performed in accordance with Section 205 of the 2020 Standard Specifications for Construction except as described herein. This item of work includes the removal and proper disposal of all landscape stones as noted in the plans regardless of thickness/depth. It is the Contractors responsibility to evaluate the site conditions prior to submitting a bid price. No price adjustments will be made for variations due to undiscovered thickness/depth of stoned area(s).

G. **ITEM G – Light Pole, REM**

1. **Description.**

- a. This work consists of removing and disposing of a light pole and its foundation as located and indicated on the plans.

2. **Materials.**

- a. All materials shall be in accordance with Section 902 of the MDOT 2020 Standard Specifications for Construction.

3. **Construction.**

- a. Remove the light pole entirely, including any concrete footings, to a depth which will not interfere with the proposed construction. The light, pole and footing shall be disposed of in accordance with Section 204 of the MDOT 2020 Standard Specifications for Construction. Any associated electrical connections and wiring shall be cut and capped within the footing excavated area.
- b. Backfill all excavated areas with 21AA limestone as described in Section 204 of the MDOT 2020 Standard Specifications for Construction.

H. **ITEM H – POST, STEEL, TENNIS, REM**

1. **Description.**

- a. This work consists of providing labor, equipment and materials to provide proper removal and disposal of any steel post.

2. **Materials.**

- a. This work consists of providing labor, equipment and materials to provide proper removal and disposal of any steel post.

3. **Construction.**

- a. Contractor shall remove steel posts as indicated on the plans. It is expected that the steel post to be removed with the foundation. Any post that includes foundation removal shall be backfilled with 21AA limestone compacted to 95% maximum dry density. All posts to be disposed of properly by the Contractor.

I. **ITEM I – SIGN, REM**

1. **Description.**

- a. Signs with posts exist, which need to be removed to construct the proposed work under this Contract. The Contractor shall carefully remove and dispose of the items indicated on the construction plans.

2. **Materials.**

- a. None.

3. **Construction.**

- a. Perform work in accordance with Section 810 of the MDOT 2020 Standard Specifications for Construction. In addition, this work will include the sign and the sign post along with any foundation the post is in.

J. **ITEM J – WASTE RECEPTACLE, REM, SALV**

1. **Description.**

- a. This work consists of providing labor, equipment and materials to provide proper removal and salvage of the waste receptacle.

2. **Materials.**

- a. The contractor is responsible for providing the necessary labor, equipment and materials to complete proper removal and salvage of the waste receptacle.

3. **Construction.**

- a. Contractor shall remove and salvage the waste receptacle as indicated on the plans. Waste receptacle shall be safely removed from the existing location while taking precautions not to damage the waste receptacle. Waste receptacle shall then be moved to a proposed location within the property determined by the Owner.

**END OF SECTION 02 4119.13**

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

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Cast-in-place concrete, including concrete materials, mixture design, and finishes.
  - 2. Steel reinforcement bars and welded-wire reinforcement.
  - 3. Concrete formwork.

#### **1.3 DEFINITIONS**

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.
- B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.
- C. Form-Facing Material: Temporary structure or mold for the support of concrete while the concrete is setting and gaining sufficient strength to be self-supporting.
- D. Formwork: The total system of support of freshly placed concrete, including the mold or sheathing that contacts the concrete, as well as supporting members, hardware, and necessary bracing.

#### **1.4 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
    - a. Contractor's superintendent.
    - b. Independent testing agency responsible for concrete design mixtures.
    - c. Ready-mix concrete manufacturer.
    - d. Concrete Subcontractor.
  - 2. Review the following:
    - a. Vapor-retarder installation.
    - b. Steel-reinforcement installation
    - c. Anchor rod and anchorage device installation tolerances.
    - d. Forms and form-removal limitations.
    - e. Construction joints, control joints, isolation joints, and joint-filler strips.
    - f. Concrete finishes and finishing.
    - g. Floor and slab flatness and levelness measurements.
    - h. Cold and hot weather concreting procedures.
    - i. Curing procedures.
    - j. Concrete repair procedures.
    - k. Concrete protection.
    - l. Special inspection and testing and inspecting agency procedures for field quality control.

## **1.5 ACTION SUBMITTALS**

- A. Product Data: For each type of product and material.
- B. Design Mixtures: For each concrete mixture.
  - 1. Include indication where each mix design will be used.
  - 2. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- C. Shop Drawings:
  - 1. Construction Joint Layout:
    - a. Indicate proposed construction joints required to construct the structure.
      - 1) Location of construction joints is subject to approval of the Architect.
  - 2. Concrete Reinforcement:
    - a. Include placing drawings that detail fabrication, bending, and placement.
    - b. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.
  - 3. Concrete Formwork:
    - a. For exposed vertical concrete walls, indicate dimensions and form tie locations.
    - b. Indicate location of waterstops.
- D. Samples: Submit 3 samples for each of the following:
  - 1. Vapor Retarder: 4 by 4 inch sample.

## **1.6 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For the following:
  - 1. Installer: Include copies of applicable ACI certificates.
  - 2. Ready-mixed concrete manufacturer.
  - 3. Testing and inspection agency: Include copies of applicable ACI certificates.
- B. Welding certificates.
  - 1. Reinforcement To Be Welded: Welding procedure specification in accordance with AWS D1.4/D1.4M
- C. Material Certificates: For each of the following, signed by manufacturers:
  - 1. Cementitious materials.
  - 2. Admixtures.
  - 3. Steel reinforcement and accessories
  - 4. Form materials and form-release agents.
  - 5. Floor and slab treatments.
  - 6. Bonding agents.
  - 7. Vapor retarders.
  - 8. Joint-filler strips.



- D. Material Test Reports: For the following, from a qualified testing agency:
  - 1. Portland cement.
  - 2. Fly ash.
  - 3. Aggregates.
  - 4. Admixtures.
  - 5. Steel Reinforcement:
- E. Floor surface flatness and levelness measurements report, indicating compliance with specified tolerances.
- F. Research Reports:
  - 1. For concrete admixtures in accordance with ICC's Acceptance Criteria AC198.
  - 2. For sheet vapor retarder, showing compliance with ICC AC380.
- G. Field quality-control reports.

## **1.7 QUALITY ASSURANCE**

- A. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94 requirements for production facilities and equipment; with not less than 5 years of documented experience.
  - 1. Manufacturer certified in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- B. Installer Qualifications: A qualified installer who employs Project personnel qualified as an ACI-certified Flatwork Technician and Finisher and a supervisor who is a certified ACI Flatwork Concrete Finisher/Technician or an ACI Concrete Flatwork Technician.
  - 1. Supervisors shall have not less than 5 years of documented experience
- C. Laboratory Testing Agency Qualifications: A testing agency qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated and employing an ACI-certified Concrete Quality Control Technical Manager.
  - 1. Personnel performing laboratory tests shall be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.
- D. Field Quality Control Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.
  - 1. Personnel conducting field tests shall be qualified as an ACI Concrete Field Testing Technician, Grade 1, in accordance with ACI CPP 610.1 or an equivalent certification program.
- E. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.4/D 1.4M.
- F. Mockups: Cast concrete slab-on-grade and formed-surface panels to demonstrate typical joints, surface finish, texture, tolerances, floor treatments, and standard of workmanship.
  - 1. Slab-On-Grade: Build panel approximately 15 feet by 15 feet in the location indicated or, if not indicated, as directed by Architect.
    - a. Divide panel into four equal panels to demonstrate saw joint cutting.

2. Formed Surfaces: Build panel approximately 100 sq. ft. in the location indicated or, if not indicated, as directed by Architect.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

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

- A. Comply with ASTM C94 and ACI 301.
- B. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
  1. Store reinforcement to avoid contact with earth.

## **1.9 FIELD CONDITIONS**

- A. Cold-Weather Placement: Comply with ACI 301 and ACI 306.1 and as follows.
  1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
  2. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
  3. Do not use frozen materials or materials containing ice or snow.
  4. Do not place concrete in contact with surfaces less than 35 deg F, other than reinforcing steel.
  5. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:
  1. Maintain concrete temperature at time of discharge to not exceed 95 deg F.
  2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. Concrete:
  1. Comply with ACI 301 unless modified by requirements in the Contract Documents.
    - a. Provide construction and movement joints required to construct the structure in accordance with ACI 301.
      - 1) Location of construction joints is subject to approval of the Architect.
  2. Concrete Reinforcement shall comply with ACI SP-066.

B. Concrete Formwork:

1. Design, engineer, erect, shore, brace, and maintain formwork, shores, and reshores in accordance with ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.
  - a. Design wood panel forms in accordance with APA's "Concrete Forming Design/Construction Guide."
  - b. Design formwork to limit deflection of form-facing material to 1/240 of center-to-center spacing of supports.

**2.2 FORM-FACING MATERIALS**

A. Exposed Surface Form-Facing Material: Smooth as-cast surface form-facing material.

1. Provide continuous, true, and smooth concrete surfaces.
2. Furnish in largest practicable sizes to minimize number of joints.
3. Acceptable Materials: As required to comply with Surface Finish designations specified and as follows:
  - a. Plywood, metal, or other approved panel materials.

B. Concealed Surface Form-Facing Material: Lumber, plywood, metal, plastic, or another approved material.

1. Provide lumber dressed on at least two edges and one side for tight fit.

**2.3 RELATED FORMWORK MATERIALS**

A. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

B. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
2. Form release agent for form liners shall be acceptable to form liner manufacturer.

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 of concrete on removal.

1. Furnish units that leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
2. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.

**2.4 CONCRETE MATERIALS**

A. Source Limitations:

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

B. Cementitious Materials:

1. Portland Cement: ASTM C150, Type I, gray or white.

2. Fly Ash: ASTM C618, Class C or F.

- C. Normal-Weight Aggregates: ASTM C33, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source.

1. Provide Class 4S at exterior flatwork and wet interior flatwork areas.
2. Maximum Coarse-Aggregate Size: 1 inch nominal, unless otherwise indicated.
3. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

## **2.5 ADMIXTURES**

- A. Air-Entraining Admixture: ASTM C260.

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

1. Water-Reducing Admixture: ASTM C494, Type A.
2. Retarding Admixture: ASTM C494, Type B.
3. Water-Reducing and -Retarding Admixture: ASTM C494, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C494, Type F.
5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494, Type G.
6. Plasticizing and Retarding Admixture: ASTM C1017, Type II

- C. Water and Water Used to Make Ice: ASTM C94, potable

## **2.6 STEEL REINFORCEMENT**

- A. Fabricating Reinforcement

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

- B. Reinforcing Bars: ASTM A615, Grade 60, deformed.

- C. Steel Bar Mats: ASTM A184, fabricated from ASTM A615, Grade 60, deformed bars, assembled with clips.

- D. Plain-Steel Welded-Wire Reinforcement: ASTM A1064, plain, fabricated from as-drawn steel wire into flat sheets.

## **2.7 REINFORCEMENT ACCESSORIES**

- A. Joint Dowel Bars: ASTM A615, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.

- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.

1. Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
  - a. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.

- C. Steel Tie Wire: ASTM A1064, annealed steel, not less than 0.0508 inch in diameter.

1. Finish: Plain.

## **2.8 VAPOR RETARDERS**

- A. Sheet Vapor Retarder: ASTM E1745, Class A; not less than 15 mils thick with a permeance of not more than 0.01 Perms. Include manufacturer's recommended adhesive or pressure-sensitive tape.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Henry Company, a Carlisle Company: Moistop Ultra 15 [www.henry.com](http://www.henry.com).
- b. Inteplast Group; Barrier-Bac, VB-350: [www.barrierbac.com](http://www.barrierbac.com).
- c. Reef Industries, Inc.; Griffolyn 15 Mil: [www.reefindustries.com](http://www.reefindustries.com).
- d. Stego Industries, LLC; Stego Wrap Vapor Barrier (15 Mil): [www.stegoindustries.com](http://www.stegoindustries.com).
- e. Viaflex, Inc.; VaporBlock VB15: [www.viaflex.com](http://www.viaflex.com).
- f. W. R. Meadows, Inc; Perminator 15 Mil: [www.wrmeadows.com](http://www.wrmeadows.com).

## **2.9 LIQUID FLOOR TREATMENTS**

- A. Concrete Hardener/Densifier (Sealer): Refer to Section 07 1900 – Water Repellents.

## **2.10 CURING MATERIALS**

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

- B. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.

1. Color:

- a. Ambient Temperature Below 50 deg F: Black.
- b. Ambient Temperature between 50 deg F and 85 deg F: Any color.
- c. Ambient Temperature Above 85 deg F: White.

- C. Water: Potable or complying with ASTM C1602/C1602M.

## **2.11 RELATED MATERIALS**

- A. Bonding Agents: Provide one or more of the following:

1. Latex Bonding Agent: ASTM C1059, Type II, nonredispersible, acrylic emulsion or styrene butadiene.
2. Epoxy Bonding Adhesive: ASTM C881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade and class to suit requirements, and as follows:

- a. Types I and II, nonload bearing and Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

- B. Expansion- and Isolation-Joint-Filler Strips:

1. Size and Configuration: Unless otherwise indicated, 1/2 inch thick by height equal to slab thickness, optionally with removable top section that will form 1/2 inch deep sealant pocket after removal.
2. Materials: Provide products manufactured from one or more of the following:
  - a. Cellulose fiber, ASTM D1751.
  - b. PVC (Type IV), ASTM D1752.
  - c. Semi-rigid, closed-cell polypropylene foam ASTM D8139.

3. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
  - a. Oscoda Plastics, Inc; Proflex Vinyl Expansion Joints: [www.oscodaplastics.com](http://www.oscodaplastics.com).
  - b. W. R. Meadows, Inc; Fiber Expansion Joint Filler with Snap-Cap: [www.wrmeadows.com](http://www.wrmeadows.com).
  - c. W. R. Meadows, Inc; Deck-O-Foam Joint Filler with pre-scored top strip: [www.wrmeadows.com](http://www.wrmeadows.com).

## **2.12 CONCRETE MIXTURES, GENERAL**

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301.
  1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
  1. Fly Ash or Other Pozzolans: 25 percent by mass.
  2. Total Fly Ash and Pozzolan: 25 percent by mass.
- C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.
  1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.
  2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
  3. Use water-reducing admixture in pumped concrete, and concrete with a w/cm below 0.50.

## **2.13 CONCRETE MIXTURES**

- A. Class A: Normal-weight concrete used for footings and foundations.
  1. Exposure Class: ACI 318 F2.
  2. Minimum Compressive Strength: 4000 psi, at 28 days.
  3. Maximum w/cm: 0.45.
  4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for concrete containing 1-inch nominal maximum aggregate size.
- B. Class B: Normal-weight concrete used for exterior slabs-on-grade and equipment pads.
  1. Exposure Class: ACI 318 F3, C2.
  2. Minimum Compressive Strength: 5000 psi at 28 days.
  3. Maximum w/cm: 0.40.
  4. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
  5. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for concrete containing 1-inch nominal maximum aggregate size.
- C. Class C: Normal-weight concrete used for interior slabs-on-grade and equipment pads.
  1. Exposure Class: ACI 318 F0, C2.
  2. Minimum Compressive Strength: 5000 psi at 28 days.
  3. Maximum w/cm: 0.40.
  4. Minimum Cementitious Materials Content: 520 lb/cu. yd.
  5. Air Content: Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.

## **2.14 CONCRETE MIXING**

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

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

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

### **3.2 INSTALLATION OF FORMWORK**

- A. Comply with ACI 301.
- B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 and to comply with the Surface Finish designations specified for as-cast finishes.
- C. Limit concrete surface irregularities as follows:
  - 1. For concealed concrete:
    - a. Surface Finish-1.0: ACI 117 Class D, 1 inch.
  - 2. For exposed concrete, concrete surfaces to receive a rubbed finish, or concrete to be covered with a coating or covering material applied directly to concrete:
    - a. Surface Finish-3.0: ACI 117 Class A, 1/8 inch.
- D. Construct forms tight enough to prevent loss of concrete mortar.
  - 1. Minimize joints.
  - 2. Exposed Concrete: Symmetrically align joints in forms.
- E. Construct removable forms for easy removal without hammering or prying against concrete surfaces.
  - 1. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces.
  - 2. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
  - 3. Install keyways, reglets, recesses, and other accessories, for easy removal.
- F. Do not use rust-stained, steel, form-facing material.
- G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces.
  - 1. Provide and secure units to support screed strips
  - 2. Use strike-off templates or compacting-type screeds.

- H. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible.
  - 1. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar.
  - 2. Locate temporary openings in forms at inconspicuous locations.
- I. Chamfer exterior corners and edges of permanently exposed concrete.
- J. At construction joints, overlap forms onto previously placed concrete not less than 12 inches.
- K. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.
  - 1. Determine sizes and locations from trades providing such items.
- L. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.
  - 1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
  - 2. Close temporary ports and openings with tight-fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.
- M. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- N. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- O. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

### **3.3 REMOVING AND REUSING FORMS**

- A. Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.
  - 1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
  - 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work.
  - 1. Split, frayed, delaminated, or otherwise damaged form-facing material are unacceptable for exposed surfaces.
  - 2. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints.
  - 1. Align and secure joints to avoid offsets.
  - 2. Do not use patched forms for exposed concrete surfaces unless approved by Architect.



### **3.4 SHORING AND RESHORING INSTALLATION**

- A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.
  - 1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.
- B. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

### **3.5 INSTALLATION OF EMBEDDED ITEMS**

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete.
  - 1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
  - 3. Clean embedded items immediately prior to concrete placement.

### **3.6 INSTALLATION OF VAPOR RETARDER**

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

### **3.7 INSTALLATION OF STEEL REINFORCEMENT**

- A. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.
- B. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.
- C. Accurately position, support, and secure reinforcement against displacement.
  - 1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
  - 2. Do not tack weld crossing reinforcing bars.
- D. Preserve clearance between bars of not less than 1 inch, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.
- E. Provide concrete coverage in accordance with ACI 318 and as follows:
  - 1. Match clear cover shown on the Structural Drawings.

- F. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- G. Splices: Lap splices as indicated on Drawings.
  - 1. Bars indicated to be continuous, and all vertical bars shall be lapped per the structural Drawings and not less than 36 bar diameters at splices, or 24 inches, whichever is greater.
  - 2. Stagger splices in accordance with ACI 318.
- H. Install welded-wire reinforcement in longest practicable lengths.
  - 1. Support welded-wire reinforcement in accordance with CRSI "Manual of Standard Practice."
    - a. For reinforcement less than W4.0 or D4.0, continuous support spacing shall not exceed 12 inches.
  - 2. Lap edges and ends of adjoining sheets at least one wire spacing plus 2 inches for plain wire and 8 inches for deformed wire.
  - 3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
  - 4. Lace overlaps with wire.

### **3.8 JOINTS**

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

- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
  - 1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated on Drawings.
  - 2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface, where joint sealants, specified in Section 07 9200 "Joint Sealants," are indicated.
  - 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints:
  - 1. Install dowel bars and support assemblies at joints where indicated on Drawings.
  - 2. Lubricate or asphalt coat one-half of dowel bar length to prevent concrete bonding to one side of joint.

### 3.9 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.
  - 1. Do not proceed until unsatisfactory conditions have been corrected.
  - 2. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
  - 3. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.
- B. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.
- C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect in writing, but not to exceed the amount indicated on the concrete delivery ticket.
  - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.
  - 1. If a section cannot be placed continuously, provide construction joints as indicated.
  - 2. Deposit concrete to avoid segregation.
  - 3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
  - 4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.
    - a. Do not use vibrators to transport concrete inside forms.
    - b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
    - c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
    - d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
  - 1. Do not place concrete floors and slabs in a checkerboard sequence.

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

### **3.10 FINISHING FORMED SURFACES**

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

1. At concrete surfaces not exposed to view:
  - a. ACI 301 Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.
    - 1) Patch voids larger than 1-1/2 inches wide or 1/2 inch deep.
    - 2) Remove projections larger than 1 inch.
    - 3) Tie holes do not require patching.
    - 4) Surface Tolerance: ACI 117 Class D.
2. At concrete surfaces exposed to view:
  - a. ACI 301 Surface Finish SF-3.0:
    - 1) Patch voids larger than 3/4 inch wide or 1/2 inch deep.
    - 2) Remove projections larger than 1/8 inch.
    - 3) Patch tie holes.
    - 4) Surface Tolerance: ACI 117 Class A.

#### **B. Related Unformed Surfaces:**

1. At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a color and texture matching adjacent formed surfaces.
2. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

### **3.11 FINISHING FLOORS AND SLABS**

#### **A. Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.**

#### **B. Float Finish:**

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

#### **C. Trowel Finish:**

1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.

2. Continue troweling passes and restraighthen until surface is free of trowel marks and uniform in texture and appearance.
3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
4. Do not add water to concrete surface.
5. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.
6. Apply a trowel finish to all interior slab surfaces, unless otherwise indicated.

D. Broom Finish:

1. Apply broom finish to the following:
  - a. Exterior concrete platforms, steps, ramps, and locations indicated on Drawings.
2. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.

**3.12 TOLERANCES**

- A. Conform to ACI 117.

**3.13 FLOOR FLATNESS AND LEVELNESS TOLERANCES**

- A. Measure F(F) Floor Flatness and F(L) Floor Levelness in accordance with ACI 117 and ASTM E1155, within 48 hours after slab installation; report both composite overall values and local values for each measured section.
1. Correct the slab surface if composite overall value is less than specified and if local value is less than two-thirds of specified value or less than F(F) 13/F(L) 10.
  2. 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.
- B. Minimum F(F) Floor Flatness and F(L) Floor Levelness Values: F(L) applies to on-grade slabs only.
1. Exposed to View (without a finish flooring material) and Foot Traffic: F(F) of 25; F(L) of 20.
  2. At Floors Receiving Finish Flooring Material (except as otherwise indicated in this list): F(F) of 35; F(L) of 25.

**3.14 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS**

- A. Equipment Pads and Bases:
1. Coordinate sizes and locations of concrete bases with actual equipment provided.
  2. Construct concrete bases 4 inches high unless otherwise indicated on Drawings, and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated on Drawings, or unless required for seismic anchor support.
  3. Prior to pouring concrete, place and secure anchorage devices.
    - a. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

**3.15 CONCRETE CURING**

- A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
1. Comply with ACI 301 and ACI 306.1 for cold weather protection during curing.
  2. Comply with ACI 301 and ACI 305.1 for hot-weather protection during curing.

3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h, calculated in accordance with ACI 305.1, before and during finishing operations.

B. Curing Formed Surfaces:

1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.
2. If forms remain during curing period, moist cure after loosening forms.
3. If removing forms before end of curing period, continue curing for remainder of curing period.

C. Curing Unformed Surfaces:

1. Begin curing immediately after finishing concrete.
  - a. Interior Concrete Floors: Cure for not less than seven days.

D. Cure concrete according to ACI 308.1, and by one or a combination of the following methods:

1. Moisture Curing:
  - a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
  - b. Continuous Sprinkling: Maintain concrete surface continuously wet.
  - c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.
  - a. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.

### **3.16 APPLICATION OF LIQUID FLOOR TREATMENTS**

- A. Refer to Section 07 1900 – Water Repellents, for application of concrete hardener/densifiers (sealers).

### **3.17 JOINT FILLING**

- A. Refer to Section 07 9200 - Sealants.

### **3.18 CONCRETE SURFACE REPAIRS**

- A. Defective Concrete:
  1. Repair and patch defective areas when approved by Architect.
  2. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete.
    - a. Limit cut depth to 3/4 inch.
    - b. Make edges of cuts perpendicular to concrete surface.
    - c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
    - d. Fill and compact with patching mortar before bonding agent has dried.
    - e. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
  2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement, so that, when dry, patching mortar matches surrounding color.
    - a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
    - b. Compact mortar in place and strike off slightly higher than surrounding surface.
  3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance as determined by Architect.
- D. Repairing Unformed Surfaces:
1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.
    - a. Correct low and high areas.
    - b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
  2. Repair finished surfaces containing surface defects, including spalls, popouts, honeycombs, rock pockets, crazing, and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions. After concrete has cured at least 14 days, correct high areas by grinding.
  3. Correct localized low areas during, or immediately after, completing surface-finishing operations by cutting out low areas and replacing with patching mortar.
    - a. Finish repaired areas to blend into adjacent concrete.
  5. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete.
    - a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a 3/4-inch clearance all around.
    - b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.
    - c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
    - d. Place, compact, and finish to blend with adjacent finished concrete.
    - e. Cure in same manner as adjacent concrete.
  6. Repair random cracks and single holes 1 inch or less in diameter with patching mortar.
    - a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
    - b. Dampen cleaned concrete surfaces and apply bonding agent.
    - c. Place patching mortar before bonding agent has dried.
    - d. Compact patching mortar and finish to match adjacent concrete.

- e. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

### **3.19 FIELD QUALITY CONTROL**

- A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports.
- B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
  - 1. Testing agency shall be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31.
  - 2. Testing agency shall immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
  - 3. Testing agency shall report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.
    - a. Test reports shall include reporting requirements of ASTM C31, ASTM C39, and ACI 301,
- C. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.
- D. Inspections:
  - 1. Inspect formwork for shape, location, and dimensions of the concrete member being formed.
  - 2. Steel-reinforcement placement.
  - 3. Steel-reinforcement welding.
  - 4. Headed bolts and studs.
  - 5. Verification of use of required design mixture.
  - 6. Concrete placement, including conveying and depositing.
  - 7. Curing procedures and maintenance of curing temperature.
  - 8. Verification of concrete strength before removal of shores and forms from beams and slabs.
- E. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172M shall be performed in accordance with the following requirements:
  - 1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day
  - 2. Slump: ASTM C143:
    - a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
    - b. Perform additional tests when concrete consistency appears to change.
  - 3. Air Content: ASTM C231 pressure method, for normal-weight concrete:
    - a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.



4. Concrete Temperature: ASTM C1064:
    - a. One test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.
  5. Compression Test Specimens: ASTM C31:
    - a. Cast and laboratory cure two sets of two 6-inch by 12-inch or three sets of 4-inch by 8-inch cylinder specimens for each composite sample.
    - b. Cast and laboratory cure two sets of two 6-inch by 12-inch or 4-inch by 8-inch cylinder specimens for each composite sample.
    - c. Cast, initial cure, and field cure two sets of two standard cylinder specimens for each composite sample.
  6. Compressive-Strength Tests: ASTM C39.
    - a. Test one set of two laboratory-cured specimens at seven days and one set of two specimens at 28 days.
    - b. Test one set of two field-cured specimens at seven days and one set of two specimens at 28 days.
    - c. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
  7. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
  8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 10 percent of specified compressive strength.
  9. 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.
  10. Additional Tests:
    - a. Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
    - b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42 or by other methods as directed by Architect.
      - 1) Acceptance criteria for concrete strength shall be in accordance with ACI 301, section 1.6.6.3.
  11. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
  12. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- F. Measure floor and slab flatness and levelness in accordance with ACI 117 and ASTM E1155 within 24 hours of completion of floor finishing and promptly report test results to Architect.

### **3.20 PROTECTION**

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

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

**END OF SECTION 03 3000**

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

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Concrete masonry units (CMU).
  - 2. Decorative concrete masonry units.
  - 3. Mortar and grout.
  - 4. Steel reinforcing bars.
  - 5. Masonry-joint reinforcement.
  - 6. Ties and anchors.
  - 7. Embedded flashing.
  - 8. Cavity wall insulation.
  - 9. Miscellaneous masonry accessories.
- B. Products Installed but not Furnished under this Section:
  - 1. Anchors and fasteners for connecting stone cladding to masonry backup construction, furnished by Section 04 4200 – Exterior Stone Cladding.
  - 2. Steel lintels in unit masonry; furnished by Section 05 5000 – Metal Fabrications.
  - 3. Bent metal restraints; furnished by Section 05 5000 – Metal Fabrications.
- C. Products Furnished but not Installed under this Section:
  - 1. Mortar and embedded flashing materials and veneer anchors and joint reinforcement for stone cladding specified in Section 04 4200 – Exterior Stone Cladding.
  - 2. Structural steel anchor sections for connecting masonry to structural steel; installed by Section 05 1200 – Structural Steel Framing.

#### **1.3 DEFINITIONS**

- A. CMU(s): Concrete masonry unit(s).
- B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.
- C. BIA: The Brick Industry Association.
- D. TMS: The Masonry Society.

#### **1.4 PREINSTALLATION MEETINGS**

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

#### **1.5 ACTION SUBMITTALS**

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

- B. Shop Drawings: For the following:
  - 1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
  - 2. Reinforcing Steel: Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315. Show elevations of reinforced walls.
  - 3. Flashing: Provide details of embedded flashings including end dams, corners, drips, and other special applications.
- C. Masonry Veneer Anchors at Wall Cavities Greater Than 4-1/2 inches:
  - 1. Include delegated-design analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- D. Samples for Initial Selection:
  - 1. Decorative CMUs, in the form of small-scale units.
  - 2. Colored mortar.
  - 3. Weep inserts.
- E. Samples for Verification: Submit 3 samples for each type and color of the following:
  - 1. Decorative CMUs.
  - 2. Colored mortar. Make Samples using same sand and mortar ingredients to be used on Project.
  - 3. Weep inserts.
  - 4. Accessories embedded in masonry.

## **1.6 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For manufacturers, installers, and testing agency.
- B. Masonry Veneer Anchors: At wall cavities greater than 4-1/2 inches, provide masonry veneer anchor manufacturer's test reports indicating compliance with TMS 402/602 for lateral load requirements; wall cavity depth includes airspace and cavity wall insulation thickness.
- C. Material Certificates: For each type and size of the following:
  - 1. Masonry units.
    - a. Include data on material properties material test reports substantiating compliance with requirements.
  - 2. Integral water repellent used in CMUs.
  - 3. Cementitious materials. Include name of manufacturer, brand name, and type.
  - 4. Mortar admixtures.
  - 5. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
  - 6. Grout mixes. Include description of type and proportions of ingredients.
  - 7. Reinforcing bars.
  - 8. Joint reinforcement.
  - 9. Anchors, ties, and metal accessories.
- D. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
  - 1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C109 for compressive strength, ASTM C1506 for water retention, and ASTM C91 for air content.
  - 2. Include test reports, according to ASTM C1019, for grout mixes required to comply with compressive strength requirement.

- E. Field quality-control reports.
- F. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.
  - 1. Submittal is for information only. Receipt of list does not constitute approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.
- G. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

## 1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section with minimum 5 years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least 5 years of documented experience.
- C. Professional Engineer Qualifications: Professional engineer experienced with providing delegated-design engineering services of the kind indicated, including documentation that engineer is licensed in the state in which Project is located.
- D. Testing Agency Qualifications: Qualified according to ASTM C1093 for testing indicated.
- E. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
  - 1. Build mockups for each type of exterior wall unit masonry construction in sizes approximately 60 inches long by 60 inches high by full thickness, including face and backup wythes and accessories.
    - a. Include a sealant-filled joint at least 16 inches long.
    - b. Include lower corner of window opening at upper corner of exterior wall mockup. Make opening approximately 12 inches wide by 16 inches (400 mm) high.
    - c. Include through-wall flashing installed for a 24-inch length in corner of exterior wall mockup approximately 16 inches down from top of mockup, with a 12-inch length of flashing left exposed to view (omit masonry above half of flashing).
    - d. Include metal studs, sheathing, water-resistive barrier, veneer anchors, flashing, cavity drainage material, and weep inserts in exterior masonry-veneer wall mockup.
    - e. Include stone cladding in mockup; coordinate with Section 04 4200 – Exterior Stone Cladding.
  - 2. Clean one-half of exposed faces of mockups with masonry cleaner as indicated.
  - 3. Protect accepted mockups from the elements with weather-resistant membrane.
  - 4. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
    - a. Approval of mockups is also for other material and construction qualities specifically approved by Architect in writing.
    - b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 5. Demolish and remove mockups when directed by Architect
  - 6. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

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

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

## **1.9 FIELD CONDITIONS**

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
  - 1. Extend cover a minimum of 24 inches down both sides of walls, and hold cover securely in place.
  - 2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe, and hold cover in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
  - 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
  - 2. Protect sills, ledges, and projections from mortar droppings.
  - 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
  - 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 402/602.
  - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.
- E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 402/602.

## **1.10 COORDINATION**

- A. Coordinate installation of embedded flashing materials, veneer anchors, and anchors and fasteners for installing stone cladding in masonry construction with Section 04 4200 – Exterior Stone Cladding.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.
- B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

### **2.2 PERFORMANCE REQUIREMENTS**

- A. Masonry Standard: Comply with TMS 402/602 - Building Code Requirements and Specification for Masonry Structures, except as modified by requirements in the Contract Documents.
- B. Masonry Veneer Anchors at Wall Cavities Greater Than 4-1/2 inches:
  - 1. Wall cavity depth includes airspace and cavity wall insulation thickness.
  - 2. Provide masonry veneer anchor manufacturer's test reports indicating compliance with TMS 402/602 for lateral load requirements.
  - 3. Limit the total lateral mechanical play of the ties to 1/16 inch, in accordance with BIA Tech Note 44B – Wall Ties for Brick Masonry.
  - 4. Minimum Tie Stiffness. Comply with BIA Tech Note 44B – Wall Ties for Brick Masonry, and as follows:
    - a. Tie deflection should be less than 0.05 inches when tested at an axial load of 100 lbs in tension or compression.
  - 5. Calculations: Tie loads shall be based on ASCE 7-16 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures. Include components and cladding wind loads, tie stiffness, and backup wall stiffness; tributary load calculation alone is insufficient.
- C. Reinforcing Steel: Comply with ACI 315 - Guide to Presenting Reinforcing Steel Design Details.
- D. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.

### **2.3 UNIT MASONRY, GENERAL**

- A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work and will be within 20 ft. vertically and horizontally of a walking surface.

### **2.4 CONCRETE MASONRY UNITS**

- A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
  - 1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
  - 2. Provide bullnose units for outside corners unless otherwise indicated.
    - a. Field-ground radiused corners are not permitted.

B. Integral Water Repellent Admixture:

1. Integral Water Repellent Admixture: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested according to ASTM E514 as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive, with test period extended to 24 hours, shall show no visible water or leaks on the back of test specimen.
2. Locations: Provide units made with integral water repellent admixture at exposed exterior locations and where indicated.
3. Limitations:
  - a. Use only in combination with mortar containing integral water repellent admixture.
  - b. Source Limitations: Use water repellent admixtures for masonry units and mortar from a single manufacturer.
4. Products: Subject to compliance with requirements, provide one of the following:
  - a. BASF Corp.; MasterPel 240: [www.master-builders-solutions.basf.us](http://www.master-builders-solutions.basf.us).
  - b. Euclid Chemical Company (The); an RPM company; Eucon Blocktite Admixture: [www.euclidchemical.com](http://www.euclidchemical.com).
  - c. GCP Applied Technologies Inc.; Dry-Block Block Admixture: [www.gcpat.com](http://www.gcpat.com).

C. CMUs: ASTM C90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2800 psi.
2. Density Classification: Normal weight.
3. Sizes (Widths): As indicated on Drawings, manufactured to dimensions 3/8 inch less than nominal dimensions.
4. Manufacturer: Subject to compliance with requirements, provide products from one of the following:
  - a. Best Block Company: [www.bestblock.net](http://www.bestblock.net).
  - b. Consumers Concrete Corp.: [www.consumersconcrete.com](http://www.consumersconcrete.com).
  - c. Echelon by Oldcastle: [www.echelonmasonry.com](http://www.echelonmasonry.com).
  - d. Fendt Builder's Supply, Inc.: [www.fendtproducts.com](http://www.fendtproducts.com).
  - e. Grand Blanc Cement Products: [www.grandblancementproducts.com](http://www.grandblancementproducts.com).
  - f. Michigan Certified Concrete: [www.micertconcrete.com](http://www.micertconcrete.com).
  - g. National Block Company: [www.nationalblock.com](http://www.nationalblock.com).

D. Decorative CMUs: ASTM C90.

1. Ground-Face (Burnished) Units:
  - a. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2800 psi.
  - b. Density Classification: Normal weight.
  - c. Sizes (Widths): As indicated on Drawings, manufactured to dimensions 3/8 inch less than nominal dimensions.
  - d. Pattern and Texture: Standard pattern, ground-face finish
  - e. Colors: Equal to Grand Blanc Cement Products, Niagara.
- 1) 

Note: Owner has 1800 eight-inch units that will be provided for use in the project.
- f. Sealer: Non-yellowing, low VOC, penetrating sealer which provides wet-look finish on ground-face units as recommended by manufacturer of ground-face units; and as follows:
  - 1) Comply with Michigan Department of Environment, Great Lakes, and Energy's (EGLE) air pollution rules, Part 6: Emission Limitations and Prohibitions – Existing Sources of Volatile Organic Compound Emissions.



- 2) Comply with Ozone Transport Commission (OTC), Model Rule for Architectural and Industrial Maintenance (AIM) Coatings; as referenced in EGLE's air pollution rules, Part 6.
  - a) OTC Phase II.
- 3) VOC Content Limits: 100g/L.
- 4) Coats:
  - a) First Coat: Factory applied.
  - b) Second Coat: Field applied after ground face units have been cleaned.
- g. Manufacturer: Subject to compliance with requirements, provide products from one of the following:
  - 1) Best Block Company: [www.bestblock.net](http://www.bestblock.net).
  - 2) Consumers Concrete Corp.: [www.consumersconcrete.com](http://www.consumersconcrete.com).
  - 3) Echelon by Oldcastle: [www.echelonmasonry.com](http://www.echelonmasonry.com).
  - 4) Fendt Builder's Supply, Inc.: [www.fendtproducts.com](http://www.fendtproducts.com).
  - 5) Grand Blanc Cement Products: [www.grandblancementproducts.com](http://www.grandblancementproducts.com).
  - 6) Michigan Certified Concrete: [www.micertconcrete.com](http://www.micertconcrete.com).
  - 7) National Block Company: [www.nationalblock.com](http://www.nationalblock.com).

## 2.5 MASONRY LINTELS

### A. Masonry Lintels:

1. General: 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. Cure prefabricated lintels before handling and installing. Temporarily support built-in-place lintels until cured.
2. Refer to Drawings for lintel sizing, reinforcing, and other requirements. Where not otherwise indicated on Drawings, fabricate lintels with reinforcing bars in accordance with the following table:

LINTEL SECTION (WxH)	CLEAR SPAN						
	Up to 3'-4"	3'-4"+ to 4'-8"	4'-8"+ to 5'-4"	5'-4"+ to 6'	6'+ to 6'-8"	6'-8"+ to 7'-4"	7'-4"+ to 8'-8"
4"x8"	1-#4	1-#4	1-#5	Not Permitted	Not Permitted	Not Permitted	Not Permitted
6"x8"	1-#4	1-#4	2-#4	2-#5	Not Permitted	Not Permitted	Not Permitted
8"x8"	1-#4	2-#4	2-#5	2-#5	2-#5	2-#6	2-#5(T) + 2-#6 (B)
10"x8"	2-#4	2-#4	2-#5	2-#5	2-#5	2-#5(T) + 2-#6 (B)	2-#5(T) + 2-#6 (B)
12"x8"	2-#4	2-#5	2-#5	2-#5	2-#6	2-#5(T) + 2-#6 (B)	2-#5(T) + 2-#6 (B)

- a. Unless otherwise indicated, place reinforcing bars 1 inch from bottom web.
- b. (B) = Bottom.
- c. (T) = Top, place reinforcing bars 1 inch from top of unit.
- d. Refer to Structural Drawings for clear spans and lintel sections not indicated in table.
3. Do not splice reinforcing bars.
4. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.
5. Place and consolidate grout fill without displacing reinforcing.
6. Fully grout masonry course immediately above lintel for the length of the lintel.

## **2.6 MORTAR AND GROUT MATERIALS**

- A. Portland Cement: ASTM C150, Type I or II. Provide natural color or white cement as required to produce mortar color indicated.
  - 1. Alkali content shall not be more than 0.1 percent when tested according to ASTM C114.
- B. Hydrated Lime: ASTM C207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- D. Masonry Cement: ASTM C91.
- E. Mortar Cement: ASTM C1329.
- F. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C979. Use only pigments with a record of satisfactory performance in masonry mortar.
  - 1. Manufacturer: Subject to compliance with requirements, provide products from one of the following:
    - a. Davis Colors: [www.daviscolors.com](http://www.daviscolors.com).
    - b. Lambert Corporation: [www.lambertusa.com](http://www.lambertusa.com).
    - c. Lehigh Hanson: [www.lehighhanson.com](http://www.lehighhanson.com)
    - d. Solomon Colors: [www.solomoncolors.com](http://www.solomoncolors.com).
- G. Aggregate for Mortar: ASTM C144.
  - 1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
- H. Aggregate for Grout: ASTM C404.
- I. Water: Potable.
- J. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs containing integral water repellent.
  - 1. Limitations:
    - a. Use only in combination with masonry units containing integral water repellent admixture.
    - b. Source Limitations: Use water repellent admixtures for masonry units and mortar from a single manufacturer.
  - 2. Products: Subject to compliance with requirements, provide one of the following:
    - a. BASF Corp.; MasterPel 210MA: [www.master-builders-solutions.basf.us](http://www.master-builders-solutions.basf.us).
    - b. Euclid Chemical Company (The); an RPM company; Blocktite Mortar Admixture: [www.euclidchemical.com](http://www.euclidchemical.com).
    - c. GCP Applied Technologies Inc.; Dry-Block Mortar Admixture: [www.gcpat.com](http://www.gcpat.com).

K. Packaged Dry Material for Mortar for Unit Masonry.

1. At Contractor's option, prepackaged dry material for mortar may be used subject to compliance with mortar requirements of this section including, but not limited to, the following:
  - a. Mortar Types: As indicated.
  - b. Color(s): As selected by Architect from manufacturer's full range.
  - c. Use only water repellent admixture for mortar from the same manufacturer as water repellent admixture in masonry units.
2. Portland Cement Based: Premixed Portland cement, hydrated lime, and sand; complying with ASTM C1714 and capable of producing mortar of the specified strength in accordance with ASTM C270 with the addition of water only.
  - a. Manufacturer: Subject to compliance with requirements, provide products from one of the following:
    - 1) Amerimix, an Oldcastle brand; [www.amerimix.com](http://www.amerimix.com).
    - 2) The QUIKRETE Companies; [www.quikcrete.com](http://www.quikcrete.com).
    - 3) SPEC MIX, Inc.; [www.specmix.com](http://www.specmix.com).
3. Masonry Cement Based: Premixed masonry cement and mason's sand; complying with ASTM C1714 and capable of producing mortar of the specified strength in accordance with ASTM C270 with the addition of water only.
  - a. Manufacturer: Subject to compliance with requirements, provide products from one of the following:
    - 1) Amerimix, an Oldcastle brand; [www.amerimix.com](http://www.amerimix.com).
    - 2) The QUIKRETE Companies; [www.quikcrete.com](http://www.quikcrete.com).
    - 3) SPEC MIX, Inc.; [www.specmix.com](http://www.specmix.com).

L. Packaged Dry Material for Grout for Masonry: Premixed cementitious materials and dried aggregates; capable of producing grout of the specified strength in accordance with ASTM C476 with the addition of water only.

1. At Contractor's option, prepackaged dry material for grout may be used subject to compliance with grout requirements of this section.
2. Manufacturer: Subject to compliance with requirements, provide products from one of the following:
  - a. Amerimix, an Oldcastle brand; [www.amerimix.com](http://www.amerimix.com).
  - b. The QUIKRETE Companies; [www.quikcrete.com](http://www.quikcrete.com).
  - c. SPEC MIX, Inc.; [www.specmix.com](http://www.specmix.com).

## 2.7 REINFORCEMENT

A. Manufacturers: Where Basis of Design Products are listed, comply with the following:

1. Basis of Design Product: The design for each item specified is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the following:
  - a. Fero Corp.; [www.ferocorp.com](http://www.ferocorp.com).
  - b. Heckmann Building Products; [www.heckmannbuildingprods.com](http://www.heckmannbuildingprods.com).
  - c. Hohmann & Barnard, Inc.; [www.h-b.com](http://www.h-b.com).
  - d. Wire-Bond; [www.wirebond.com](http://www.wirebond.com).

B. Uncoated-Steel Reinforcing Bars: ASTM A615 or ASTM A996, Grade 60 (Grade 420).

- C. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.156-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.
  - 1. Basis-of-Design Product: Hohmann & Barnard, Inc.; [www.h-b.com](http://www.h-b.com): RB and RB-Twin Rebar Positioners.
- D. Reinforcing Bar Lap Joint Ties: ASTM A1064 steel wire, mill galvanized to 16 CFR 1201 Class 3.
  - 1. Basis-of-Design Product: Hohmann & Barnard, Inc.; [www.h-b.com](http://www.h-b.com): Spyra-Lox Rebar Lap-Joint Tie.
- E. Masonry-Joint Reinforcement, General: ASTM A951.
  - 1. Interior Walls: Hot-dip galvanized carbon steel.
  - 2. Exterior Walls: Hot-dip galvanized carbon steel.
  - 3. Wire Size for Side Rods: 0.148-inch diameter.
  - 4. Wire Size for Cross Rods: 0.148-inch diameter.
  - 5. Wire Size for Veneer Ties: 0.187-inch diameter.
  - 6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
  - 7. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.
- F. Masonry-Joint Reinforcement for Single-Wythe Masonry: Ladder type with single pair of side rods.
  - 1. Basis-of-Design Product: Hohmann & Barnard, Inc.; [www.h-b.com](http://www.h-b.com): 220 Ladder-Mesh.
- G. Masonry-Joint Reinforcement for Multiwythe Masonry: Adjustable (two-piece) type, ladder design, with one side rod at each face shell of backing wythe and with separate adjustable ties with pintle-and-eye connections having a maximum horizontal play of 1/16 inch and maximum vertical adjustment of 1-1/4 inches. Size ties to extend at least halfway through facing wythe but with at least 5/8-inch cover on outside face.
  - 1. Basis-of-Design Product: Hohmann & Barnard, Inc.; [www.h-b.com](http://www.h-b.com): 270 Ladder LOX-ALL Adjustable Eye Wire with 2X-HOOK.

## **2.8 TIES AND ANCHORS**

- A. Manufacturers: Where Basis of Design Products are listed, comply with the following:
  - 1. Basis-of-Design Product: The design for each item specified is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the following:
    - a. Fero Corp.; [www.ferocorp.com](http://www.ferocorp.com).
    - b. Heckmann Building Products; [www.heckmannbuildingprods.com](http://www.heckmannbuildingprods.com).
    - c. Hohmann & Barnard, Inc.; [www.h-b.com](http://www.h-b.com).
    - d. Wire-Bond; [www.wirebond.com](http://www.wirebond.com).
- B. General: Ties and anchors shall extend at least 1-1/2 inches into veneer but with at least a 5/8-inch cover on outside face.
- C. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:
  - 1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A82, with ASTM A153, Class B-2 coating.
    - a. Wire Size: 0.187-inch diameter, unless otherwise indicated.

2. Steel Sheet, Galvanized after Fabrication: ASTM A1008, Commercial Steel, with ASTM A153, Class B coating.
  3. Steel Plates, Shapes, and Bars: ASTM A36.
- D. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch diameter wire.
  2. Tie Section: Triangular-shaped wire tie.
  3. Basis-of-Design Product: Hohmann & Barnard, Inc.; [www.h-b.com](http://www.h-b.com): 359/359FP anchors with 301W or VBT ties.
- E. Mesh Wall Ties: 1/2 inch square, 0.060 inch (16 gage) hot-dip galvanized, carbon-steel wire screen.
1. Comply with ASTM A740.
  2. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A153.
  3. Width: As required to match wall width.
  4. Basis-of-Design Product: Hohmann & Barnard, Inc.; [www.h-b.com](http://www.h-b.com); MWT Mesh Wall Tie.
- F. Rigid Anchors: Fabricate from steel bars 1-1/2 inches wide by 1/4 inch thick by 24 inches long, with ends turned up 2 inches.
1. Basis-of-Design Product: Hohmann & Barnard, Inc.; [www.h-b.com](http://www.h-b.com): 344 Rigid Partition Anchor.

## **2.9 EMBEDDED FLASHING MATERIALS**

- A. Self-Adhering Stainless Steel Flashing (Self-Adhering Flexible Flashing):
1. Stainless steel sheet, ASTM A240, Type 304, 2 mils thick, minimum; optionally bonded to polymeric fabric as standard with manufacturer. Flashing shall be self-adhering using a butyl adhesive or permanent clear adhesive, with release liner, 10 mils thick, bonded to back of stainless steel sheet or polymeric fabric.
    - a. Surface-Burning Characteristics: Class A per ASTM E84.
    - b. Mold Resistant: Passes ASTM D3273.
    - c. Puncture: 2,500 psi, minimum per ASTM E154.
  2. Products: Subject to compliance with requirements, provide one of the following products:
    - a. Hohmann & Barnard, Inc.; Mighty-Flash SA: [www.h-b.com](http://www.h-b.com).
    - b. Wire-Bond; Bond-N-Flash SA: [www.wirebond.com](http://www.wirebond.com).
    - c. York Manufacturing, Inc.; York 304 SA: [www.yorkmfg.com](http://www.yorkmfg.com).
- B. Factory-Fabricated Inside and Outside Flashing Corners and End Dams: Stainless steel.
1. Manufacturer shall be the same as self-adhering flexible flashing manufacturer.
- C. Factory-Fabricated Drip Plates including Inside and Outside Corners: Stainless steel.
1. Pre-formed smooth drip plates with hemmed edges.
  2. Manufacturer shall be the same as self-adhering flexible flashing manufacturer.
- D. Flashing Sealant/Adhesives: Silicone, polyurethane, or silyl-terminated polyether/polyurethane or other type required or recommended by flashing manufacturer; type capable of adhering to type of flashing used.

## **2.10 MISCELLANEOUS MASONRY ACCESSORIES**

- A. Termination Bars: Stainless steel, 1/8 inch thick by 1-1/2 inch high with 3/8 inch sealant flange at top; compatible with flashing membrane and adhesives.
1. Manufacturers: Subject to compliance with requirements, provide products from one of the following:
    - a. Advanced Building Products Inc.; [www.advancedbuildingproducts.com](http://www.advancedbuildingproducts.com)
    - b. Heckmann Building Products; [www.heckmannbuildingprods.com](http://www.heckmannbuildingprods.com)
    - c. Hohmann & Barnard, Inc.; [www.h-b.com](http://www.h-b.com)
    - d. Wire-Bond; [www.wirebond.com](http://www.wirebond.com)
    - e. York Manufacturing, Inc.; [www.yorkmfg.com](http://www.yorkmfg.com)
- B. Compressible Joint Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from closed cell neoprene.
1. Manufacturers: Subject to compliance with requirements, provide products from one of the following:
    - a. Hohmann & Barnard, Inc: [www.h-b.com](http://www.h-b.com)
    - b. WIRE-BOND: [www.wirebond.com](http://www.wirebond.com)
- C. Preformed Control Joints: Made from styrene-butadiene-rubber compound, complying with ASTM D2000, Designation M2AA-805. Provide with corner and tee accessories.
1. Manufacturers: Subject to compliance with requirements, provide products from one of the following:
    - a. Hohmann & Barnard, Inc: [www.h-b.com/sle](http://www.h-b.com/sle)
    - b. WIRE-BOND: [www.wirebond.com/#sle](http://www.wirebond.com/#sle)
- D. Bond-Breaker Material (Felt): Asphalt-saturated felt complying with ASTM D226, Type I (No. 15 asphalt felt).
- E. Column Isolator: Closed cell expanded polyvinyl chloride with pressure sensitive temporary position adhesive, 1/2" thick.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Williams Products, Inc.; Everlastic Vinyl Type U 1000 Series with PSA.
- F. Mortar and Grout Screen: 1/4 inch square, polypropylene monofilament screening for preventing grout flow; width sized to match masonry widths.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Hohmann & Barnard, Inc.; [www.h-b.com](http://www.h-b.com); MGS or a comparable product by one of the following:
    - a. Heckmann Building Products; [www.heckmannbuildingprods.com](http://www.heckmannbuildingprods.com)
    - b. Wire-Bond; [www.wirebond.com](http://www.wirebond.com)
- G. Weep Inserts: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch less than depth of outer wythe.
1. Color(s): As selected by Architect from manufacturer's full range.
  2. Basis-of-Design Product: Subject to compliance with requirements, provide Hohmann & Barnard, Inc.; [www.h-b.com](http://www.h-b.com); QV Quadro-Vent or a comparable product by one of the following:
    - a. Advanced Building Products Inc.; [www.advancedbuildingproducts.com](http://www.advancedbuildingproducts.com)
    - b. Heckmann Building Products; [www.heckmannbuildingprods.com](http://www.heckmannbuildingprods.com)
    - c. Mortar Net Solutions; [www.mortarnet.com](http://www.mortarnet.com)

d. Wire-Bond; [www.wirebond.com](http://www.wirebond.com).

H. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

1. Configuration: Strips, full depth of cavity and 10 inches high, with dovetail-shaped notches 7 inches deep that prevent clogging with mortar droppings.
2. Basis-of-Design Product: Subject to compliance with requirements, provide Hohmann & Barnard, Inc.; [www.h-b.com](http://www.h-b.com); Mortar Trap or a comparable product by one of the following:

- a. Advanced Building Products Inc.; [www.advancedbuildingproducts.com](http://www.advancedbuildingproducts.com).
- b. Heckmann Building Products; [www.heckmannbuildingprods.com](http://www.heckmannbuildingprods.com).
- c. Mortar Net Solutions; [www.mortarnet.com](http://www.mortarnet.com).
- d. Wire-Bond; [www.wirebond.com](http://www.wirebond.com).

## **2.11 CAVITY WALL INSULATION**

A. Refer to Section 07 2100 – Thermal Insulation.

## **2.12 MASONRY CLEANERS**

A. Proprietary Acidic Cleaner - For Brick: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

1. Basis-of-Design Product: Subject to compliance with requirements, provide PROSOCO, Inc.; [www.prosoco.com](http://www.prosoco.com): Sure Klean 600, Sure Klean Vana Trol or a comparable product by one of the following:

a. Diedrich Technologies, Inc.; [www.diedrichtechnologies.com](http://www.diedrichtechnologies.com).

B. Proprietary Acidic Cleaner – For CMU and Decorative CMU: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

1. Basis-of-Design Product: Subject to compliance with requirements, provide PROSOCO, Inc.; [www.prosoco.com](http://www.prosoco.com): Sure Klean Light Duty Concrete Cleaner or a comparable product by one of the following:

a. Diedrich Technologies, Inc.; [www.diedrichtechnologies.com](http://www.diedrichtechnologies.com).

## **2.13 MORTAR AND GROUT MIXES**

A. General:

1. Use portland cement-lime, masonry cement, or mortar cement mortar unless otherwise indicated.
2. Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
3. Do not use calcium chloride in mortar or grout.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Water-Repellent Admixture: Provide water-repellent admixture in mortar used at exterior concrete block and elsewhere as indicated.

- D. Mortar for Unit Masonry: Comply with ASTM C270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated.
1. For masonry below grade or in contact with earth, use Type M.
  2. For reinforced masonry, use Type S.
  3. For exterior, load-bearing masonry, use Type S
  4. For exterior, above-grade nonload-bearing walls and parapet walls, use Type N.
  5. For interior load-bearing and nonload-bearing walls and partitions, use Type N.
  6. For setting limestone units, use Type N.
  7. For pointing mortar: Type N.
  8. For other applications where another type is not indicated, use Type N.
- E. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.
1. Pigments shall not exceed 10 percent of portland cement by weight.
  2. Pigments shall not exceed 5 percent of masonry cement or mortar cement by weight.
  3. Mix to match Architect's samples.
  4. Application: Use pigmented mortar for exposed mortar joints at the following units:
    - a. Decorative CMUs.
    - b. Limestone.
    - c. Pointing mortar
    - d. As indicated on Drawings.
- F. Grout for Unit Masonry: Comply with ASTM C476.
1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602/ACI 530.1 for dimensions of grout spaces and pour height.
  2. Proportion grout in accordance with ASTM C476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000psi.
  3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C143.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
  2. Verify that foundations are within tolerances specified.
  3. Verify that reinforcing dowels are properly placed.
  4. Verify that substrates are free of substances that impair mortar bond.
  5. Verify that built-in items are in proper location, and ready for roughing into masonry work
  6. Verify that related items provided under other sections are properly sized and located.
  7. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.



### **3.2 INSTALLATION, GENERAL**

- A. Coursing and Bonding:
  - 1. Concrete Masonry Units: Unless otherwise indicated:
    - a. Bond: Running.
    - b. Coursing: One unit and one mortar joint to equal 8 inches.
    - c. Mortar Joints: Concave.
    - d. Mortar Joint Thickness: 3/8 inch.
  - 2. Establish lines, levels, and coursing indicated. Protect from displacement
  - 3. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
  - 4. Do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.
  - 5. Bond and interlock each course of each wythe at corners.
- B. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.
- C. Build chases and recesses to accommodate items specified in this and other Sections.
- D. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.
- E. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- F. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.
- G. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested according to ASTM C67. Allow units to absorb water so they are damp but not wet at time of laying.

### **3.3 LAYING MASONRY WALLS**

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- C. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- D. Wall Penetrations:
  - 1. Cut and set masonry units tightly around steel, pipes, conduit, and other wall penetrations; space between penetrating items and masonry shall not exceed 1 inch in width unless otherwise indicated.
  - 2. Fill space between penetrating items and masonry solidly with mortar unless otherwise indicated.
  - 3. At fire-rated wall construction, refer to Section 07 8413 – Firestopping, for application of firestopping materials.

- E. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.
- F. Fill cores in hollow CMUs with grout 16 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.
- G. Build nonload-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.
  - 1. Install compressible filler in joint between top of partition and underside of structure above.
  - 2. Bent Metal Restraints: Refer to Section 05 5000 - Metal Fabrications.
  - 3. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 07 8413 – Firestopping.

### **3.4 MORTAR BEDDING AND JOINTING**

- A. Lay CMUs as follows:
  - 1. Bed face shells in mortar and make head joints of depth equal to bed joints.
  - 2. Bed webs in mortar in all courses of piers, columns, and pilasters.
  - 3. Bed webs in mortar in grouted masonry, including starting course on footings.
  - 4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.
  - 5. Fully bed units and fill cells with mortar at anchors and ties as needed to fully embed anchors and ties in mortar.
- B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- C. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- D. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
  - 1. Cut joints flush at the following locations:
    - a. Where wall tile is scheduled.
    - b. At masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.
    - c. Where indicated to receive waterproofing, wall insulation, or air barriers unless otherwise indicated.

### **3.5 SETTING STONE UNITS WITH MORTAR**

- A. Refer to Section 04 4200 – Exterior Stone Cladding, for stone installation.

### **3.6 CONTROL AND EXPANSION JOINTS**

- A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form control joints in concrete masonry using one of the following methods:
  - 1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout, and rake out joints in exposed faces for application of sealant.
  - 2. Install preformed control-joint gaskets designed to fit standard sash block.

3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar, or rake out joint for application of sealant.
  - a. Installation of sealant and backer rod specified in Section 07 9200 - Joint Sealants.
- C. Form expansion joints in brick as follows:
  1. 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 9200 - Joint Sealants.
- D. 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 9200 - Joint Sealants, but not less than 3/8 inch
  1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry and as indicated.

### **3.7 MASONRY-JOINT REINFORCEMENT**

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
  1. Space reinforcement not more than 16 inches o.c.
  2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
  3. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
- B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- C. Provide continuity at corners by using prefabricated L-shaped units.
- D. Cut and bend reinforcing units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures, and other special conditions.
- E. Intersecting and Abutting Walls: Unless vertical expansion or control joints are indicated at juncture, bond walls together using one of the following, unless otherwise indicated on Drawings:
  1. Provide continuity with masonry-joint reinforcement by using prefabricated T-shaped units.
  2. Provide rigid metal anchors not more than 24 inches o.c., embed ends in mortar-filled cores.
  3. Provide mesh wall ties not more than 24 inches o.c., embedded in mortar joints

### **3.8 REINFORCED UNIT MASONRY AND GROUTING**

- A. Placing Reinforcement: Comply with requirements in TMS 402/602.
- B. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
  1. Comply with requirements in TMS 402/602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
  2. Limit height of vertical grout pours to not more than 60 inches.
  3. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.
  4. Place and consolidate grout fill without displacing reinforcing.

### **3.9 LINTELS**

- A. Install steel lintels where indicated.
- B. Provide steel or masonry lintels at the following locations:
  - 1. Where indicated on Drawings
  - 2. At openings of more than 12 inches wide at modular brick-size units and 24 inches wide at CMU block-size units; whether or not a lintel is indicated on Drawings.
- C. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.
- D. Fully grout masonry course immediately above masonry and concrete lintels for the length of the lintel.

### **3.10 BOND BEAMS**

- A. Bond Beams: At bond beams or other locations for horizontally reinforced masonry, provide special masonry units or saw to accommodate reinforcement.
  - 1. Reinforce bond beams with 2, No. 5 bars, 1 inch from bottom web unless otherwise indicated.
  - 2. Lap reinforcing bar splices minimum 24 bar diameters, unless otherwise indicated.
  - 3. Place and consolidate grout fill without displacing reinforcing.

### **3.11 CAVITY WALLS**

- A. Bond wythes of cavity walls together as follows:
  - 1. Masonry-Joint Reinforcement: Installed in horizontal mortar joints.
    - a. Where bed joints of both wythes align, use ladder-type reinforcement extending across both wythes.
    - b. Where bed joints of wythes do not align, use adjustable-type (two-piece-type) reinforcement.
    - c. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable-type (two-piece-type) reinforcement to allow for differential movement regardless of whether bed joints align.
    - d. Embed tie sections in masonry joints. Provide minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere.
- B. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.

### **3.12 CAVITY WALL INSULATION BOARD**

- A. Refer to Section 07 2100 – Thermal Insulation.

### **3.13 ANCHORING MASONRY TO STRUCTURAL STEEL**

- A. Anchor masonry to structural steel, where masonry abuts or faces structural steel or concrete, to comply with the following:
  - 1. Provide an open space not less than 1/2 inch wide between masonry and structural steel unless otherwise indicated. Keep open space free of mortar and other rigid materials.
  - 2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
  - 3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

### **3.14 FLASHING, WEEP HOLES, AND CAVITY VENTS**

- A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.
  - 1. Remove or cover protrusions or sharp edges that could puncture flashings.
  - 2. Install flashing in accordance with manufacturer's instructions and BIA Technical Notes No. 7, unless more stringent requirements are specified in this section.
- B. Install self-adhering flexible flashing as follows, unless otherwise indicated:
  - 1. Install masonry flashings according to manufacturer's instructions and as indicated on the Drawings.
  - 2. Extend flashing to within 1/4 inch of exterior face of masonry overlapping metal drip plate.
  - 3. Extend flashing full width of cavity space and turn up inner masonry wythe or sheathing at least 8 inches.
  - 4. Lap end/splice joints of flashings at least 6 inches, minimum, and seal joint watertight with sealant/adhesive.
  - 5. Secure flashing to wall with continuous termination bar and apply sealant across top of termination bar; seal fastener heads after installation.
  - 6. At corners and end dams use factory-fabricated inside and outside flashing corners and end dams. Seal joint between factory-fabricated units and flashing watertight with sealant/adhesive.
  - 7. At drips provide factory-fabricated drip plates including inside and outside corners; seal joints watertight with sealant/adhesive.
- C. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.
- D. Install weep inserts in exterior wythes and veneers in head joints of first course of masonry immediately above embedded flashing.
  - 1. Space weep inserts 24 inches o.c. unless otherwise indicated.

### **3.15 TOLERANCES**

- A. Dimensions and Locations of Elements:
  - 1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
  - 2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
  - 3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.
- B. Lines and Levels:
  - 1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet, or 1/2-inch maximum.
  - 2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
  - 3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
  - 4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
  - 5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
  - 6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2-inc maximum.

7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

### 3.16 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.
- B. Inspections: Special inspections according to Level B in TMS 402/ACI 530/ASCE 5.
  1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
  2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
  3. Place grout only after inspectors have verified proportions of site-prepared grout.
- C. Testing Prior to Construction: One set of tests.
- D. Clay Masonry Unit Test: For each type of unit provided, according to ASTM C67 for compressive strength.
- E. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C140 for compressive strength.
- F. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C780.
- G. Grout Test (Compressive Strength): For each mix provided, according to ASTM C1019.

### 3.17 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
  1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.

2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean masonry using one or more of the following methods:
  - a. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
  - b. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.
  - c. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
  - d. Stone: Refer to Section 04 4200 – Exterior Stone Cladding.

### **3.18 SEALER**

- A. Ground-Face CMU: Field apply second coat of sealer on ground face units.
  1. Apply after final cleaning.
  2. Apply coat evenly; cover entire ground-face CMU wall surface including mortar joints.

### **3.19 MASONRY WASTE DISPOSAL**

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.
- B. Masonry Waste Recycling: Return broken CMUs to manufacturer for recycling.
- C. Excess Masonry Waste: Remove excess masonry waste that cannot be recycled and legally dispose of off Owner's property.

**END OF SECTION 04 2000**

## **SECTION 04 4200 – EXTERIOR STONE CLADDING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Stone masonry set with mortar and anchored to backup construction
- B. Products Furnished but not Installed under this Section:
  - 1. Anchors and fasteners for connecting stone cladding to masonry backup construction, installed by Section 04 2000 - Unit Masonry.

#### **1.3 DEFINITIONS**

- A. Definitions contained in ASTM C119 apply to this Section.

#### **1.4 PREINSTALLATION MEETINGS**

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

#### **1.5 ACTION SUBMITTALS**

- A. Product Data: For each variety of stone, stone accessory, and manufactured product.
- B. Shop Drawings: Show fabrication and installation details for stone cladding assembly, including dimensions and profiles of stone units.
  - 1. Show locations and details of joints both within stone cladding assembly and between stone cladding assembly and other construction.
  - 2. Include details of mortar joints, sealant joints, and mortar joints pointed with sealant.
  - 3. Show locations and details of anchors.
  - 4. Show direction of veining, grain, or other directional pattern.
- C. Stone Samples for Verification: Sets for each variety of stone; provide at least three samples, not less than 12 inches square, showing the full range of color and other visual characteristics.

#### **1.6 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For fabricator and installer.
- B. Welding certificates.
- C. Material Test Reports:
  - 1. Stone Test Reports: For each stone variety proposed for use on Project, by a qualified testing agency, indicating compliance with required physical properties, other than abrasion resistance, according to referenced ASTM standards. Base reports on testing done within previous five years.
  - 2. For metal components, by a qualified testing agency, indicating chemical and physical properties of metal.



- D. Cold-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with cold-weather requirements.

#### **1.7 QUALITY ASSURANCE**

- A. Fabricator Qualifications: Fabricator that employs skilled workers who custom fabricate stone cladding assemblies similar to that required for this Project and whose products have a record of successful in-service performance; with at least 5 years of documented experience.
- B. Installer Qualifications: Installer experienced in installing stone cladding assemblies similar in material, design, and extent to that indicated for this Project, whose work has a record of successful in-service performance; with at least 5 years of documented experience.
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code - Steel AWS D1.3, "Structural Welding Code - Sheet Steel and AWS D1.6, "Structural Welding Code - Stainless Steel."
- D. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
  - 1. Build mockups of typical exterior wall area not less than 72 inches long by 48 inches high.
    - a. Mockup may be part of the masonry mockup specified in Section 04 2000 – Unit Masonry.
    - b. Include typical components, attachments to building structure, and methods of installation.
    - c. Include sealant-filled joint complying with requirements in Section 07 9200 "Joint Sealants."
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

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

- A. Store and handle stone and related materials to prevent deterioration or damage due to moisture, temperature changes, contaminants, corrosion, breaking, chipping, and other causes.
  - 1. Lift stone with wide-belt slings; do not use wire rope or ropes that might cause staining. Move stone, if required, using dollies with cushioned wood supports.
  - 2. Store stone on wood skids or pallets with nonstaining, waterproof covers. Arrange to distribute weight evenly and to prevent damage to stone. Ventilate under covers to prevent condensation.
- B. Mark stone units, on surface that will be concealed after installation, with designations used on Shop Drawings to identify individual stone units. Orient markings on vertical panels so that they are right side up when units are installed.

#### **1.9 FIELD CONDITIONS**

- A. Protect stone cladding during erection by doing the following:
  - 1. Cover tops of stone cladding installation with nonstaining, waterproof sheeting at end of each day's work. Cover partially completed structures when work is not in progress. Extend cover a minimum of 24 inches down both sides and hold securely in place.
  - 2. Prevent staining of stone from mortar, grout, sealants, and other sources. Immediately remove such materials without damaging stone.
  - 3. Protect base of walls from rain-splashed mud and mortar splatter by coverings spread on ground and over wall surface.
  - 4. Protect sills, ledges, and projections from mortar and sealant droppings.

5. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
- B. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Remove and replace stone cladding damaged by frost or freezing conditions. Comply with cold-weather construction and protection requirements for masonry contained in TMS 602/ACI 530.1/ASCE 6.
- C. Hot-Weather Requirements: Comply with hot-weather construction and protection requirements for masonry contained in TMS 602/ACI 530.1/ASCE 6.
- D. Environmental Limitations for Sealants: Do not install sealants when ambient and substrate temperatures are outside limits permitted by sealant manufacturer or below 40 deg F or when joint substrates are wet.

#### **1.10 COORDINATION**

- A. Coordinate installation of embedded flashing materials, veneer anchors, and anchors and fasteners for installing stone cladding in masonry construction with Section 04 2000 – Unit Masonry.
- B. Coordinate installation of inserts that are to be embedded in concrete or masonry to be used by stone cladding Installer for anchoring and supporting stone cladding. Furnish setting drawings, templates, and directions for installing such items and deliver to Project site in time for installation.
- C. Time delivery and installation of stone cladding to avoid extended on-site storage and to coordinate with work adjacent to stone cladding.

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Source Limitations for Stone: Obtain each variety of stone, from single quarry with resources to provide materials of consistent quality in appearance and physical properties.

#### **2.2 PERFORMANCE REQUIREMENTS**

- A. Design stone anchors and anchoring systems according to ASTM C1242.
  1. Stone anchors shall withstand not less than two times the weight of the stone cladding in both compression and tension.
- B. Corrosion and Staining Control: Prevent galvanic and other forms of corrosion as well as staining by isolating metals and other materials from direct contact with incompatible materials. Materials shall not stain exposed surfaces of stone and joint materials.

#### **2.3 LIMESTONE**

- A. Material Standard: Comply with ASTM C568.
  1. Classification: III High-Density.
- B. Description: Dolomitic limestone.
- C. Varieties and Sources: Eden-Valders Dolomitic Limestone quarried in Valders, Wisconsin, and manufactured/cut by Eden-Valders Stone, Inc.: [www.evstone.net](http://www.evstone.net).
  1. Color: Valders Gray.

2. Finish: Honed.

D. Thickness of Stone: Provide thickness indicated, but not less than the following:

1. Thickness: 4 inches plus or minus 1/4 inch.

E. Cut stone from one block or contiguous, matched blocks in which natural markings occur.

## **2.4 MORTAR MATERIALS AND MIXES**

A. Refer to Section 04 2000 - Unit Masonry for mortar.

1. Set limestone with Type N mortar; point with Type N mortar.

## **2.5 ANCHORS AND FASTENERS**

A. Manufacturers: Where Basis of Design Products are listed, comply with the following:

1. Basis-of-Design Product: The design for each item specified is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the following:

- a. Fero Corp.; [www.ferocorp.com](http://www.ferocorp.com).
- b. Heckmann Building Products; [www.heckmannbuildingprods.com](http://www.heckmannbuildingprods.com).
- c. Hohmann & Barnard, Inc.; [www.h-b.com](http://www.h-b.com).
- d. Wire-Bond; [www.wirebond.com](http://www.wirebond.com).

B. Fabricate anchors from stainless steel, ASTM A240 or ASTM A666, Type 304; temper as required to support loads imposed without exceeding allowable design stresses. Fabricate dowels and pins for anchors from stainless steel, ASTM A276, Type 304.

1. Stone Anchors: Includes, but is not limited to, the following:

- a. Basis-of-Design Product: Hohmann & Barnard, Inc: 435 Stone Anchor, 0.109 inch (12 gage) minimum thickness.

C. Postinstalled Anchor Bolts for Concrete and Masonry: Torque-controlled expansion anchors made from stainless-steel components complying with ASTM F593 and ASTM F594, Alloy Group 1 or 2 for bolts and nuts; ASTM A240, ASTM A276, or ASTM A666, Type 304 or 316, for anchors, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed, for masonry, as determined by testing per ASTM E488, conducted by a qualified independent testing agency.

D. Threaded Fasteners: Heavy hexagon structural bolts, heavy hexagon nuts, and hardened washers.

1. For stainless steel, use annealed stainless-steel bolts, nuts, and washers; for bolts, ASTM F593; and for nuts, ASTM F594, Alloy Group 1 (A1).

E. Weld Plates for Installation in Concrete: Comply with Section 055000 "Metal Fabrications."

## **2.6 VENEER ANCHORS AND JOINT REINFORCEMENT**

A. Adjustable Veneer Anchors and Masonry-Joint Reinforcement:

1. Refer to Section 04 2000 – Unit Masonry.

## **2.7 EMBEDDED FLASHING MATERIALS**

- A. Refer to Section 04 2000 - Unit Masonry for embedded flashing materials and miscellaneous masonry accessories, including, but not limited to, self-adhering flashing, factory-fabricated drip plates, termination bars, weep inserts, and cavity drainage materials.

## **2.8 STONE ACCESSORIES**

- A. Setting Shims: Strips of resilient plastic, nonstaining to stone, of thickness needed to prevent point loading of stone on anchors and of depths to suit anchors without intruding into required depths of pointing materials.
- B. Setting Buttons: Resilient plastic buttons, nonstaining to stone, sized to suit joint thicknesses and bed depths of stone units without intruding into required depths of pointing materials.
- C. Sealants for Joints in Stone Cladding: Silicone complying with applicable requirements in Section 07 9200 - Joint Sealants, and as follows:
  - 1. Sealants shall not stain stone.
- D. Cleaning Solution: Type that will not harm stone, joint materials, or adjacent surfaces.
  - 1. Nonacidic Cleaner: Manufacturer's standard mildly alkaline gel cleaner formulated for removing mold, mildew, and other organic soiling from natural stone.
    - a. Basis-of-Design: Subject to compliance with requirements, provide PROSOCO, Inc.; [www.prosoco.com](http://www.prosoco.com): Sure Klean 942 Limestone & Marble Cleaner or a comparable product by one of the following:
      - 1) Diedrich Technologies, Inc.; [www.diedrichtechnologies.com](http://www.diedrichtechnologies.com).

## **2.9 FABRICATION OF STONE**

- A. General: Fabricate stone units in sizes and shapes required to comply with requirements indicated.
- B. Dress joints (bed and vertical) straight and at right angle to face unless otherwise indicated. Shape beds to fit supports.
- C. Cut and drill sinkages and holes in stone for anchors, fasteners, and supports. For large units provide lifting devices as indicated or needed to set stone securely in place.
- D. Cut stone to produce uniform joints 3/8 inch wide and in locations indicated.
- E. Finish exposed faces and edges of stone to comply with requirements indicated for finish and to match approved samples and mockups.
- F. Contiguous Work: Provide chases, reveals, reglets, openings, and similar features as required to accommodate contiguous work.
- G. Fabricate molded work, including washes and drips, to produce stone shapes with a uniform profile throughout entire unit length, with precisely formed arris slightly eased to prevent snipping, and with matching profile at joints between units.
- H. Clean backs of stone to remove rust stains, iron particles, and stone dust.

- I. Inspect finished stone units at fabrication plant for compliance with requirements for appearance, material, and fabrication. Replace defective units.
  1. Grade and mark stone for overall uniform appearance when assembled in place. Natural variations in appearance are acceptable if installed stone units match range of colors and other appearance characteristics represented in approved samples and mockups.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine surfaces to receive stone cladding and conditions under which stone cladding will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of stone cladding.
- B. Examine substrate to verify that inserts, veneer anchors, and other items installed in backup substrates and required for or extending into stone masonry are correctly installed
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of stone cladding.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION OF STONE CLADDING, GENERAL**

- A. Before setting stone, clean surfaces that are dirty or stained by removing soil, stains, and foreign materials. Clean stone by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives.

#### **3.3 SETTING STONE MASONRY WITH MORTAR**

- A. Perform necessary field cutting and trimming as stone is set.
  1. Use power saws with diamond blades to cut stone. Produce lines cut straight and true, with edges eased slightly to prevent snipping.
- B. Sort stone before it is placed in wall to remove stone that does not comply with requirements relating to aesthetic effects, physical properties, or fabrication, or that is otherwise unsuitable for intended use.
- C. Arrange stones with color and size variations uniformly dispersed for an evenly blended appearance.
- D. Set stone accurately in locations indicated with edges and faces aligned according to established relationships and indicated tolerances.
- E. Set units in full bed of mortar with full head joints unless otherwise indicated.
  1. Maintain uniform joint widths except for variations due to different stone sizes and where minor variations are required to maintain bond alignment if any.
  2. Lay walls with 3/8 mortar joints, where joints are not less than 1/4 inch at narrowest points or more than 1/2 inch at widest points.
- F. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure stone masonry in place. Install veneer anchors and joint reinforcement in coordination with adjacent unit masonry.
  1. Build anchors and ties into mortar joints as units are set.

2. Comply with Section 04 4200 – Unit Masonry, for installing veneer anchors and joint reinforcement; and as follows:
    - a. Space veneer anchors as indicated, but not more than 16 inches o.c. vertically and 24 inches o.c. horizontally, with not less than one anchor for each 2 sq. ft. of wall area.
    - b. Install additional anchors within 12 inches of openings and at intervals, not exceeding 8 inches, around perimeter.
  3. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure stone masonry in place.
- G. Coordinate installation of stone with installation of flashing.
1. Comply with Section 04 4200 – Unit Masonry, for installing embedded flashing materials and miscellaneous masonry accessories.
  2. Build concealed flashing into mortar joints as units are set.
- H. Use setting buttons of adequate size, in sufficient quantity, and of thickness required to maintain uniform joint width and to prevent mortar from extruding. Hold buttons back from face of stone a distance at least equal to width of joint, but not less than depth of pointing materials.
- I. Do not set heavy units or projecting courses until mortar in courses below has hardened enough to resist being squeezed out of joint.
- J. Support and brace projecting stones until wall above is in place and mortar has set.
- K. Joint Pointing - General: Point joints with mortar or sealant as specified.
- L. Pointing Joints with Mortar: Point joints with mortar except where sealant is specified
1. Rake out joints for pointing with mortar to depths of not less than 1/2 inch. Rake joints to uniform depths with square bottoms and clean sides.
  2. Prepare stone-joint surfaces for pointing with mortar by removing dust and mortar particles. Where setting mortar was removed to depths greater than surrounding areas, apply first layer of pointing mortar in layers not more than 3/8 inch until a uniform depth is formed.
  3. Point stone joints by placing pointing mortar in layers not more than 3/8 inch. Compact each layer thoroughly and allow to become thumbprint hard before applying next layer.
  4. Tool joints with a round jointer having a diameter 1/8 inch larger than width of joint, when pointing mortar is thumbprint hard.
- M. Pointing Joints with Sealant:
1. Rake out the following joints for pointing with sealant
    - a. Head joints in top courses, including copings, parapets, cornices, sills, and steps.
    - b. Joints in projecting units.
  2. At raked joints pointed with sealant:
    - a. Rake out mortar from sealant-pointed joints to depths required for sealant and sealant backing, but not less than 3/4 inch.
      - 1) Rake joints to uniform depths with square bottoms and clean sides.
    - b. Prepare stone-joint surfaces for pointing with sealant by removing dust and mortar particles.

- c. Point joints with sealant to comply with applicable requirements in Section 07 9200 - Joint Sealants.

- 1) If required by sealant manufacturer, prime stone surfaces to receive sealant.
- 2) Install compressible backer rod in joints before applying sealant unless otherwise indicated.

### **3.4 INSTALLATION TOLERANCES**

- A. Variation from Plumb: For vertical lines and surfaces of walls, do not exceed 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch in 40 feet or more. For external corners, corners and jambs within 20 feet of an entrance, expansion joints, and other conspicuous lines, do not exceed 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 3/8 inch in 40 feet or more.
- B. Variation from Level: For lintels, sills, water tables, parapets, horizontal bands, horizontal grooves, and other conspicuous lines, do not exceed 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 3/8 inch maximum.
- C. Variation of Linear Building Line: For positions shown in plan and related portions of walls and partitions, do not exceed 1/4 inch in 20 feet or 1/2 inch in 40 feet or more.
- D. Variation in Cross-Sectional Dimensions: For thickness of walls from dimensions indicated, do not exceed plus or minus 1/4 inch.
- E. Variation in Joint Width: Do not vary from average joint width more than plus or minus 1/8 inch or a quarter of nominal joint width, whichever is less. For joints within 60 inches of each other, do not vary more than 1/8 inch or a quarter of nominal joint width, whichever is less from one to the other.
- F. Variation in Plane between Adjacent Stone Units (Lipping): Do not exceed 1/16-inch difference between planes of adjacent units.

### **3.5 ADJUSTING AND CLEANING**

- A. Remove and replace broken, chipped, stained, or otherwise damaged stone, defective joints, and stone cladding that does not match approved samples and mockups. Damaged stone may be repaired if Architect approves methods and results.
- B. Replace damaged or defective work in a manner that results in stone cladding's matching approved samples and mockups, complying with other requirements, and showing no evidence of replacement.
- C. In-Progress Cleaning: Clean cast stone as work progresses.
  - 1. Remove mortar fins and smears before tooling joints.
  - 2. Remove excess sealant and smears as sealant is installed.
- D. Final Cleaning: Clean stone no fewer than six days after completion of pointing and sealing, using nonacidic cleaner or clean water and stiff-bristle fiber brushes.
  - 1. Clean limestone units to comply with recommendations of stone manufacturer/fabricator.
  - 2. Do not use wire brushes, acid-type cleaning agents, cleaning agents containing caustic compounds or abrasives, or other materials or methods that could damage stone.
  - 3. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
  - 4. Test cleaning methods on sample area of stone; leave one-half of area uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of stone.
  - 5. Protect adjacent surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.

6. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.

**END OF SECTION 04 4200**



## **SECTION 05 3100 – STEEL DECKING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section includes:
  - 1. Roof deck.

#### **1.3 ACTION SUBMITTALS**

- A. Product Data: For the following:
  - 1. Roof deck.
  - 2. Galvanized repair paint.
- B. Shop Drawings:
  - 1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Welding certificates.
- B. Paint Compatibility Certificates: From manufacturers of shop-applied primers certifying material compatibility with field-applied primers and finish (top) coats.
- C. Product Certificates: For each type of steel deck.
- D. Product Test Reports: For tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
  - 1. Power-actuated mechanical fasteners.
- E. Research Reports: For steel deck, from ICC-ES.
- F. Field quality-control reports.

#### **1.5 QUALITY ASSURANCE**

- A. Manufacturer: Company specializing in performing the work of this section with minimum 5 years of documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum five years documented experience and approved by manufacturer.
- C. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.

- D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."

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

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Store products in accordance with SDI MOC3. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

### **2.2 ROOF DECK**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Canam Steel Corporation: [www.canam-construction.com](http://www.canam-construction.com).
  - 2. Cordeck, Inc: [www.cordeck.com](http://www.cordeck.com)
  - 3. James River Steel, Inc.: [www.jamesriversteel.com](http://www.jamesriversteel.com)
  - 4. New Millennium Building Systems, LLC: [www.newmill.com](http://www.newmill.com)
  - 5. Roof Deck, Inc.: [www.roofdeckinc.com](http://www.roofdeckinc.com)
  - 6. Vulcraft: [www.vulcraft.com](http://www.vulcraft.com).
- B. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:
  - 1. Galvanized-Steel Sheet: ASTM A653, Structural Steel (SS), Grade 33, G90 zinc coating.
  - 2. Deck Profile: Type B, wide rib; unless otherwise indicated on Drawings.
  - 3. Profile Depth: 1-1/2 inches; unless otherwise indicated on Drawings.
  - 4. Design Uncoated-Steel Thickness: 0.0474 inch (18 gage), unless otherwise indicated on Drawings.
  - 5. Span Condition: Triple span or more; unless otherwise indicated on Drawings.
  - 6. Side Laps: Overlapped or interlocking seam at Contractor's option; unless otherwise indicated on Drawings.

### **2.3 ACCESSORIES**

- A. Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.
- D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch (20 gage) design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

- F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile recommended by SDI Publication No. 31 for overhang and slab depth; unless otherwise indicated on Drawings.
- G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.
- H. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0598 inch (16 gage) thick, with factory-punched hole of 3/8-inch minimum diameter.
- I. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch (14 gage) thick, of same material and finish as deck. For drains, cut holes in the field.
- J. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch (14 gage) thick, of same material and finish as deck, with 3-inch-wide flanges and level or sloped recessed pans of 1-1/2-inch minimum depth. For drains, cut holes in the field.

## **2.4 GALVANIZING**

- A. For galvanized steel decking indicated to be field painted:
  - 1. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.
- B. Galvanizing Repair Paint: Organic zinc-rich coating containing 95 percent metallic zinc by weight in the dried film.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide ZRC Worldwide; ZRC Cold Galvanizing Repair Compound: [www.zrcworldwide.com](http://www.zrcworldwide.com), or one of the following comparable products:
    - a. Or approved equal.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION, GENERAL**

- A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.
- B. Install temporary shoring before placing deck panels if required to meet deflection limitations.
- C. Locate deck bundles to prevent overloading of supporting members.
- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

### **3.3 INSTALLATION OF ROOF DECK**

- A. Fasten roof-deck panels to cold-formed steel trusses by mechanical pins/screws as indicated on the Structural Drawings.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the spacing indicated in the Structural Drawings or the lesser of one-half of the span or 18 inches, and as follows:
  - 1. Mechanically fasten with self-drilling, No. 12 diameter or larger, carbon-steel screws.
  - 2. Contractor's Option: Fasten with a minimum of 1-1/2-inch-long welds if deck is 0.0474 inch (18 gage) thick, minimum.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
  - 1. End Joints: Lapped 2 inches minimum.
- D. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld to substrate to provide a complete deck installation.
  - 1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.
- E. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

### **3.4 REPAIR**

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A780 and manufacturer's written instructions.

### **3.5 FIELD QUALITY CONTROL**

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Field welds will be subject to inspection.
- C. Prepare test and inspection reports.

**END OF SECTION 05 3100**

## **SECTION 05 4000 - COLD-FORMED METAL FRAMING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section includes:
  - 1. Cold-formed metal framing.

#### **1.3 DEFINITIONS**

- A. CFMF: Cold-formed metal framing.

#### **1.4 PREINSTALLATION MEETINGS**

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

#### **1.5 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings:
  - 1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
  - 2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
- C. Delegated-Design Submittal: Shop drawings and calculations for cold-formed steel framing; sealed by a professional engineer.

#### **1.6 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For manufacturer, installer, professional engineer, and testing agency.
- B. Welding certificates.
- C. Product Test Reports: For each listed product, for tests performed by manufacturer and witnessed by a qualified testing agency or a qualified testing agency.
  - 1. Steel sheet.
  - 2. Expansion anchors.
  - 3. Mechanical fasteners.
  - 4. Vertical deflection clips.
  - 5. Miscellaneous structural clips and accessories.
- D. Research Reports:
  - 1. For nonstandard cold-formed steel framing post-installed anchors, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.
  - 2. For sill sealer gasket, showing compliance with ICC-ES AC308.

- E. Field quality-control reports.

## **1.7 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least five years of documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum five years documented experience and approved by manufacturer.
- C. Professional Engineer Qualifications: Professional engineer experienced with providing delegated-design engineering services of the kind indicated, including documentation that engineer is licensed in the state in which Project is located.
- D. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.
- E. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.
- F. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1, "Structural Welding Code - Steel."
  - 2. AWS D1.3, "Structural Welding Code - Sheet Steel."

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products from one of the following:
  - 1. ClarkDietrich Building Systems: [www.clarkdietrich.com](http://www.clarkdietrich.com).
  - 2. Jaimes Industries Inc.: [www.jaimesind.com](http://www.jaimesind.com).
  - 3. MarinoWARE: [www.marinoware.com](http://www.marinoware.com).
  - 4. MBA Building Supplies, Inc.: [www.mbastuds.com](http://www.mbastuds.com).
  - 5. MRI Steel Framing LLC: [www.mristeel Framing.com](http://www.mristeel Framing.com)
  - 6. Telling Industries; [www.buildstrong.com](http://www.buildstrong.com).

### **2.2 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 - Quality Requirements, to design cold-formed steel framing.
- B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.
  - 1. Design Loads: As indicated on Drawings.
  - 2. Deflection Limits: Unless otherwise indicated, design framing systems to withstand design loads without deflections greater than the following:
    - a. Exterior Wall Framing:
      - 1) With Masonry Veneer: Horizontal deflection of L/720 of the wall height.
      - 2) Without Masonry Veneer: Horizontal deflection of L/360 of the wall height.

- b. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.
- 3. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
  - a. Upward and downward movement of 3/4 inch, unless otherwise indicated.
- 4. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.
- C. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing shall comply with AISI S100, AISI S200, and the following:
  - 1. Floor and Roof Systems: AISI S210.
  - 2. Wall Studs: AISI S211.
  - 3. Headers: AISI S212.
  - 4. Lateral Design: AISI S213.
- D. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency acceptable to authorities having jurisdiction.

## **2.3 COLD-FORMED STEEL FRAMING MATERIALS**

- A. Steel Sheet: ASTM A1003, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:
  - 1. Grade: ST33H but not less than as required by structural performance requirements.
  - 2. Coating: G60; exception, provide G90 at masonry stud backup.
- B. Steel Sheet for Clips: ASTM A653, structural steel, zinc coated, of grade and coating as follows:
  - 1. Grade: 33 (230) but not less than as required by structural performance.
  - 2. Coating: G60.

## **2.4 Z-SHAPED FURRING**

- A. Z-shaped Furring: Manufacturer's standard steel Z-shaped steel sections, minimum face flange of 1-1/4 inches and minimum wall attachment flange of 7/8 inch.
  - 1. Minimum Base-Metal Thickness: 0.0538 inch (16 gage).
  - 2. Depth: As indicated on Drawings and as required to accommodate thickness of rigid board insulation.

## **2.5 FRAMING ACCESSORIES**

- A. Fabricate steel-framing accessories from ASTM A1003, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation used for framing members

- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
  - 1. Supplementary framing.
  - 2. Bracing and bridging.
  - 3. Web stiffeners.
  - 4. Miscellaneous Clips.
  - 5. Backer plates.
  - 6. And other miscellaneous items required for a complete installation.

## **2.6 ANCHORS, CLIPS, AND FASTENERS**

- A. Steel Shapes and Clips: ASTM A36, zinc coated by hot-dip process according to ASTM A123.
- B. Anchor Bolts: ASTM F1554, Grade 36, threaded carbon-steel hex-headed bolts and headless, hooked bolts, carbon-steel nuts, and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A153, Class C.
- C. Post-Installed Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC193, ICC-ES AC58, or ICC-ES AC308 as appropriate for the substrate.
  - 1. Uses: Securing cold-formed steel framing to structure.
  - 2. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.
  - 3. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F593, and nuts, ASTM F594.
- D. Mechanical Fasteners: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
  - 1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.
- E. Welding Electrodes: Comply with AWS standards.

## **2.7 MISCELLANEOUS MATERIALS**

- A. Galvanizing Repair Paint: ASTM A780 or SSPC-Paint 20.
- B. Nonmetallic, Nonshrink Grout: Factory-packaged, nonmetallic, noncorrosive, nonstaining grout, complying with ASTM C1107, and with a fluid consistency and 30-minute working time.
- C. Shims: Load-bearing, high-density, multimonomer, nonleaching plastic; or cold-formed steel of same grade and metallic coating as framing members supported by shims.

## **2.8 FABRICATION**

- A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
  - 1. Fabricate framing assemblies using jigs or templates.
  - 2. Cut framing members by sawing or shearing; do not torch cut.



3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
    - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    - b. Locate mechanical fasteners and install according to Shop Drawings, with screws penetrating joined members by no fewer than three exposed screw threads.
  4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies by means that prevent damage or permanent distortion.
- C. Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable variation of 1/8 inch in 10 feet and as follows:
1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
  2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

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

#### **3.2 PREPARATION**

- A. Install load-bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch to ensure a uniform bearing surface on supporting concrete or masonry construction.

#### **3.3 INSTALLATION, GENERAL**

- A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.
- B. Install cold-formed steel framing according to AISI S200, AISI S202, and manufacturer's written instructions unless more stringent requirements are indicated.
- C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
  1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.
- D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
  1. Cut framing members by sawing or shearing; do not torch cut.

2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
  - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
  - b. Locate mechanical fasteners, install according to Shop Drawings, and comply with requirements for spacing, edge distances, and screw penetration.
- E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.
- F. Install temporary bracing and supports to secure framing and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.
- H. Install insulation, specified in Section 07 2100 - Thermal Insulation, in framing-assembly members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- I. Fasten hole-reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

### **3.4 INSTALLATION OF MISCELLANEOUS FRAMING**

- A. Framing:
  1. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacings as follows:
    - a. Anchor Spacing: As determined by delegated cold formed engineer, but not more than 24 inches oc maximum
  2. Squarely seat studs against top and bottom tracks, with gap not exceeding 1/8 inch between the end of wall-framing member and the web of track.
    - a. Fasten both flanges of studs to top and bottom tracks.
- B. Space studs as follows:
  1. Stud Spacing: 16 inches, unless otherwise indicated on Drawings.
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar configurations.
- D. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.
  1. If type of supplementary support is not indicated, comply with stud manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.

- E. Install horizontal bridging in stud system, spaced vertically 48 inches, unless otherwise indicated on Shop Drawings. Fasten at each stud intersection.
  - 1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs. At load-bearing framing provide minimum of two screws into each flange of the clip angle for framing members up to 6 inches deep.
    - a. At Contractor's option provide the following instead of channel bridging:
      - 1) Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
- F. Install miscellaneous framing and connections, including supplementary framing, stud kickers, diagonal bracing straps, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable framing system.

### **3.5 INSTALLATION OF Z-SHAPED FURRING**

- A. Erect insulation, specified in Section 07 2100 "Thermal Insulation," vertically, unless otherwise indicated, and hold in place with Z-shaped furring members spaced 24 inches o.c.
- B. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
- C. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.

### **3.6 INSTALLATION TOLERANCES**

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

### **3.7 REPAIR**

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

### **3.8 FIELD QUALITY CONTROL**

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

### **3.9 PROTECTION**

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

**END OF SECTION 05 4000**

## **SECTION 05 4400 - COLD-FORMED METAL TRUSSES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section includes:
  - 1. Roof trusses.

#### **1.3 DEFINITIONS**

- A. CFMF: Cold-formed metal framing.

#### **1.4 PREINSTALLATION MEETINGS**

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

#### **1.5 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings:
  - 1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel trusses; fabrication; and fastening and anchorage details, including mechanical fasteners.
  - 2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
- C. Delegated-Design Submittal: Shop drawings and calculations for cold-formed steel trusses and permanent truss bracing; sealed by a professional engineer.

#### **1.6 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For manufacturer, installer, professional engineer, and testing agency.
- B. Welding certificates.
- C. Product Test Reports: For each listed product, for tests performed by manufacturer and witnessed by a qualified testing agency or a qualified testing agency.
  - 1. Steel sheet.
  - 2. Expansion anchors.
  - 3. Mechanical fasteners.
  - 4. Vertical deflection clips.
  - 5. Miscellaneous structural clips and accessories.
- D. Research Reports:
  - 1. For nonstandard cold-formed steel framing post-installed anchors, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.
  - 2. For sill sealer gasket, showing compliance with ICC-ES AC380.

- E. Field quality-control reports.

## **1.7 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least five years of documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum five years documented experience and approved by manufacturer.
- C. Professional Engineer Qualifications: Professional engineer experienced with providing delegated-design engineering services of the kind indicated, including documentation that engineer is licensed in the state in which Project is located.
- D. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.
- E. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.
- F. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  - 2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products from one of the following:
  - 1. Aegis Metal Framing: [www.aegismetalframing.com](http://www.aegismetalframing.com)
  - 2. Alpine TrusSteel: [www.trussteel.com](http://www.trussteel.com).
  - 3. Jaimes Industries Inc.: [www.jaimesind.com](http://www.jaimesind.com).
  - 4. MarinoWARE: [www.marinoware.com](http://www.marinoware.com).

### **2.2 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 - Quality Requirements, to design cold-formed steel trusses.
- B. Structural Performance: Provide cold-formed steel trusses capable of withstanding design loads within limits and under conditions indicated.
  - 1. Design Loads: As indicated on Drawings.
  - 2. Deflection Limits: Design trusses to withstand design loads without deflections greater than the following, unless otherwise indicated on Drawings:
    - a. Roof Trusses: Vertical deflection of 1/480 for live loads and 1/360 for total loads of the span.
  - 3. Design trusses to provide for movement of truss members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.

- C. Cold-Formed Steel Truss Standards: Unless more stringent requirements are indicated, trusses shall comply with the following:
  - 1. Floor and Roof Systems: AISI S210.
  - 2. Lateral Design: AISI S213.
  - 3. Roof Trusses: AISI S214.
- D. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Indicate design designations from UL or from the listings of another qualified testing agency acceptable to authorities having jurisdiction.

## **2.3 COLD-FORMED STEEL TRUSS MATERIALS**

- A. Steel Sheet: ASTM A1003, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:
  - 1. Grade: ST33H but not less than as required by structural performance requirements.
  - 2. Coating: G60, A60.

## **2.4 ROOF TRUSSES**

- A. Roof Truss Members: Manufacturer's standard steel sections.
  - 1. Minimum Base-Metal Thickness: 0.0428 inch (18 gage).
  - 2. Connecting Flange Width: 1-5/8 inches, minimum at top and bottom chords connecting to sheathing or other directly fastened construction.

## **2.5 FRAMING ACCESSORIES**

- A. Fabricate steel-truss accessories from steel sheet, ASTM A1003, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation used for truss members.
- B. Provide accessories of manufacturer's standard thickness and configuration unless otherwise indicated.

## **2.6 ANCHORS, CLIPS, AND FASTENERS**

- A. Steel Shapes and Clips: ASTM A36, zinc coated by hot-dip process according to ASTM A123.
- B. Anchor Bolts: ASTM F1554, Grade 36, threaded carbon-steel hex-headed bolts and headless, hooked bolts, carbon-steel nuts, and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A153, Class C.
- C. Post-Installed Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC193, ICC-ES AC58, or ICC-ES AC308 as appropriate for the substrate.
  - 1. Uses: Securing cold-formed steel trusses to structure.
  - 2. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.
  - 3. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F593, and nuts, ASTM F594.

- D. Mechanical Fasteners: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.

- 1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.

- E. Welding Electrodes: Comply with AWS standards.

## **2.7 MISCELLANEOUS MATERIALS**

- A. Galvanizing Repair Paint: ASTM A780 or SSPC-Paint 20.
- B. Shims: Load-bearing, high-density multimonomer, nonleaching plastic; or cold-formed steel of same grade and metallic coating as truss members supported by shims.

## **2.8 FABRICATION**

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

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

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



### **3.2 INSTALLATION**

- A. Install bridge, and brace cold-formed steel trusses according to AISI S200, AISI S202, AISI S214, and manufacturer's written instructions unless more stringent requirements are indicated.
  - 1. Coordinate with wall framing to align webs of bottom chords and load-bearing studs or continuously reinforce track to transfer loads to structure or add additional cold-formed metal studs in the field to ensure alignment.
  - 2. Anchor trusses securely at all bearing points.
  - 3. Install continuous bridging and permanently brace trusses as indicated on Drawings but not less than as indicated on Shop Drawings and designed according to CFSEI's Technical Note 551e, "Design Guide: Permanent Bracing of Cold-Formed Steel Trusses."
- B. Install cold-formed steel trusses and accessories true to line and location, and with connections securely fastened.
  - 1. Erect trusses with plane of truss webs plumb and parallel to each other. Align and accurately position trusses at required spacings.
  - 2. Erect trusses without damaging truss members or connections.
  - 3. Fasten cold-formed steel trusses by welding or mechanical fasteners.
    - a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    - b. Locate mechanical fasteners, install according to Shop Drawings, and comply with requirements for spacing, edge distances, and screw penetration.
- C. Install temporary bracing and supports to secure trusses and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to trusses are secured.
- D. Truss Spacing: As indicated on Drawings; maximum spacing not to exceed 48 inches on center.
- E. Do not alter, cut, or remove truss members or connections of trusses.

### **3.3 INSTALLATION TOLERANCES**

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

### **3.4 REPAIR**

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

### **3.5 FIELD QUALITY CONTROL**

- A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:
  - 1. Cold-Formed Steel Trusses Spanning 60 Feet or Longer: Verify temporary installation restraint/bracing and the permanent individual truss member restraint/bracing are installed according to the approved truss submittal package.

- B. Testing Agency: Owner may engage a qualified testing agency to perform tests and inspections.
- C. Cold-formed metal trusses will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

**3.6 PROTECTION**

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

**END OF SECTION 05 4400**

## **SECTION 05 5000 - METAL FABRICATIONS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Miscellaneous faming and supports for:
    - a. Mechanical and electrical equipment.
    - b. Applications where framing and supports are not specified in other Sections.
    - c. Other items as indicated on Drawings.
  - 2. Steel framing at sectional doors.
  - 3. Bent metal wall restraints at top of interior masonry walls.
  - 4. Miscellaneous steel trim including, but not limited to:
    - a. Steel edgings.
  - 5. Metal bollards.
- B. Products furnished, but not installed, under this Section include the following:
  - 1. Loose steel lintels; refer to Section 04 2000 – Unit Masonry, for installation.
  - 2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
  - 3. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

#### **1.3 COORDINATION**

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

#### **1.4 ACTION SUBMITTALS**

- A. Product Data: For manufactured items that are not shop fabricated, including but not limited to the following:
  - 1. Shop primers.
  - 2. Grouts.
  - 3. Slotted channel framing.
  - 4. Bollard covers.
- B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
  - 1. Shop Drawings requirements include but are not limited to the following:
    - a. Miscellaneous faming and supports

- b. Loose steel lintels
  - c. Bent metal wall restraints.
  - d. Steel framing at sectional doors.
  - e. Miscellaneous steel trim.
  - f. Metal bollards.
- 2. Include delegated-design analysis data signed and sealed by the qualified professional engineer responsible for their preparation for shop and field fabricated items.
- C. Samples for Initial Selection: For each type of exposed factory-applied finish.
- D. Samples for Verification:
  - 1. Three samples of each type and color of exposed factory-applied finish.

#### **1.5 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For fabricator.
- B. Qualification Data: For professional engineer.
- C. Welding certificates.
- D. Paint Compatibility Certificates: From manufacturers of shop-applied primers certifying material compatibility with field-applied primers and finish (top) coats.
- E. Research Reports: For post-installed anchors.

#### **1.6 QUALITY ASSURANCE**

- A. Fabricator: Company specializing in performing the work of this section with minimum 5 years of documented experience.
- B. Professional Engineer Qualifications: Professional engineer experienced with providing delegated-design engineering services of the kind indicated, including documentation that engineer is licensed in the state in which Project is located.
- C. Welding Qualifications: Qualify procedures and personnel in accordance with the following:
  - 1. AWS D1.1, "Structural Welding Code - Steel."

#### **1.7 FIELD CONDITIONS**

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

### **PART 2 - PRODUCTS**

#### **2.1 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 "Quality Requirements," to design shop or field fabricated items.

- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
  - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
- C. Paint Compatibility: Shop-applied primers shall be compatible with field-applied primers and finish (top) coats; coordinate with Section 09 9100 – Painting, and Section 09 9600 – High Performance Coatings, for field-applied primers and finish (top) coats.

## **2.2 METALS**

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Ferrous Metals:
  - 1. Steel Plates, Shapes, and Bars: ASTM A36.
  - 2. Steel Tubing: ASTM A500, cold-formed steel tubing.
  - 3. Steel Pipe: ASTM A53, Standard Weight (Schedule 40) unless otherwise indicated.
  - 4. Cast Iron: Either gray iron, ASTM A48, or malleable iron, ASTM A47, unless otherwise indicated.

## **2.3 SLOTTED CHANNEL FRAMING:**

- A. Slotted Channel Framing:
  - 1. Size of Channels: 1-5/8 by 1-5/8 inches, unless otherwise indicated or required.
  - 2. Material:
    - a. Steel: Cold-formed metal box channels (struts) complying with MFMA-4. Provide one or more of the following:
      - 1) Galvanized: Galvanized steel, ASTM A653, structural steel, Grade 33, with G90 coating; 0.064-inch (16 gage), minimum, nominal thickness.
      - 2) Prefinished: Cold-rolled steel, ASTM A1008, structural steel, Grade 33; 0.0677-inch (16 gage) minimum thickness; coated with rust-inhibitive, baked-on, acrylic enamel.
        - a) Color: Standard color as selected by Architect.
      - 3) Manufacturer: Subject to compliance with requirements, available manufacturers that may be incorporated into the Work include, but are not limited to, the following:
        - a) Atkore International, Inc/Unistrut: [www.unistrut.us](http://www.unistrut.us).
  - 3. Fittings, Accessories, and Related Hardware: Manufacturer's standard; finished to match slotted channel framing.
    - a. Provide as required for applications and conditions indicated on Drawings.

## **2.4 FASTENERS AND ANCHORS**

- A. General: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941, Class Fe5, at exterior walls. Select fasteners for type, grade, and class required.
  - 1. Provide stainless steel fasteners for fastening aluminum, stainless steel, or nickel silver.
  - 2. Provide stainless steel fasteners in wet locations.

B. Fasteners:

1. Steel Fasteners:

- a. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.
- b. High-Strength Bolts, Nuts, and Washers: ASTM F3125, Grade A325, Type 3, heavy-hex steel structural bolts; ASTM A563, Grade DH3, heavy-hex carbon-steel nuts; and where indicated, flat washers.

2. Stainless Steel Fasteners:

- a. Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, ASTM F593; with hex nuts, ASTM F594; and, where indicated, flat washers; Alloy Group 1.

C. Anchors:

1. General:

- a. Anchors shall be capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E488, conducted by a qualified independent testing agency.

2. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563; and, where indicated, flat washers.

- a. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

3. Cast-in-Place Anchors in Concrete: Either threaded or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47 malleable iron or ASTM A27 cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F2329.

4. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.

- a. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.
- b. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless steel bolts, ASTM F593, and nuts, ASTM F594.

**2.5 MISCELLANEOUS MATERIALS**

A. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187.

B. Shrinkage-Resistant Grout: Factory-packaged, nonmetallic, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

C. Concrete: Comply with requirements in Section 03 3000 - Cast-in-Place Concrete, for normal-weight, air-entrained concrete with a minimum 28-day compressive strength of 3000 psi.

## **2.6 FABRICATION, GENERAL**

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

## **2.7 MISCELLANEOUS FRAMING AND SUPPORTS**

- A. General:
  - 1. Provide steel framing and supports as needed to complete the Work for:
    - a. Mechanical and electrical equipment.
    - b. Applications where framing and supports are not specified in other Sections.
    - c. Other items as indicated on Drawings.
  - 2. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
    - a. Fabricate units from slotted channel framing where indicated.
    - b. Furnish inserts for units installed after concrete is placed.

## 2.8 STEEL FRAMING AT SECTIONAL DOORS

- A. Fabricate steel door frames from shapes, plates, and bars of fully welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated on Drawings and as necessary to receive adjacent construction.
- B. Provide integrally welded steel strap anchors for securing frames into adjoining concrete or masonry.
- C. Extend bottom of frames to floor elevation indicated with steel angle clips welded to frames for anchoring frame to floor with expansion shields and bolts.

## 2.9 LOOSE STEEL LINTELS

- A. General: Fabricate loose steel lintels from steel angles and shapes as indicated on Drawings. Provide at openings and recesses in masonry walls and partitions as indicated on Drawings. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit.
- B. Refer to Drawings for lintel sizing and other requirements. Where not otherwise indicated on Drawings, comply with the following:
  1. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span, but not less than 8 inches.
  2. Fabricate loose steel lintels in accordance with the following table:

CLEAR SPAN (Feet)	WALL WIDTH (Inches)	ANGLE SIZE (LLV)	BEAM SIZE	VERTICAL PLATES (Inches)	HORIZONTAL PLATE SIZE (Inches)
0 to 4	0 to 4	4x4x3/8	-	-	--
	4+ to 8	-	-	4x1/4	Wall Width minus 1 x 3/8
	8+ to 12	-	-	(2) 4x1/4, 4 oc	Wall Width minus 1 x 3/8
	12+ to 16	-	-	(3) 4x1/4, 4 oc	Wall Width minus 1 x 3/8
4+ to 6	0 to 4	4x4x3/8	-	-	-
	4+ to 8	-	-	4x1/4	Wall Width minus 1 x 3/8
	8+ to 12	-	-	(2) 4x1/4, 4 oc	Wall Width minus 1 x 3/8
	12+ to 16	-	-	(3) 4x1/4, 4 oc	Wall Width minus 1 x 3/8
6+ to 8	0 to 4	6x4x3/8	-	-	-
	4+ to 8	-	-	5x3/8	Wall Width minus 1 x 3/8
	8+ to 12	-	-	(2) 5x3/8, 4 oc	Wall Width minus 1 x 3/8
	12+ to 16	-	-	(3) 5x3/8, 4 oc	Wall Width minus 1 x 3/8
8+ to 12	4+ to 8	-	W8x10	-	Wall Width minus 1 x 3/8
	8+ to 12	-	W8x10	-	Wall Width minus 1 x 3/8
	12+ to 16	-	W8x13	-	Wall Width minus 1 x 3/8 including gusset reinforcement (32" o.c.)

3. Refer to Drawings for conditions other than those listed in table above.
4. At interior locations, excluding exterior walls, vertical and horizontal plates may be 1/4 inch thick instead of 3/8 inch thick.
5. At interior locations, excluding exterior walls, angle size may be 1/4 inch thick instead of 3/8 inch thick.



## **2.10 BENT METAL RESTRAINTS**

- A. Bent Metal Restraints: Bent metal restraints that restrain top of interior masonry walls.
1. Restraints: Fabricate bent metal restraints from 12 gage, 0.108 inch thick, galvanized sheet steel.
    - a. Profile: Provide L-shaped restraints. Each leg 4 inches long, minimum, in lengths as follows:
      - 1) Where Concealed from View Above Ceilings: Provide 4 inch wide restraints spaced 48 inches on center on both sides of wall.
        - a) Exception: Space restraints 24 inches on center at walls over 20 feet tall.
      - 2) Where Exposed to View Without Ceilings: Provide continuous restraints in lengths not less than 48 inches long.
  2. Plates: Fabricate from 12 gage, 0.108 inch thick, galvanized sheet.
    - a. Provide at masonry walls running parallel with deck flutes.
    - b. Size plate to span deck flutes above masonry walls and to provide anchorage for restraints.
    - c. Provide continuous plate in lengths not less than 48 inches long.
  3. Fasteners: Provide the following fasteners as appropriate for substrates unless otherwise indicated on Drawings.
    - a. Restraints:
      - 1) Provide the following fasteners:
        - a) At Plate: 4, No. 10 screws
        - b) At Metal Deck: 4, No. 10 screws
        - c) At Concrete: 2 powder actuated fasteners equal to 0.145 by 1.25 inch Hilti Ramset.
        - d) At Composite Concrete and Metal Deck: 2 powder actuated fasteners equal to 0.145 by 1.25 inch Hilti Ramset.
      - 2) At continuous restraints space each grouping of fasteners 24 inches on center
    - b. Sheet/Plate:
      - 1) Provide the following fasteners:
        - a) At Metal Deck: 2, No. 10 screws; each pair 6 inches on center, on each side of sheet/plate.
        - b) At Concrete: 1 powder actuated fastener 24 inches on center, on each side of plate. Fastener equal to 0.145 by 1.25 inch Hilti Ramset.
        - c) At Composite Concrete and Metal Deck: 1 powder actuated fastener 24 inches on center, on each side of plate. Fastener equal to 0.145 by 1.25 inch Hilti Ramset

## **2.11 MISCELLANEOUS STEEL TRIM**

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

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

## **2.12 METAL BOLLARDS**

- A. General:
  - 1. Fabricate metal bollards from Schedule 80 steel pipe.
  - 2. Where bollards are indicated to receive controls for door operators, provide cutouts for controls and holes for wire.
  - 3. Concrete for bollard footings and filling bollards: Refer to Section 03 3000 - Cast-in-Place Concrete.
- B. Standard fixed bollards:
  - 1. Mounting: Set in concrete footings.
  - 2. Bollard Diameter: 6 inches, unless otherwise indicated.
  - 3. Bollard Height: 42 inches above grade, unless otherwise indicated.
  - 4. Fabricate bollards with 1/2-inch-thick, 10 by 10 inch, steel baseplates for setting in concrete footings.
- C. Sleeve Covers: High-density polyethylene thermoplastic (HDPE) sleeves with rounded domed top.
  - 1. Wall Thickness: 1/4 inch.
  - 2. Color: As selected by Architect from manufacturer's standard colors.
  - 3. Provide complete with manufacturer's standard adhesive tape for securing sleeve to bollard.
  - 4. Provide covers for all bollards.
  - 5. Basis-of-Design Product: Subject to compliance with requirements, provide Ideal Shield; 1/4" Bollard Cover: [www.idealshield.com](http://www.idealshield.com), or a comparable product.

## **2.13 GENERAL FINISH REQUIREMENTS**

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

## **2.14 STEEL AND IRON FINISHES**

- A. General:
  - 1. Galvanizing: Provide hot-dip galvanizing at exterior locations, within exterior walls or building enclosure, wet areas, and elsewhere as indicated.
  - 2. Shop prime iron and steel items where galvanizing is not required or indicated, unless they are to be embedded in concrete or masonry, coated with sprayed-on fireproofing, or otherwise indicated.
- B. Shop Primer:
  - 1. Provide the following:
    - a. Lead and chromate free, quick-drying, rust-inhibiting , solvent-based, alkyd primer. Subject to compliance with requirements, provide one of the following:
      - 1) Carboline; Carbocoat 53: [www.carboline.com](http://www.carboline.com).
      - 2) Sherwin Williams; Protective and Marine Coatings, Steel Spec 4012 Universal Primer, B50 Series: [www.sherwin-williams.com](http://www.sherwin-williams.com).
      - 3) Tnemec; Tnemec Universal Primer Series AK02: [www.tnemec.com](http://www.tnemec.com).

- C. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153 for steel and iron hardware and with ASTM A123 for other steel and iron products.
  - 1. For galvanized steel to be field painted:
    - a. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.
- D. Galvanizing Repair Paint: Organic zinc-rich coating containing 95 percent metallic zinc by weight in the dried film.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide ZRC Worldwide; ZRC Cold Galvanizing Repair Compound: [www.zrcworldwide.com](http://www.zrcworldwide.com), or one of the following comparable products:
    - a. Or approved equal.
- E. Preparation for Shop Priming:
  - 1. Uncoated, Ferrous-Metal Surfaces: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces in accordance with the following specifications and standards:
    - a. SSPC-SP 6 commercial blast cleaning.
- F. Shop Priming: Immediately after surface preparation, apply shop primer in accordance with manufacturer's written instructions and in compliance with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
  - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION, GENERAL**

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

F. Tolerances

1. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
2. Maximum Offset From True Alignment: 1/4 inch.
3. Maximum Out-of-Position: 1/4 inch.

**3.2 INSTALLATION OF MISCELLANEOUS FRAMING AND SUPPORTS**

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
- B. Overhead Supports: Anchor supports securely to, and rigidly brace from, building structure. Includes but is not limited to supports for the following:
1. Mechanical and electrical equipment.
  2. Applications where framing and supports are not specified in other Sections.
  3. Other items as indicated on Drawings.

**3.3 INSTALLATION OF STEEL FRAMING AT SECTIONAL DOORS**

- A. General: Install framing to comply with requirements indicated on Drawings.
- B. Anchor framing securely to building structure.

**3.4 INSTALLATION OF LOOSE STEEL LINTELS**

- A. Loose Steel Lintels: Refer to 04 2000 – Unit Masonry, for installation.

**3.5 INSTALLATION OF BENT METAL RESTRAINTS**

- A. Install bent metal restraints and plates at top of interior masonry walls.
- B. Install plates to deck at walls running parallel with deck flutes.
- C. Secure restraints to plate or deck as appropriate for conditions above interior masonry wall.
- D. Secure with appropriate fasteners.

**3.6 INSTALLATION OF METAL BOLLARDS**

- A. Standard Fixed Bollards:
1. Secure bollards in place with concrete footings.
    - a. Center and align bollards in holes 3 inches, minimum, above bottom of excavation.
    - b. Place concrete and vibrate or tamp for consolidation.
    - c. Support and brace bollards in position until concrete has cured.
    - d. Hold top of concrete 8 inches below finish grade, unless otherwise indicated.
  2. Fill bollards solidly with concrete, mounding top surface to shed water.
    - a. Where bollards are indicated to receive controls for door operators, provide junction boxes and conduit for controls and wiring before filling with concrete.
- B. Bollard Sleeve Covers: Install sleeve covers according to manufacturer's written instructions.

### **3.7 REPAIRS**

- A. Touchup Painting:
  - 1. Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
    - a. Apply by brush or spray to provide a minimum dry film thickness recommended by primer manufacturer.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing using galvanizing repair paint to comply with ASTM A780.

**END OF SECTION 05 5000**

## **SECTION 06 1000 - ROUGH CARPENTRY**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Miscellaneous lumber.
  - 2. Plywood backing panels.
  - 3. Miscellaneous panels and sheathing.
  - 4. Glass-mat gypsum sheathing.
  - 5. Composite nail base insulated roof sheathing
  - 6. Wood blocking and nailers.

#### **1.3 DEFINITIONS**

- A. Dimension Lumber: Lumber of 2 inches nominal size or greater but less than 5 inches nominal size in least dimension.
- B. Timber: Lumber of 5 inches nominal size or greater in least dimension.
- C. Lumber grading agencies, and abbreviations used to reference them, include the following:
  - 1. NLGA: National Lumber Grades Authority.
  - 2. SPIB: The Southern Pine Inspection Bureau.
  - 3. WCLIB: West Coast Lumber Inspection Bureau.
  - 4. WWPAA: Western Wood Products Association.

#### **1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
  - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
  - 2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
  - 3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D5664.
  - 4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

#### **1.5 INFORMATIONAL SUBMITTALS**

- A. Evaluation Reports: For the following, from ICC-ES:
  - 1. Wood-preservative-treated wood.
  - 2. Fire-retardant-treated wood.
  - 3. Post-installed anchors.

## **1.6 QUALITY ASSURANCE**

- A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

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

- A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

# **PART 2 - PRODUCTS**

## **2.1 LUMBER PRODUCTS, GENERAL**

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
  - 1. Factory mark each piece of lumber with grade stamp of grading agency.
  - 2. Dress lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content of Lumber: 15 percent unless otherwise indicated.

## **2.2 SHEATHING AND PANEL PRODUCTS, GENERAL**

- A. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.
- B. Factory mark panels to indicate compliance with applicable standard.

## **2.3 WOOD-PRESERVATIVE-TREATED LUMBER**

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. Lonza Group: [www.wolmanizedwood.com](http://www.wolmanizedwood.com).
  - 2. Hoover Treated Wood Products, Inc.: [www.frtw.com](http://www.frtw.com).
  - 3. Koppers Performance Chemicals, Inc.: [www.koppersperformancechemicals.com](http://www.koppersperformancechemicals.com).
  - 4. Viance, LLC: [www.treatedwood.com](http://www.treatedwood.com).
- B. Preservative Treatment by Pressure Process: AWP A U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.
  - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
    - a. Inorganic boron (SBX) is prohibited.
  - 2. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.
- C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.

- D. Kiln-dry plywood and other wood panels after treatment to maximum moisture content of 15 percent.
- E. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
  - 1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by inspection agency.
- F. Identify fire-retardant-treated plywood and panels with appropriate classification marking of qualified testing agency.
  - 1. For exposed plywood and other wood panels indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by inspection agency.
- G. Application: Treat items indicated on Drawings, and the following:
  - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
  - 2. Plywood and other wood paneling in contact with masonry or concrete or used with roofing, flashing, vapor barriers, and waterproofing
  - 3. Wood sills, sleepers, blocking, and similar concealed members in contact with masonry or concrete.
  - 4. Wood framing attached directly to the interior of below-grade exterior masonry or concrete walls.
  - 5. Wood framing members that are less than 18 inches above the ground in crawlspaces or unexcavated areas.
  - 6. Wood floor plates that are installed over concrete slabs-on-grade.
  - 7. Other items as indicated on Drawings.

## **2.4 FIRE-RETARDANT-TREATED MATERIALS**

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. Lonza Group: [www.wolmanizedwood.com](http://www.wolmanizedwood.com).
  - 2. Hoover Treated Wood Products, Inc.: [www.frtw.com](http://www.frtw.com).
  - 3. Koppers Performance Chemicals, Inc.: [www.koppersperformancechemicals.com](http://www.koppersperformancechemicals.com).
  - 4. Viance, LLC: [www.treatedwood.com](http://www.treatedwood.com).
- B. General: Where fire-retardant-treated materials are indicated, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- C. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
  - 1. Treatment shall not promote corrosion of metal fasteners.
  - 2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D2898. Use for exterior locations and where indicated.
  - 3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D3201 at 92 percent relative humidity. Use where exterior type is not indicated.
- D. Kiln-dry lumber after treatment to maximum moisture content of 19 percent. Kiln-dry plywood after treatment to maximum moisture content of 15 percent.



- E. Identify fire-retardant-treated lumber with appropriate classification marking of qualified testing agency.
  - 1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by testing agency.
- F. Identify fire-retardant-treated plywood and other wood panels with appropriate classification marking of qualified testing agency.
  - 1. For exposed plywood and other wood paneling indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by testing agency.
- G. Application: Treat items indicated on Drawings, and the following:
  - 1. All interior rough carpentry items unless otherwise indicated.
  - 2. Other items as indicated on Drawings.

## **2.5 MISCELLANEOUS LUMBER**

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
  - 1. Miscellaneous framing, blocking, and nailers
- B. Dimension Lumber Items:
  - 1. Species: Provide one of the following:
    - a. Southern pine or mixed southern pine; SPIB.
    - b. Spruce-pine-fir; NLGA.
    - c. Hem-fir; WCLIB, or WWPA
  - 2. Grade: No. 2 or as follows:
    - a. Standard Grade, provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- C. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

## **2.6 PLYWOOD BACKING PANELS**

- A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, A-C, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.

## **2.7 MISCELLANEOUS PANELS AND SHEATHING**

- A. Plywood Concealed from View and Part of Exterior Enclosure: DOC PS 1, Exposure 1, Grade C-D
- B. Concealed Plywood at Interior Locations: DOC PS 1, Exposure 2, Grade C-D.

## **2.8 GLASS-MAT GYPSUM SHEATHING**

- A. Glass-Mat Gypsum Sheathing: ASTM C1177/C1177M.
1. Products: Subject to compliance with requirements provide one of the following:
    - a. CertainTeed Corp.; GlasRoc Sheathing: [www.certainteed.com](http://www.certainteed.com).
    - b. Georgia-Pacific Gypsum: DensGlass Sheathing: [www.gp.com](http://www.gp.com).
    - c. National Gypsum Company; Gold Bond Brand eXP Sheathing: [www.nationalgypsum.com](http://www.nationalgypsum.com).
    - d. United States Gypsum Co.; Securock Brand Glass-Mat Sheathing; [www.usg.com](http://www.usg.com).
  2. Type and Thickness: Type X, 5/8 inch thick.
  3. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
  4. Size: 48 by 96 inches for vertical installation.

## **2.9 COMPOSITE NAIL BASE INSULATED ROOF SHEATHING**

- A. Vented, Plywood-Surfaced, Polyisocyanurate-Foam Sheathing: ASTM C1289, Type II, Class 1, insulation with DOC PS 1, Exposure 1, Grade C-D, plywood on one face, vented.
1. Basis of Design Product: Subject to compliance with requirements provide Hunter Panels; Cool-Vent: [www.hunterpanels.com](http://www.hunterpanels.com); or a comparable product from one of the following:
    - a. Atlas Roofing Corp; ACFoam CrossVent: [www.atlasroofing.com](http://www.atlasroofing.com).
    - b. Kurt Building Materials; TechVent: [www.kurtbuildingmaterials.com](http://www.kurtbuildingmaterials.com).
  2. Polyisocyanurate-Foam Thickness: 6 inches, unless otherwise indicated on Drawings.
  3. Spacers: Wood furring strips or blocks spaced not more than 24 inches o.c.
  4. Air Space Depth: 1 inch, minimum.
  5. Plywood Nominal Thickness: 3/4 inch.
  6. Minimum Net Free Area: 9 sq. inches per linear foot
- B. Fasteners: Mechanical fasteners as recommended by composite nail base insulated roof sheathing manufacturer for substrates, design loads, and conditions indicated on Drawings.

## **2.10 FASTENERS**

- A. General: Fasteners shall be of size and type indicated and shall comply with requirements specified in this article for material and manufacture.
1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners of Type 304 stainless steel.
- B. Nails, Brads, and Staples: ASTM F1667.
- C. Screws for Fastening Sheathing to Wood Framing: ASTM C1002.
- D. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.
- E. Screws for Fastening Glass-mat Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached.
1. For steel framing from 0.033 to 0.112 inch thick, use screws that comply with ASTM C954.

- F. Screws for Fastening Composite Nail Base Insulated Roof Sheathing to Metal Roof Deck: Steel drill screws, in type and length recommended by sheathing manufacturer for thickness of sheathing to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B117. Provide washers or plates if recommended by sheathing manufacturer.
- G. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 or ICC-ES AC193 as appropriate for the substrate.
  - 1. Interior Locations: Carbon-steel components, zinc plated to comply with ASTM B633, Class Fe/Zn 5.
  - 2. Exterior and high relative Humidity Locations: Stainless steel with bolts and nuts complying with ASTM F593 and ASTM F594, Alloy Group 1 or 2.

## **2.11 MISCELLANEOUS MATERIALS**

- A. Organic Felt: Asphalt-saturated organic felts, nonperforated and complying with the following:
  - 1. ASTM D226: Type I.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION, GENERAL**

- A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- B. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- C. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels.
- D. Do not splice structural members between supports unless otherwise indicated.
- E. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
- F. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- G. Comply with AWP A M4 for applying field treatment to cut surfaces of preservative-treated lumber.
  - 1. Use copper naphthenate for items not continuously protected from liquid water.
- H. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous organic felt separator between wood and metal decking.
- I. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
  - 1. Table 2304.10.1, "Fastening Schedule," in Michigan Building Code.
  - 2. ICC-ES evaluation report for fastener.

- J. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.
- K. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced, and with adjacent rows staggered.
  - 1. Comply with approved fastener patterns where applicable.
  - 2. Use finishing nails unless otherwise indicated. Countersink nail heads and fill holes with wood filler.

### **3.2 PANEL AND SHEATHING INSTALLATION, GENERAL**

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
- D. Coordinate composite nail base insulated roof sheathing installation, and other sheathing installations, with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

### **3.3 INSTALLATION OF WOOD BLOCKING AND NAILERS**

- A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

### **3.4 WOOD PANEL AND SHEATHING INSTALLATION**

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

### **3.5 GLASS-MAT GYPSUM SHEATHING INSTALLATION**

- A. Comply with GA-253 and with manufacturer's written instructions.
  - 1. Fasten gypsum sheathing to wood framing with screws.
  - 2. Fasten gypsum sheathing to cold-formed metal framing with screws.
  - 3. Install panels with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
  - 4. Install panels with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.
- B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.

- C. Horizontal Installation: Install sheathing with long edges in contact with edges of adjacent panels without forcing. Abut ends over centers of studs, and stagger end joints of adjacent panels not less than one stud spacing. Attach at perimeter and within field of panel to each stud.
  - 1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of panels.
- D. Vertical Installation: Install vertical edges centered over studs. Abut ends and edges with those of adjacent panels. Attach at perimeter and within field of panel to each stud.
  - 1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of panels.

### **3.6 COMPOSITE NAIL BASE INSULATED ROOF SHEATHING INSTALLATION**

- A. Install composite nail base insulated roof sheathing using approved mechanical fasteners in accordance with manufacturer's written instructions
- B. Ensure that plywood facers are spaced a minimum 1/8 inch apart from adjoining plywood facers at edges and ends.
  - 1. Polyisocyanurate-foam shall butt tightly together without gaps or spaces.

**END OF SECTION 06 1000**

## **SECTION 07 1113 - BITUMINOUS DAMPPROOFING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Cold-applied emulsified-asphalt dampproofing.

#### **1.3 ACTION SUBMITTALS**

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

#### **1.4 QUALITY ASSURANCE**

- A. Installer Qualifications: Company specializing in performing the work of this section with at least 5 years of documented experience.

#### **1.5 FIELD CONDITIONS**

- A. Weather Limitations: Proceed with application only when existing and forecasted weather conditions permit dampproofing to be performed according to manufacturers' written instructions.
- B. Ventilation: Provide adequate ventilation during application of dampproofing in enclosed spaces. Maintain ventilation until dampproofing has cured.

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Source Limitations: Obtain primary dampproofing materials and primers from single source from single manufacturer. Provide auxiliary materials recommended in writing by manufacturer of primary materials.

#### **2.2 PERFORMANCE REQUIREMENTS**

- A. VOC Content: Products shall comply with VOC content limits of authorities having jurisdiction unless otherwise indicated.

#### **2.3 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING**

- A. Products: Subject to compliance with requirements, provide one or more of the following products:
  - 1. BASF Corp., Master Builders Solutions; Masterseal 610: [www.master-builders-solutions.basf.us](http://www.master-builders-solutions.basf.us).
  - 2. BASF Corp., Master Builders Solutions; Masterseal 615: [www.master-builders-solutions.basf.us](http://www.master-builders-solutions.basf.us).
  - 3. The Euclid Chemical Company; Dehydratine 75: [www.euclidchemical.com](http://www.euclidchemical.com).
  - 4. Henry, a Carlisle Company.; Non-Fibered Asphalt Emulsion Dampproofing 788: [www.henry.com](http://www.henry.com).
  - 5. Henry, a Carlisle Company.; HE789 FIB Asphalt Emulsion Dampproofing: [www.henry.com](http://www.henry.com).
  - 6. Karnak Corp.; 100 Non-fibred Emulsion Dampproofing: [www.karnakcorp.com](http://www.karnakcorp.com).
  - 7. Karnak Corp.; 220 Fibered Emulsion Dampproofing: [www.karnakcorp.com](http://www.karnakcorp.com).
  - 8. W. R. Meadows, Inc.; Sealmatic Type I: [www.wrmeadows.com](http://www.wrmeadows.com).

9. W. R. Meadows, Inc.; Sealastic Type II: [www.wrmeadows.com](http://www.wrmeadows.com).
- B. Vertical Application: Comply with ASTM D1227 Type III or ASTM D1187/D1187M Type I, Class 1.
  1. Brush or spray-applied.
- C. Horizontal and Low-Slope Applications: Comply with ASTM D1227 Type II or III, Class 1.
  1. Brush or spray-applied.

## **2.4 AUXILIARY MATERIALS**

- A. Furnish auxiliary materials recommended in writing by dampproofing manufacturer for intended use and compatible with bituminous dampproofing.
- B. Emulsified-Asphalt Primer: ASTM D1227, Type III, Class 1, except diluted with water as recommended in writing by manufacturer.
- C. Asphalt-Coated Glass Fabric: ASTM D1668/D1668M, Type I.
- D. Patching Compound: Epoxy or latex-modified repair mortar of type recommended in writing by dampproofing manufacturer.
- E. Protection Course: Provide one of the following:
  1. ASTM D6506, semirigid sheets of fiberglass or mineral-reinforced-asphaltic core, pressure laminated between two asphalt-saturated fibrous liners.
    - a. Thickness: Nominal 1/8 inch.
    - b. Adhesive: Rubber-based solvent type recommended in writing by waterproofing manufacturer for protection course type.
  2. Fan folded, with a core of extruded-polystyrene board insulation faced on one side or both sides with plastic film, nominal thickness 1/4 inch, with a compressive strength of not less than 8 psi per ASTM D1621, and maximum water absorption by volume of 0.6 percent per ASTM C272/C272M.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for surface smoothness, maximum surface moisture content, and other conditions affecting performance of the Work.
- B. Proceed with application only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for dampproofing application.
- B. Mask or otherwise protect adjoining exposed surfaces from being stained, spotted, or coated with dampproofing. Prevent dampproofing materials from entering and clogging weep holes and drains.

- C. Clean substrates of projections and substances detrimental to dampproofing work; fill voids, seal joints, and remove bond breakers if any.
- D. Apply patching compound to patch and fill tie holes, honeycombs, reveals, and other imperfections; cover with asphalt-coated glass fabric as recommended by dampproofing manufacturer.

### **3.3 APPLICATION, GENERAL**

- A. Comply with manufacturer's written instructions for dampproofing application, cure time between coats, and drying time before backfilling unless otherwise indicated.
  - 1. Apply dampproofing to provide continuous plane of protection.
  - 2. Apply additional coats if recommended in writing by manufacturer or to achieve a smooth surface and uninterrupted coverage.
- B. Application: Apply dampproofing to the following surfaces.
  - 1. Exterior, below-grade surfaces of foundation walls in contact with earth.
- C. Where dampproofing footings and foundation walls, apply from finished-grade line to top of footing; extend over top of footing and down a minimum of 6 inches over outside face of footing; unless otherwise indicated on Drawings.
  - 1. Install corner protection stripping at internal and external corners, changes in plane, construction joints, cracks, and where indicated as "reinforced," by embedding an 8-inch-wide strip of asphalt-coated glass fabric in a heavy coat of dampproofing. Dampproofing coat for embedding fabric is in addition to other coats required.

### **3.4 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING**

- A. Concrete Foundations: Apply two brush or spray coats at not less than 1.5 gal./100 sq. ft. for first coat and 1 gal./100 sq. ft. for second coat or one fibered brush or spray coat at not less than 3 gal./100 sq. ft.

### **3.5 PROTECTION COURSE INSTALLATION**

- A. Install protection course over completed-and-cured dampproofing. Comply with dampproofing-material and protection-course manufacturers' written instructions for attaching protection course.
  - 1. Fan folded, extruded-polystyrene protection board: Support protection course over cured coating with spot application of adhesive type recommended in writing by protection-board manufacturer.
  - 2. Fiberglass or mineral-reinforced-asphaltic protection board: Install protection course on same day of dampproofing installation (while coating is tacky) to ensure adhesion.

### **3.6 PROTECTION**

- A. Correct dampproofing that does not comply with requirements; repair substrates, and reapply dampproofing.

**END OF SECTION 07 1113**



## **SECTION 07 1900 – WATER REPELLENTS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Penetrating hardener/densifier with water repellents and salt protection (sealer).

#### **1.3 PREINSTALLATION MEETINGS**

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

#### **1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of water repellent.
  - 1. Include manufacturer's printed statement of VOC content.
  - 2. Include manufacturer's recommended number of coats for each type of substrate and spreading rate for each separate coat.

#### **1.5 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer.
- B. Product Certificates: For each type of water repellent.
- C. Field quality-control reports.
- D. Warranty: Sample of special warranty.

#### **1.6 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than 5 years of documented experience.
- B. Installer/Applicator Qualifications: A firm experienced in applying water repellents similar in material, design, and extent to that indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.
  - 1. With at least 5 years of documented experience.
- C. Mockups: Prepare mockups of each required water repellent on each type of substrate required to demonstrate aesthetic effects, and to set quality standards for materials and execution.
  - 1. Locate mockups on concrete sample panels or on surfaces where directed by Architect; include both horizontal slab application and vertical wall application.
    - a. Size: 10 sq. ft. each.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

## **1.7 FIELD CONDITIONS**

- A. Weather Limitations: Proceed with application only when existing and forecasted weather conditions permit water repellent application to be performed according to manufacturer's written instructions.
- B. Ambient Conditions: Proceed with water repellent application only if temperature is maintained at 40 deg F or above during work and cure period, and space is well ventilated and kept free of water.
- C. Proceed with water repellent application only if substrate is not frozen and substrate-surface temperature is above 40 deg F and below 95 deg F.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. Performance: Water repellents must meet the following performance requirements as determined by testing on manufacturer's standard substrates representing those indicated for this Project.
- B. Water Absorption: Minimum 80 percent reduction of water absorption after 24 hours for treated compared to untreated specimens when tested according to the following:
  1. Cast-in-Place Concrete: ASTM C642.
- C. Water-Vapor Transmission: Comply with the following:
  1. Minimum 80 percent water-vapor transmission of treated compared to untreated specimens, in accordance with ASTM D1653.
- D. Water Penetration and Leakage through Masonry: Minimum 90 percent reduction in leakage rate of treated compared to untreated specimens, in accordance with ASTM E514.
- E. Durability: Maximum 5 percent loss of water-repellent performance after 2500 hours of weathering in accordance with ASTM G154 compared to water-repellent-treated specimens before weathering.
- F. Chloride-Ion Intrusion in Concrete: NCHRP Report 244, Series II tests.
  1. Reduction of Water Absorption: 80 percent.
  2. Reduction in Chloride Content: 80 percent.

### **2.2 WATER REPELLENTS**

- A. Penetrating Hardener/Densifier with Water Repellents and Salt Protection for Horizontal Traffic Surfaces (Sealer):
  1. Drawing DesignationL CONC-01

2. For Concrete Mixes with Type 1 Portland Cement:
  - a. Concrete Hardener/Densifier (Sealer) with Salt Protection Additive: Penetrating liquid floor treatment. Clear, chemically reactive, waterborne solution of silicates and proprietary components; that penetrates, hardens, and densifies concrete surfaces. Includes water-based silane/siloxane chloride screening and water repellent additive for salt and moisture protection.
    - 1) Products: Subject to Compliance with requirements, provide Prosoco, Inc.; Consolideck LS/CS with 244 Salt Screen Additive: [www.prosoco.com](http://www.prosoco.com), or a comparable product(s) from one of the following:
      - a) Or approved equal.
3. For Concrete Mixes with Type 1L Blended Hydraulic Cement:
  - a. Concrete Hardener/Densifier (Sealer) with Salt Protection Additive: Penetrating liquid floor treatment. Clear, chemically reactive, waterborne solution of silicates and proprietary components; that penetrates, hardens, and densifies concrete surfaces. Includes water-based silane/siloxane chloride screening and water repellent additive for salt and moisture protection.
    - 1) Products: Subject to Compliance with requirements, provide Prosoco, Inc.; Consolideck BD1 with 244 Salt Screen Additive: [www.prosoco.com](http://www.prosoco.com), or a comparable product(s) from one of the following:
      - a) Or approved equal.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Applicator present, for suitable conditions where water repellent is to be applied.
  1. Verify that surfaces are clean and dry in accordance with water repellent manufacturer's requirements. Check moisture content in three representative locations by method recommended by manufacturer.
  2. Verify that there is no efflorescence or other removable residues that would be trapped beneath the application of water repellent.
- B. Test pH level in accordance with water repellent manufacturer's written instructions to ensure chemical bond to silica-containing or siliceous minerals.
- C. Proceed with application only after unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- A. Comply with water repellent manufacturer's written instructions.
- B. New Construction and Repairs: Allow concrete and other cementitious materials to age before application of water repellent, in accordance with repellent manufacturer's written instructions.

- C. Cleaning: Before application of water repellent, clean substrate of substances that could impair penetration or performance of product in accordance with water-repellent manufacturer's written instructions and as follows:
  - 1. Cast-in-Place Concrete and Concrete Unit Masonry: Remove oil, curing compounds, laitance, and other substances that inhibit penetration or performance of water repellents in accordance with ASTM E1857.
- D. Protect adjoining work, including mortar and sealant bond surfaces, from spillage or blow-over of water repellent. Cover adjoining and nearby surfaces of aluminum and glass if there is the possibility of water repellent being deposited on surfaces. Cover live vegetation.
- E. Coordination with Sealant Joints: Do not apply water repellent until sealants for joints adjacent to surfaces receiving water-repellent treatment have been installed and cured.
  - 1. Water-repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those required.

### **3.3 APPLICATION OF WATER REPELLENTS**

- A. Comply with water repellent manufacturer's written instructions.
- B. Apply coating of water repellent on surfaces to be treated using low pressure spray with a fan-type spray nozzle, roller, or brush the point of saturation. Apply coating in dual passes of uniform, overlapping strokes. Remove excess material; do not allow material to puddle beyond saturation. Comply with manufacturer's written instructions for application procedure unless otherwise indicated.

### **3.4 FIELD QUALITY CONTROL**

- A. Testing of Water-Repellent Material: Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when water repellent is being applied:
  - 1. Owner will engage the services of a qualified testing agency to sample water-repellent material being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
  - 2. Testing agency will perform tests for compliance of water-repellent material with product requirements.
  - 3. Owner may direct Contractor to stop applying water repellents if test results show material being used does not comply with product requirements. Contractor to remove noncomplying material from Project site, pay for testing, and correct deficiency of surfaces treated with rejected materials, as approved by Architect.
- B. Coverage Test: In the presence of Architect, hose down a dry, repellent-treated surface to verify complete and uniform product application. A change in surface color will indicate incomplete application.
  - 1. Notify Architect seven days in advance of the dates and times when surfaces will be tested.
  - 2. Reapply water repellent until coverage test indicates complete coverage in accordance with water repellent manufacturer's instructions.
- C. Prepare test and inspection reports.

### **3.5 CLEANING**

- A. Immediately clean water repellent from adjoining surfaces and surfaces soiled or damaged by water-repellent application as work progresses. Correct damage to work of other trades caused by water-repellent application, as approved by Architect.

- B. Comply with manufacturer's written cleaning instructions.

### **3.6 PROTECTION AND REPAIR**

- A. Protect water repellents from damage and wear during remainder of construction period.

**END OF SECTION 07 1900**

## **SECTION 07 2100 - THERMAL INSULATION**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Board insulation.
  - 2. Blanket insulation.

#### **1.3 ACTION SUBMITTALS**

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

#### **1.4 INFORMATIONAL SUBMITTALS**

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

#### **1.5 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with not less than 5 years of documented experience.
- B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer, with not less than 5 years of documented experience.

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

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect foam-plastic board insulation as follows:
  - 1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
  - 2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
  - 3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

## **PART 2 - PRODUCTS**

### **2.1 BOARD INSULATION - EXTRUDED POLYSTYRENE FOAM-PLASTIC**

- A. Extruded Polystyrene (XPS) Insulation Board - Cavity Walls: Complies with ASTM C578, and manufactured using carbon black technology.
1. Type and Compressive Resistance: Type IV, 25 psi, minimum.
  2. Thermal Resistance, R-value: 5.6, minimum, per 1 inch thickness at 75 degrees F mean temperature.
    - a. Labeling: Provide identification mark indicating R-value of each piece of insulation 12 inches and wider in width.
  3. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
  4. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
  5. Water Absorption: 0.3 percent by volume, maximum, by total immersion.
  6. Board Size: 16 inch by 96 inch at brick ties; 48 inch by 96 inch at other locations.
  7. Board Thickness: 3 inch, unless otherwise indicated.
  8. Board Edges: Square.
  9. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dow Chemical Company; Styrofoam Cavtymate Ultra: [www.dow.com/en-us/building](http://www.dow.com/en-us/building).
    - b. Owens Corning; Foamular High-R CW Plus: [www.owenscorning.com](http://www.owenscorning.com).
- B. Extruded Polystyrene Board Insulation - All Other Locations: Type IV: ASTM C578, Type IV, 25-psi minimum compressive strength; unfaced.
1. Thermal Resistance, R-value: 5, minimum, per 1 inch thickness at 75 degrees F mean temperature.
    - a. Labeling: Provide identification mark indicating R-value of each piece of insulation 12 inches and wider in width.
  2. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.
  3. Smoke-Developed Index: Not more than 450 when tested in accordance with ASTM E84.
  4. Water Absorption: 0.3 percent by volume, maximum, by total immersion.
  5. Board Size: 48 inch by 96 inch.
  6. Board Thickness: 2.0 inch, unless otherwise indicated.
  7. Board Edges: Square.
  8. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dow Building Solutions, Dow Chemical Company/DuPont; Styrofoam Brand Square Edge Insulation: [www.dow.com](http://www.dow.com).
    - b. Owens Corning; Foamular 250: [www.owenscorning.com](http://www.owenscorning.com).

### **2.2 BLANKET INSULATION - MINERAL-WOOL**

- A. Mineral-Wool Blanket Insulation, Unfaced: ASTM C665, Type I (blankets without membrane facing); consisting of fibers; passing ASTM E136 for combustion characteristics.
1. Flame-Spread Index: Not more than 0 when tested in accordance with ASTM E84.
  2. Smoke-Developed Index: Not more than 0 when tested in accordance with ASTM E84.
  3. Density: 2.5 pcf, minimum.
  4. Thermal Resistance: R-value of 3.7 per inch.
    - a. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.

5. Thickness: As indicated on Drawings.
6. Products: Subject to compliance with requirements, provide one of the following:
  - a. Johns Manville; Mineral Wool Sound Attenuation Fire Batts (SAFB): [www.jm.com](http://www.jm.com).
  - b. Rockwool; Comfortbatt: [www.rockwool.com](http://www.rockwool.com).
  - c. Thermafiber Inc., an Owens Corning Company; UltraBatt: [www.owenscorning.com](http://www.owenscorning.com).

## **2.3 INSULATION FASTENERS**

- A. Metal Straps and Retainers: As standard with insulation manufacturer; non-corrosive.
- B. Insulation Adhesive: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.
  1. Provide type recommended by insulation manufacturer for application

## **2.4 ACCESSORIES**

- A. Wire Mesh: Galvanized steel, hexagonal wire mesh.
- B. Foam Sealant: Single-component spray polyurethane insulating foam sealant.
  1. Gun-applied.
  2. Expands to fill gaps up to 3 inches.
  3. Closed Cell Content: 70 percent, minimum; ASTM D2856.
  4. Flammability: ASTM E84.
    - a. Flame-spread Index: 25, maximum.
    - b. Smoke-developed Index: 450, maximum.
  5. Thermal Resistance (R) Value: 4 per inch; ASTM C518.
  6. Air Permeance: 0.001 cfm per sq ft at 6.24psf at 1 inch, maximum; ASTM E2178.
  7. Product: Subject to compliance with requirements, provide one of the following:
    - a. Dow Building Solutions, Dow Chemical Company/DuPont; GreatStuff Pro Gaps & Cracks Sealant: [www.dow.com](http://www.dow.com).
    - b. Owens Corning Corporation; ProPink ComfortSeal Gun Foam: [www.owenscorning.com](http://www.owenscorning.com).

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

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

### **3.2 INSTALLATION, GENERAL**

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Install insulation with manufacturer's R-value label exposed after insulation is installed.
- D. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and penetration, and fill voids with insulation. Remove projections that interfere with placement.



- E. Insulation shall be installed continuously without gaps.
- F. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

### **3.3 INSTALLATION OF SLAB AND FOUNDATION INSULATION**

- A. On horizontal surfaces, loosely lay board insulation according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.
  - 1. If not otherwise indicated, extend insulation a minimum of 24 inches in from exterior walls.
- B. On vertical slab edge and foundation surfaces, set insulation board using manufacturer's recommended adhesive according to manufacturer's written instructions.
  - 1. If not otherwise indicated, extend insulation a minimum of 24 inches below exterior grade line.

### **3.4 INSTALLATION OF CAVITY-WALL INSULATION**

- A. Board Insulation:
  - 1. Masonry Cavity Walls:
    - a. Adhere cavity wall insulation to substrates.
      - 1) Place small dabs of adhesive, spaced approximately 12 inches o.c. both ways, on inside face of insulation boards.
      - 2) Press units firmly against inside wythe of masonry or other construction as shown.
    - b. Install boards horizontally on walls.
      - 1) Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions, and with faces flush.
      - 2) Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.
      - 3) Install in running bond pattern.
    - c. Extend boards over expansion joints, unbonded to wall on one side of joint.
    - d. Foam Sealant:
      - 1) Apply formed-in-place foam sealant in accordance with manufacturer's instructions at the following locations:
        - a) Joints between boards.
        - b) Between boards and abutting adjacent construction.
        - c) Between boards and penetrating items.
      - 2) Foam sealant shall be installed continuously without breaks or gaps.
      - 3) When complete, board insulation installation shall be continuous without holes or air gaps, including penetrations, joints, and perimeter.
    - e. Soffits and overhead insulation installation is similar.

### **3.5 INSTALLATION OF INSULATION AT Z-SHAPED FURRING**

A. Board Insulation at Z-Shaped Furring Members:

1. Erect board insulation vertically, unless otherwise indicated, and hold in place with Z-shaped furring members spaced 24 inches o.c.
  - a. Refer to Section 05 4000 – Cold-formed Metal Framing, for Z-shaped furring.
2. Foam Sealant:
  - a. Apply formed-in-place foam sealant in accordance with manufacturer's instructions at the following locations:
    - 1) Joints between boards.
    - 2) Between boards and abutting adjacent construction.
    - 3) Between boards and penetrating items.
  - b. Foam sealant shall be installed continuously without breaks or gaps.
  - c. When complete, board insulation installation shall be continuous without holes or air gaps, including penetrations, joints, and perimeter.

### **3.6 INSULATION AT MISCELLANEOUS VOIDS**

- A. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using one or more of the following materials:
1. Mineral-wool blanket insulation.
  2. Foam sealant.
- B. Install insulation to neatly fit spaces; fill voids completely without compressing insulation.

### **3.7 FIELD QUALITY CONTROL**

- A. Inspection: Architect shall inspect board insulation installations at cavity walls. Inspection will include the following:
1. Verification that board insulation installation is continuous without holes or air gaps, including penetrations, joints, and perimeter.
  2. Verification that insulation joints are sealed tightly with continuous foam sealant without any gaps.
  3. Verification that insulation seals tightly around penetrations and against adjacent materials without any gaps.
- B. Do not cover installed insulation until inspections have been completed.
- C. Deficiencies shall be corrected by the Contractor at no additional cost to the Owner.

### **3.8 PROTECTION**

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

**END OF SECTION 07 2100**

## **SECTION 07 2700 – FLUID-APPLIED MEMBRANE AIR BARRIERS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Vapor-permeable, fluid-applied air barriers.

#### **1.3 DEFINITIONS**

- A. Air Barrier: Airtight barrier made of material that is relatively air impermeable but water vapor permeable, both to the degree specified, with sealed seams and with sealed joints to adjacent surfaces. Note: For the purposes of this specification, vapor impermeable air barriers are classified as vapor retarders.
- B. Vapor Retarder: Airtight barrier made of material that is relatively water vapor impermeable, to the degree specified, with sealed seams and with sealed joints to adjacent surfaces.
- C. Water Vapor Permeance: For purposes of conversion,  $57.2 \text{ ng}/(\text{Pa s sq m}) = 1 \text{ perm}$ .
  - 1. Vapor Retarder (Barrier): Has water vapor permeance of 0.1 perms maximum.
  - 2. Vapor Permeable: Has water vapor permeance of 1 perms or greater.
- D. Water Barrier: Water-shedding barrier made of material that is moisture resistant, to the degree specified, intended to be installed to shed water without sealed seams.

#### **1.4 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review air-barrier requirements and installation, special details, mockups, air-leakage and bond testing, air-barrier protection, and work scheduling that covers air barriers.

#### **1.5 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include manufacturer's written instructions for evaluating, preparing, and treating each substrate; technical data; dry film thickness; and tested physical and performance properties of products.
- B. Shop Drawings: For air-barrier assemblies.
  - 1. Show locations and extent of air-barrier materials, accessories, and assemblies specific to Project conditions.
  - 2. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
  - 3. Include details of interfaces with other materials that form part of air barrier.

## **1.6 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer and manufacturer.
- B. Product Certificates: From air-barrier manufacturer, certifying compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with the barrier.
- C. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.
- D. Field quality-control reports.

## **1.7 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with not less than 5 years of documented experience.
- B. Applicator Qualifications: Company specializing in performing work of the type specified, with minimum 5 years of documented experience and as follows:
  - 1. Applicator shall be approved or certified by the air barrier manufacturer.
  - 2. Applicator shall be an accredited installer under the Air Barrier Association of America's (ABAA) Quality Assurance Program and employ certified and registered installers.
- C. Mockups: Build mockups to set quality standards for materials and execution.
  - 1. Build integrated mockups of exterior wall assembly as indicated on Drawings, approximately 4 feet long by 8 feet wide, incorporating backup wall construction, external cladding, window, storefront, door frame and sill, insulation, ties and other penetrations, and flashing to demonstrate surface preparation, crack and joint treatment, application of air barriers, and sealing of gaps, terminations, and penetrations of air-barrier assembly.
    - a. Include junction with roofing membrane, building corner condition, and foundation wall intersection.
    - b. If Architect determines mockups do not comply with requirements, reconstruct mockups and apply air barrier until mockups are approved.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

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

- A. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- B. Protect stored materials from direct sunlight.

## **1.9 FIELD CONDITIONS**

- A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended in writing by air-barrier manufacturer.
  - 1. Protect substrates from environmental conditions that affect air-barrier performance.
  - 2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Source Limitations: Obtain primary air-barrier materials and air-barrier accessories from single source from single manufacturer.

### **2.2 PERFORMANCE REQUIREMENTS**

- A. Air-Barrier Performance:
1. Air-barrier assembly and seals with adjacent construction shall be capable of performing as a continuous air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, tie-ins to installed waterproofing, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.
  2. Provide an air barrier assembly that withstands combined positive and negative design wind, fan, and stack pressures on the envelope without damage or displacement, that transfers the load to the structure, and that does not displace adjacent materials under full load. Join air barrier system materials in an airtight and flexible manner to adjacent assemblies, allowing for the relative movement of assemblies due to thermal and moisture variations and creep, and anticipated seismic movement.
- B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft., when tested according to ASTM E2357.

### **2.3 AIR BARRIER MATERIALS - VAPOR PERMEABLE AIR BARRIER**

- A. Vapor Permeable Air Barrier Membrane, Fluid-Applied: Synthetic polymer membrane with an installed dry film thickness, according to manufacturer's written instructions, of 35 mils (0.9 mm) or thicker.
1. Physical and Performance Properties:
    - a. Dry Film Thickness: As recommended by weather barrier manufacturer.
    - a. Water Penetration: No water penetration at 6.24 psf per ASTM E331.
    - b. Water Vapor Permeance: 15 perms, maximum; ASTM E96/E96M, Method B.
    - c. Air Permeance: 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft.; ASTM E2178.
    - d. Elongation: 250 percent, minimum; ASTM D412.
    - e. Tensile Strength: 100 psi, minimum; ASTM D412.
    - f. Flame Spread Index: Less than 25, Class A; ASTM E84.
    - g. Smoke Developed Index: Less than 450, Class A; ASTM E84.
    - h. Nail Sealability: Pass, no leakage; ASTM D1970/D1970M.
  2. Products: Subject to compliance with requirements, provide one of the following:
    - a. BASF; MasterSeal AWB 660: [www.master-builders-solutions.basf.us](http://www.master-builders-solutions.basf.us)
    - b. Carlisle Coatings & Waterproofing; Fire Resist Barritech VP: [www.carlisleccw.com](http://www.carlisleccw.com).
    - c. GCP Applied Technologies; Perm-a-Barrier VPL: [www.gcpat.com](http://www.gcpat.com).
    - d. Henry Company; Air-Bloc 17MR: [www.henry.com](http://www.henry.com).
    - e. Polyguard; Airluk Flex VP: [www.polyguardproducts.com](http://www.polyguardproducts.com).
    - f. Prosoco Inc.; R-Guard Spray Wrap MVP: [www.prosoco.com](http://www.prosoco.com).
    - g. Sto Corp.; StoGuard AirSeal: [www.stocorp.com](http://www.stocorp.com).
    - h. Tremco Inc.; EXOAIR 230: [www.tremcosealants.com](http://www.tremcosealants.com).
    - i. W.R. Meadows; Air-Shield LMP: [www.wrmeadows.com](http://www.wrmeadows.com).

## 2.4 ACCESSORY MATERIALS

- A. Requirement: Provide primers, transition strips, termination strips, joint reinforcing fabric and strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by air-barrier manufacturer to produce a complete air-barrier assembly and that are compatible with primary air-barrier material and adjacent construction to which they may seal.
- B. Primer: Liquid primer recommended for substrate by air-barrier material manufacturer.
- C. Transitions and Flashings:
  - 1. General:
    - a. Products shall be compatible with air barrier and approved by the air barrier manufacturer.
    - b. Maintain the continuity of the air and water barrier as it transitions to adjacent materials.
    - c. Materials shall be compatible with adjacent materials.
  - 2. Liquid-Applied Flashings and Sealants:
    - a. Non-asphaltic product: one part, fast curing, non-sag, elastomeric, gun grade, trowelable liquid flashing.
    - b. Products: Subject to compliance with requirements, available products include, but are not limited to, the following:
      - 1) The Dow Chemical Company; Dowsil 758 Silicone Weather Barrier Sealant: [www.dow.com](http://www.dow.com).
      - 2) Momentive Performance Materials, Inc./GE; Elemax 5000 Liquid Flashing: [www.siliconeforbuilding.com](http://www.siliconeforbuilding.com).
      - 3) Prosoco Inc.; R-Guard FastFlash: [www.prosoco.com](http://www.prosoco.com).
      - 4) Tremco, Inc.; Spectrem 1: [www.tremcosealants.com](http://www.tremcosealants.com).
  - 3. Silicone Sheet Transitions:
    - a. Pre-cured silicone rubber sheets and pre-molded corners.
    - b. Install using liquid-applied flashings and sealants as an adhesive.
    - c. Products: Subject to compliance with requirements, available products include, but are not limited to, the following:
      - 1) The Dow Chemical Company; Dowsil Silicone Transition Strip: [www.dow.com](http://www.dow.com).
      - 2) Momentive Performance Materials, Inc./GE; UltraSpan UST/USM Pre-Cured Silicone Transition Sheet and Molded Corners: [www.siliconeforbuilding.com](http://www.siliconeforbuilding.com).
      - 3) Prosoco Inc.; R-Guard SureSpan EX: [www.prosoco.com](http://www.prosoco.com).
      - 4) Tremco, Inc.; ProGlaze ETA and Spectrem Simple Seal: [www.tremcosealants.com](http://www.tremcosealants.com).
  - 4. Flexible Fabric Flashing - Self-Adhering: Self-adhering stainless steel/polymer fabric flashing. ASTM A240/A240M stainless steel sheet bonded with rubber-based adhesive to one sheet of polymer fabric. Flashing shall be self-adhering using a pressure-sensitive adhesive.
    - a. Type 304 stainless steel.
      - 1) Thickness: 2 mils, minimum.
    - b. Products: Subject to compliance with requirements, available products include, but are not limited to, the following:
      - 1) York Manufacturing, Inc.; York 304: [www.yorkmfg.com](http://www.yorkmfg.com).

- 2) Momentive Performance Materials, Inc./GE; GE Elemax SS Flashing: [www.siliconeforbuilding.com](http://www.siliconeforbuilding.com).
5. Flexible Fabric Flashing: Stainless steel/polymer fabric flashing. ASTM A240/A240M stainless steel sheet bonded with rubber-based adhesive to one sheet of polymer fabric.
  - a. Type 304 stainless steel.
    - 1) Thickness: 2 mils, minimum.
  - b. Products: Subject to compliance with requirements, available products include, but are not limited to, the following:
    - 1) York Manufacturing, Inc.; Multi-Flash SS: [www.yorkmfg.com](http://www.yorkmfg.com):
    - 2) Prosoco Inc.; R-Guard SS ThruWall: [www.prosoco.com](http://www.prosoco.com).
6. Metal Flashings:
  - a. Stainless-steel sheet: ASTM A666 or ASTM A240/A240M, Type 304, 0.025 inch (24 gage) thick, minimum; smooth 2D (dull cold-rolled) finish.
    - 1) Fasteners: Stainless steel.
  - b. Comply with SMACNA (ASMM) requirements and standard details, except as otherwise indicated.
- D. Sealants: Provide non-sag, single component, silicone sealants compatible with air barrier and approved by the air barrier manufacturer.
- E. Miscellaneous Accessories:
  1. As recommended by air barrier manufacturer.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
  1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
  2. Verify that substrates have cured and aged for minimum time recommended in writing by air-barrier manufacturer.
  3. Verify that substrates are visibly dry and free of moisture. Test concrete substrates for capillary moisture by plastic sheet method according to ASTM D4263.
  4. Verify that masonry joints are tooled slightly concave or cut flush and completely filled with mortar; as recommended by air barrier manufacturer.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 SURFACE PREPARATION**

- A. Clean, prepare, treat, fill, and seal substrate and joints and cracks in substrate according to manufacturer's written instructions and details. Provide clean, dust-free, and dry substrate for air-barrier application.

- B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.
- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching material.
- E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.
- F. Prepare static gaps and joints as recommended by air barrier manufacturer and as indicated on Drawings.
- G. Coordinate with isolation joints, expansion joints and discontinuous wall-to-wall, deck-to-wall, and deck-to-deck joint transitions; detail as recommended by air barrier manufacturer and as indicated on Drawings.
- H. Install transitions and flashings around corners of openings, around penetrations, and elsewhere as recommended by air barrier manufacturer and as indicated on Drawings.
  - 1. Use silicone sheet transitions and pre-molded corners adhered with liquid-applied flashings and sealants except where flexible fabric flashings or metal flashings are indicated on Drawings or recommended by air barrier manufacturer.
- I. Coordinate detailing of transitions to other materials in order to maintain a continuous air and water barrier.
  - 1. Ensure that transition materials are compatible with adjacent materials and substrates.

### **3.3 ACCESSORIES INSTALLATION**

- A. Install accessory materials according to air-barrier manufacturer's written instructions and details to form a seal with adjacent construction and ensure continuity of air and water barrier.
- B. Connect and seal exterior wall air-barrier material continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.
- C. Ensure that all transitions, bridging of gaps and joints, corners, flashings, penetrations, and terminations are completed in accordance with the recommendations of the air barrier manufacturer and as indicated on Drawings
- D. Repair punctures, voids, and deficient lapped seams. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches beyond repaired areas.

### **3.4 PRIMARY AIR-BARRIER MATERIAL INSTALLATION**

- A. Apply air-barrier material to form a seal with strips and transition strips and to achieve a continuous air barrier according to air-barrier manufacturer's written instructions and details. Apply air-barrier material within manufacturer's recommended application temperature ranges.
  - 1. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
  - 2. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.
  - 3. Where multiple prime coats are needed to achieve required bond, allow adequate drying time between coats.



- B. Air Barriers: Apply continuous unbroken air-barrier material to substrates according to air barrier manufacturer's written instructions and details.
  - 1. Apply air-barrier material in full contact around protrusions such as masonry ties.
- C. Do not cover air barrier until it has been tested and inspected by testing agency.
- D. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

### **3.5 FIELD QUALITY CONTROL**

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements. Inspections may include the following:
  - 1. Verification of substrate preparations. Do not cover until inspections are complete
    - a. Includes, but is not limited to, the following:
      - 1) Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
      - 2) Continuous structural support of air-barrier system has been provided.
      - 3) Surfaces have been primed, if applicable.
  - 2. Verification that transitions and flashing details are installed properly. Do not cover until inspections are complete.
    - a. Laps in transition membranes shall comply with minimum requirements and be shingled in the correct direction, or mastic has been applied on exposed edges, with no fishmouths.
    - b. Transition membranes are firmly adhered to substrate.
  - 3. Site conditions for application temperature and dryness of substrates have been maintained.
  - 4. Maximum exposure time of materials to UV deterioration has not been exceeded.
  - 5. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
  - 6. Compatible materials have been used.
  - 7. All penetrations have been sealed.
- C. Tests: Provide the following:
  - 1. Membrane Adhesion Test:
    - a. Test materials for a minimum air-barrier adhesion of 16 lbf/sq. in. or to manufacturer's minimum adhesion level per substrates, whichever is greater in accordance with ABAA 0002 "Standard Test Method for Pull-off Strength of Adhered Air and Water Resistive Barriers Using an Adhesion Tester".
    - b. Perform test after curing period recommended by the manufacturer.
    - c. Record mode of failure and area which failed in accordance with test standard.
    - d. Test Locations: Once daily per substrate during installation and a minimum of 3 tests per major elevation per substrate.
    - e. Provide inspection report.

2. Dry Film Thickness Test:

- a. Test material in accordance with manufacturer's requirements to confirm that cured membrane meets manufacturer's indicated dry film thickness requirements.
- b. Three 1 inch by 4 inch samples removed from separate areas; at gypsum substrates, remove with gypsum facer intact to avoid stretching membrane.
- c. Test Locations:
  - 1) 6 tests distributed uniformly across elevations.
- d. Failure Criteria:
  - 1) A measurement less than manufacturer's required dry film thickness is considered a failure.
- e. Provide inspection report indicating results and include photo documentation.

D. Air barriers will be considered defective if they do not pass tests and inspections.

1. Contractor shall correct failures at no additional cost to Owner.
2. Upon failure of Adhesion Testing:
  - a. Determine cause of failure.
  - b. Provide one additional test for each occurrence of failure.
  - c. Repair deficient air barrier components per manufacturer's recommendations.
  - d. Repair tested areas per manufacturer's recommendations.
3. Upon failure of Dry Film Testing:
  - a. Determine cause of failure.
  - b. Provide one additional test for each occurrence of failure.
  - c. Repair deficient air barrier components per manufacturer's recommendations.
  - d. Repair tested areas per manufacturer's recommendations.

E. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

F. Prepare test and inspection reports.

**3.6 CLEANING AND PROTECTION**

- A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.
  1. Where applicable, protect air barrier from exposure to UV light and harmful weather exposure as recommended in writing by manufacturer. If exposed to these conditions for longer than recommended, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed materials according to air-barrier manufacturer's written instructions.
  2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.
- B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

- C. Remove masking materials after installation.

**END OF SECTION 07 2700**

## **SECTION 07 4113 – METAL ROOF PANELS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Standing-seam metal roof panels.
  - 2. Snow guards.

#### **1.3 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Meet with Owner, Architect, Owner's insurer if applicable, metal panel Installer, metal panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal panels, including installers of roof accessories and roof-mounted equipment.
  - 2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  - 3. Review methods and procedures related to metal panel installation, including manufacturer's written instructions.
  - 4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
  - 5. Review structural loading limitations of deck during and after roofing.
  - 6. Review flashings, special details, drainage, penetrations, equipment curbs, and condition of other construction that affect metal panels.
  - 7. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
  - 8. Review temporary protection requirements for metal panel systems during and after installation.
  - 9. Review procedures for repair of metal panels damaged after installation.
  - 10. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

#### **1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
- B. Shop Drawings:
  - 1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
  - 2. Accessories: Include details of the flashing, trim, and anchorage systems.
  - 3. Snow Guards: Submit design calculations for loadings and spacings based on manufacturer testing.
- C. Samples for Initial Selection: For each type of metal panel indicated with factory-applied color finishes.
  - 1. Include similar Samples of trim and accessories involving color selection.

- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.
  - 1. Metal Panels: 12 inches long by actual panel width. Include clips, fasteners, closures, and other metal panel accessories.
  - 2. Snow Guards: 12 inches long. Include clamps.

#### **1.5 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer and manufacturer.
- B. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- C. Field quality-control reports.
- D. Sample Warranties: For special warranties.

#### **1.6 CLOSEOUT SUBMITTALS**

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

#### **1.7 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing roof panel systems specified in this section; with not less than five years of documented experience.
- B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer; with minimum five years of documented experience.
- C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
  - 1. Build mockup of typical roof area and eave, including fascia, and soffit as shown on Drawings; approximately 10 feet square by full thickness, including attachments, underlayment, and accessories.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

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

- A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on metal panels during installation.

## **1.9 FIELD CONDITIONS**

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

## **1.10 COORDINATION**

- A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.
- B. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

## **1.11 WARRANTY**

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including rupturing, cracking, or puncturing.
    - b. Deterioration of metals and other materials beyond normal weathering.
  - 2. Warranty Period: Five years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Delta E units when tested according to ASTM D2244.
    - b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  - 2. Finish Warranty Period: 20 years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:
  - 1. Wind Loads: As indicated on Drawings.
  - 2. Other Design Loads: As indicated on Drawings.
- B. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E1646 or ASTM E331 at the following test-pressure difference:
  - 1. Test-Pressure Difference: 6.24 lbf/sq. ft.

- C. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.
  - 1. Uplift Rating: UL 90.
- D. Hail Resistance: UL 2218, Class 4
- E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

## 2.2 STANDING-SEAM METAL ROOF PANELS

- A. Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.
  - 1. Steel Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E1514.
  - 2. Aluminum Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E1637.
- B. Vertical-Rib, Snap-Joint, Standing-Seam Metal Roof Panels: Formed with vertical ribs at panel edges and intermediate stiffening ribs symmetrically spaced a flat pan between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels, engaging opposite edge of adjacent panels, and snapping panels together.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Centria; SDP 175: [www.centria.com](http://www.centria.com), or one of the following comparable products:
    - a. AEP Span; Design Span HP: [www.aepspan.com](http://www.aepspan.com).
    - b. Berridge Manufacturing Company; Cee-Lock Panel: [www.berridge.com](http://www.berridge.com).
    - c. Fabral; Thin Seam: [www.fabral.com](http://www.fabral.com).
    - d. Metal Sales Manufacturing Corp.; Vertical Seam: [www.metalsales.us.com](http://www.metalsales.us.com).
    - e. Morin Corp., a Kingspan Group Company; SWL: [www.morincorp.com](http://www.morincorp.com) Petersen Aluminum Corporation; Snap-Clad Panel: [www.pac-clad.com](http://www.pac-clad.com).
    - f. Petersen Aluminum Corporation; Snap-clad Panel: [www.pac-clad.com](http://www.pac-clad.com)
  - 2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755.
    - a. Nominal Thickness: 0.028 inch (22 gage).
    - b. Exterior Finish: High-performance organic finish.
      - 1) Color: Custom color to match Architect's sample.
      - a) Design Intent: Gray.
  - 3. Clips: One-piece fixed to accommodate thermal movement.
    - a. Material: 0.048-inch- (18 gage) nominal thickness, zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet.

4. Panel Coverage: 16 inches.
5. Panel Height: 1.5 inches.

## **2.3 UNDERLAYMENT MATERIALS**

- A. Self-Adhering, High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of 40 mils thick, consisting of slip-resistant, polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing. Provide primer when recommended by underlayment manufacturer.
1. Thermal Stability: Stable after testing at 250 deg F; ASTM D1970.
  2. Water Vapor Permeance: 0.1 perm, maximum, when tested in accordance with ASTM E96 Procedure A (desiccant method)
  3. Manufacturers: Subject to compliance with requirements, provide one of the following products:
    - a. Carlisle WIP Products, a division of Carlisle Construction Materials Inc.; WIP 300HT [www.carlislewipproducts.com](http://www.carlislewipproducts.com).
    - b. Firestone Building Products; Clad-Gard SA Metal Underlayment: [www.firestonebpco.com](http://www.firestonebpco.com).
    - c. GCP Applied Technologies Inc.; Grace Ice & Water Shield HT: [www.gcpat.com](http://www.gcpat.com).
    - d. Henry Company; Blueskin PE200HT : [www.us.henry.com](http://www.us.henry.com).
    - e. Polyguard Products, Inc.; Deckguard HT: [www.polyguardproducts.com](http://www.polyguardproducts.com).
    - f. Soprema, Inc.; Lastobond Shield HT: [www.soprema.us](http://www.soprema.us).
- B. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application.

## **2.4 SNOW GUARDS**

- A. Fence Type Snow Guard: Continuous snow guard; manufacturer's standard fence rail with pre-finished sheet metal insert, set in brackets with snow plates to restrict migration of snow beneath fence.
1. Brackets: Aluminum.
  2. Fence Rail: Manufacturer's standard extruded aluminum fence with insert for pre-finished sheet metal trim.
    - a. Pre-finished Sheet Metal Insert: Of same material and finish as metal roof panels.
  3. Supplemental Plates and Clips: Attached to horizontal component; match finish of fence rail.
  4. Clamps for Standing Seam Roof: Aluminum clamps attached to standing seams of roof panels; for attachment of fence type snow guard.
    - a. Seam Profile: To match profile of metal roof.
    - b. Secure clamps to metal roof with stainless-steel set screws incorporating round nonpenetrating point.
  5. Finish: Mill finish.
  6. Manufacturers: Subject to compliance with requirements, provide one of the following products:
    - a. Ace Clamp, PMC Industries, Inc.; Color Snap A2 Snow Rail System: [www.aceclamp.com](http://www.aceclamp.com).
    - b. Alpine SnowGuards; SimpleGuard Standing Seam Fence-Style Snow Guard: [www.alpinesnowguards.com](http://www.alpinesnowguards.com).
    - c. Metal Roof Innovations, Ltd., S-5! Attachment Solutions; ColorGard 2.0: [www.s-5.com](http://www.s-5.com).
    - d. Substitutions: See Section 01 6000 - Product Requirements.



## **2.5 MISCELLANEOUS MATERIALS**

- A. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
  - 1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal panels.
  - 2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
  - 3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- B. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.
- C. Pipe Boots: Preformed EPDM molded pipe boot flashings with stainless steel drawband clamp.
- D. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
  - 1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
  - 2. Joint Sealant: ASTM C920; elastomeric silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
  - 3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

## **2.6 FABRICATION**

- A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- C. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- D. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
  - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
  - 2. Seams: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
  - 3. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
  - 4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.

5. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
  - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal panel manufacturer for application, but not less than thickness of metal being secured.

## **2.7 FINISHES**

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Steel Panels and Accessories:
  1. High-Performance Organic Finish, Two or three-Coat PVDF: Fluoropolymer finish, with suspended mica or metallic flakes as required for selected color, containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in both color coats and clear topcoat.
    - a. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
  1. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.
- B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION OF UNDERLAYMENT**

- A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply, wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.
  1. Apply over the entire roof surface.
- B. Slip Sheet: When recommended by metal roof panel manufacturer, apply slip sheet over underlayment before installing metal roof panels.

- C. Flashings: Install flashings to cover underlayment to comply with requirements specified in Section 07 6200 "Sheet Metal Flashing and Trim."

### **3.3 INSTALLATION OF STANDING SEAM METAL ROOF PANELS**

- A. Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
  - 1. Shim or otherwise plumb substrates receiving metal panels.
  - 2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
  - 3. Install screw fasteners in predrilled holes.
  - 4. Locate and space fastenings in uniform vertical and horizontal alignment.
  - 5. Install flashing and trim as metal panel work proceeds.
  - 6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
  - 7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
  - 8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.
- B. Fasteners:
  - 1. Steel Panels: Use stainless steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.
- C. Anchor Clips: Anchor metal roof panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.
- D. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.
- E. Standing-Seam Metal Roof Panel Installation: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.
  - 1. Install clips to supports with self-tapping fasteners.
  - 2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
  - 3. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.
- F. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
  - 1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal roof panel manufacturers; or, if not indicated, types recommended by metal roof panel manufacturer.
- G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
  - 1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof and weather-resistant performance.

2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches (610 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).

- H. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.

1. Pipe Boots: Install in accordance with manufacturer's instructions.

### **3.4 SNOW GUARD INSTALLATION**

1. Install snow guards according to manufacturer's written instructions
2. Space rows as recommended by manufacturer.
3. Install brackets to vertical ribs in straight rows.
4. Do not use fasteners that will penetrate metal roofing or fastening methods that void metal roofing finish warranty.
5. Install over all building entries, above sidewalks and other pavement, and elsewhere as indicated on Drawings.

### **3.5 ERECTION TOLERANCES**

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

### **3.6 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect metal roof panel installation, including accessories. Report results in writing.
- B. Remove and replace applications of metal roof panels where tests and inspections indicate that they do not comply with specified requirements.
- C. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.
- D. Prepare test and inspection reports.

### **3.7 CLEANING AND PROTECTION**

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
- B. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

**END OF SECTION 07 4113**

## **SECTION 07 4213 – FORMED METAL WALL PANELS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Formed metal wall panels.

#### **1.3 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Meet with Owner, Architect, metal panel Installer, metal panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal panels, including installers of doors, windows, and louvers.
  - 2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  - 3. Review methods and procedures related to metal panel installation, including manufacturer's written instructions.
  - 4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
  - 5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affect metal panels.
  - 6. Review temporary protection requirements for metal panel assembly during and after installation.
  - 7. Review of procedures for repair of metal panels damaged after installation.
  - 8. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

#### **1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
- B. Shop Drawings:
  - 1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
  - 2. Accessories: Include details of the flashing, trim, and anchorage systems.
- C. Samples for Verification: For each type of exposed finish, prepared on Samples of size indicated below:
  - 1. Metal Panels: 12 inches long by actual panel width. Include fasteners, closures, and other metal panel accessories.

#### **1.5 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For manufacturer and installer.

- B. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- C. Field quality-control reports.
- D. Sample Warranties: For special warranties.

#### **1.6 CLOSEOUT SUBMITTALS**

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

#### **1.7 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least 5 years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least 5 years of documented experience; and trained and approved by manufacturer.
- C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
  - 1. Build mockup of typical metal panel assembly, including corner, supports, attachments, and accessories.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

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

- A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on metal panels during installation.

#### **1.9 FIELD CONDITIONS**

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

#### **1.10 COORDINATION**

- A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

## **1.11 WARRANTY**

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including rupturing, cracking, or puncturing.
    - b. Deterioration of metals and other materials beyond normal weathering.
  - 2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Delta E units when tested according to ASTM D2244.
    - b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  - 2. Finish Warranty Period: 20 years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:
  - 1. Wind Loads: As indicated on Drawings.
  - 2. Other Design Loads: As indicated on Drawings.
  - 3. Deflection Limits: For wind loads, no greater than 1/180 of the span.
- B. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E331 at the following test-pressure difference:
  - 1. Test-Pressure Difference: 6.24 lbf/sq. ft..
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

### **2.2 CONCEALED-FASTENER, LAP-SEAM METAL WALL PANELS**

- A. Provide factory-formed metal panels designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners. Include accessories required for weathertight installation.

- B. Flush-Profile, Concealed-Fastener Metal Wall Panels: Formed with vertical panel edges and a flat pan between panel edges; with flush joint between panels.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Centria; IW-10A: [www.centria.com](http://www.centria.com) or a comparable product by one of the following:
    - a. AEP Span; Flush Panel [www.aepspan.com](http://www.aepspan.com).
    - b. Berridge Manufacturing Company; FW-12: [www.berridge.com](http://www.berridge.com).
    - c. Fabral; 12-RO: [www.fabral.com](http://www.fabral.com).
    - d. Metal Sales Manufacturing Corp.; Flush Face Series-12, TLC-1: [www.metalsales.us.com](http://www.metalsales.us.com).
    - e. Morin Corp., a Kingspan Group Company; Concealed A-12: [www.morincorp.com](http://www.morincorp.com).
    - f. Petersen Aluminum Corporation; Flush Wall Panel: [www.pac-clad.com](http://www.pac-clad.com).
  2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755.
    - a. Nominal Thickness: 0.040 inch (20 gage).
    - b. Exterior Finish: High-performance organic finish.
      - 1) Color: Custom color to match Architect's sample.
        - a) Design Intent: Gray.
  3. Panel Coverage: 12 inches.
  4. Panel Depth: 1 to 1-1/2 inches.

## 2.3 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 (Z275 hot-dip galvanized) coating designation or ASTM A792, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
- C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers.
  1. Finish flashing and trim with same finish system as adjacent metal panels.
- D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.
- E. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

## 2.4 FABRICATION

- A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.



- B. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
  - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
  - 2. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
  - 3. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
  - 4. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
    - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

## 2.5 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. For Panels, Trim, Flashings, and Accessories:
  - 1. Exposed Finish: High-Performance Organic Finish:
    - a. Two or three-Coat PVDF: AAMA 2605. Fluoropolymer finish, with suspended mica or metallic flakes as required for selected color, containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in both color coats and clear topcoat.
      - 1) Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions
  - 2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
  - 1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal wall panel manufacturer.
- B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.

### **3.3 INSTALLATION**

- A. Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
  - 1. Shim or otherwise plumb substrates receiving metal panels.
  - 2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
  - 3. Install screw fasteners in predrilled holes.
  - 4. Locate and space fastenings in uniform vertical and horizontal alignment.
  - 5. Install flashing and trim as metal panel work proceeds.
  - 6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
  - 7. Align metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
  - 8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.
- B. Fasteners:
  - 1. Steel Panels: Use stainless steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.
- C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.
- D. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.
  - 1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof performance.
  - 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).
- E. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
  - 1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal wall panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.

### **3.4 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect completed metal wall panel installation, including accessories.

- B. Remove and replace metal wall panels where tests and inspections indicate that they do not comply with specified requirements.
- C. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.
- D. Prepare test and inspection reports.

**3.5 CLEANING AND PROTECTION**

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
- B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

**END OF SECTION 07 4213**

## **SECTION 07 6200 – SHEET METAL FLASHING AND TRIM**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section includes: Formed sheet metal flashing and trim including, but not limited to, the following:
  - 1. Flashings.
  - 2. Counterflashings.
  - 3. Miscellaneous trim, including, but not limited to, the following:
    - a. Metal facias.
  - 4. Other items as indicated on Drawings.

#### **1.3 COORDINATION**

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

#### **1.4 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  - 2. Review special roof details, roof drainage, roof-penetration flashing, equipment curbs, and condition of other construction that affect sheet metal flashing and trim.
  - 3. Review requirements for insurance and certificates if applicable.
  - 4. Review sheet metal flashing observation and repair procedures after flashing installation.

#### **1.5 ACTION SUBMITTALS**

- A. Product Data: For each of the following
  - 1. Sealants.
  - 2. Seam sealer.
- B. Shop Drawings: For sheet metal flashing and trim.
  - 1. Include plans, elevations, sections, and attachment details.
  - 2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled Work.
  - 3. Include identification of material, thickness, weight, and finish for each item and location in Project.
  - 4. Include details for forming, including profiles, shapes, seams, and dimensions.
  - 5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
  - 6. Include details of termination points and assemblies.

7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
  8. Include details of roof-penetration flashing.
  9. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, flashings, and counterflashings.
  10. Include details of special conditions.
  11. Include details of connections to adjoining work.
- C. Samples for Initial Selection: For each type of sheet metal and accessory indicated with factory-applied finishes.
1. Where colors and finishes are not specified, submit 3 sets of color and finish selection charts or chips
- D. Samples for Verification: For each type of exposed finish. Submit at least three samples of each of the following:
1. Sheet Metal Flashing: 12 inches long and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
  2. Trim and Miscellaneous Fabrications: 12 inches long and in required profile. Include fasteners and other exposed accessories.

#### **1.6 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For fabricator and installer.
- B. Sample Warranty: For special warranty.

#### **1.7 CLOSEOUT SUBMITTALS**

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

#### **1.8 QUALITY ASSURANCE**

- A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
1. Fabricator shall be a company specializing in sheet metal work with 5 years of documented experience.
- B. Installer Qualifications: Company specializing in sheet metal work with 5 years of documented experience.

#### **1.9 DELIVERY, STORAGE, AND HANDLING**

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

## **1.10 WARRANTY**

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

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. Sheet Metal Standard for Flashing and Trim: Comply with SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

### **2.2 SHEET METALS**

- A. Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
- B. Aluminum Sheet: ASTM B209, alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat surface.
  - 1. Aluminum Sheet Thickness: Not less than 0.032 inches (20 gage).
  - 2. Exposed Coil-Coated Finish:
    - a. Two or Three Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish, with suspended mica or metallic flakes as required for selected color, containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in both color coats and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
      - 1) Color: Custom color to match Architect's sample.
      - a) Design Intent: Gray.
  - 3. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.

- C. Stainless Steel Sheet: ASTM A240, Type 304, dead soft, fully annealed; with smooth, flat surface.
  - 1. Stainless Steel Sheet Thickness: Not less than 0.025 inches (24 gage).
  - 2. Finish: ASTM A480, No. 2D (dull, cold rolled).
    - a. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

## **2.3 MISCELLANEOUS MATERIALS**

- A. Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
  - 1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
    - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
    - b. Blind Fasteners: High-strength aluminum or stainless steel rivets suitable for metal being fastened.
  - 2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
  - 3. Fasteners for Stainless Steel Sheet: Series 300 stainless steel.
- C. Solder:
  - 1. For Stainless Steel: ASTM B32, Grade Sn96, with acid flux of type recommended by stainless steel sheet manufacturer.
- D. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
- E. Elastomeric Sealant: ASTM C920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- F. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- G. Bituminous Coating: Cold-applied asphalt emulsion in accordance with ASTM D1187/D1187M.

## **2.4 FABRICATION, GENERAL**

- A. Materials: Unless otherwise indicated, use the following materials:
  - 1. Fabricate sheet metal flashing and trim from aluminum sheet in areas exposed to public view.
  - 2. Fabricate sheet metal flashing and trim from stainless steel sheet in areas concealed from public view.

- B. Custom fabricate sheet metal flashing and trim to comply with details indicated and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required.
  - 1. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
  - 2. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified.
  - 3. Verify shapes and dimensions of surfaces to be covered and obtain field measurements for accurate fit before shop fabrication.
  - 4. Form sheet metal flashing and trim to fit substrates without excessive oil-canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
  - 5. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.
  - 6. Fabricate in minimum 96-inch-long lengths, but not exceeding 12-foot-long sections
- C. Fabrication Tolerances:
  - 1. Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
- D. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
  - 1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
  - 2. Use lapped expansion joints only where indicated on Drawings.
- E. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal in accordance with cited sheet metal standard to provide for proper installation of elastomeric sealant.
- F. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- G. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard for application, but not less than thickness of metal being secured.
- H. Seams:
  - 1. Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.
  - 2. At Contractor's option for stainless steel: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
- I. Do not use graphite pencils to mark metal surfaces.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

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



3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

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

### **3.2 INSTALLATION, GENERAL**

A. Install sheet metal flashing and trim to comply with details indicated and recommendations of cited sheet metal standard that apply to installation characteristics required unless otherwise indicated on Drawings.

1. Install fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
2. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
3. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement.
4. Install sheet metal flashing and trim to fit substrates and to result in watertight performance.
5. Provide one of the following unless otherwise indicated on Drawings, but not less than that required to comply with performance requirements.
  - a. Install continuous cleats with fasteners spaced not more than 12 inches o.c.
  - b. Space individual cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
6. Install exposed sheet metal flashing and trim with limited oil-canning, and free of buckling and tool marks.
7. Do not field cut sheet metal flashing and trim by torch.
8. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.

1. Coat concealed side of uncoated-aluminum and stainless steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.

1. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.
2. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
3. Use lapped expansion joints only where indicated on Drawings.

D. Fasteners: Use fastener sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

F. Seal joints as required for watertight construction.

1. Use sealant-filled joints unless otherwise indicated.
  - a. Embed hooked flanges of joint members not less than 1 inch into sealant.
  - b. Form joints to completely conceal sealant.

- c. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way.
  - d. Adjust setting proportionately for installation at higher ambient temperatures.
- 1) Do not install sealant-type joints at temperatures below 40 deg F.

G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter.

- 1. Pretin edges of sheets with solder to width of 1-1/2 inches; however, reduce pretinning where pretinned surface would show in completed Work.
- 2. Do not solder aluminum sheet.
- 3. Do not use torches for soldering.
- 4. Heat surfaces to receive solder, and flow solder into joint.
  - a. Fill joint completely.
  - b. Completely remove flux and spatter from exposed surfaces.
- 5. Stainless Steel Soldering:
  - a. Tin edges of uncoated sheets, using solder for stainless steel and acid flux.
  - b. Promptly remove acid-flux residue from metal after tinning and soldering.
  - c. Comply with solder manufacturer's recommended methods for cleaning and neutralization.

### 3.3 INSTALLATION OF ROOF FLASHINGS

- A. Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard.
  - 1. Provide concealed fasteners where possible, and set units true to line, levels, and slopes.
  - 2. Install work with laps, joints, and seams that are permanently watertight and weather resistant.
- B. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches over base flashing. Install stainless steel draw band and tighten.
- C. Counterflashing: Coordinate installation of counterflashing with installation of base flashing.
  - 1. Insert counterflashing in reglets or receivers and fit tightly to base flashing.
  - 2. Extend counterflashing 4 inches over base flashing.
  - 3. Lap counterflashing joints minimum of 4 inches.
  - 4. Secure in waterproof manner by means of snap-in installation and sealant, lead wedges and sealant, or similar method unless otherwise indicated.
- D. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with butyl sealant and clamp flashing to pipes that penetrate roof.

### 3.4 INSTALLATION OF WALL FLASHINGS

- A. Install sheet metal wall flashing to intercept and exclude penetrating moisture in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.
- B. Counterflashing: Coordinate installation of counterflashing with installation of base flashing.
  - 1. Insert counterflashing in reglets or receivers and fit tightly to base flashing.
  - 2. Extend counterflashing 4 inches over base flashing.
  - 3. Lap counterflashing joints minimum of 4 inches.

4. Secure in waterproof manner by means of snap-in installation and sealant or similar method, unless otherwise indicated.

### **3.5 INSTALLATION TOLERANCES**

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

### **3.6 CLEANING**

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

### **3.7 PROTECTION**

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

**END OF SECTION 07 6200**

## **SECTION 07 7100 - MANUFACTURED ROOF SPECIALTIES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Roof-edge specialties (ridge vent and vented fascia).
  - 2. Roof-edge drainage systems (gutters and downspouts).

#### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings:
  - 1. Include plans, elevations, expansion-joint locations, keyed details, and attachments to other work. Distinguish between plant- and field-assembled work.
  - 2. Include details for expansion and contraction; locations of expansion joints, including direction of expansion and contraction.
  - 3. Indicate profile and pattern of seams and layout of fasteners, cleats, clips, and other attachments.
  - 4. Detail termination points and assemblies, including fixed points.
  - 5. Include details of special conditions.
- C. Samples for Initial Selection: For each type of roof specialty indicated with factory-applied color finishes.
- D. Samples for Verification:
  - 1. Include Samples of each type of roof specialty to verify finish and color selection, in manufacturer's standard sizes.
  - 2. Include roof-edge drainage systems made from 12-inch lengths of full-size components in specified material, and including fasteners, accessories, and attachments.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For manufacturer and installer.
- B. Product Certificates: For each type of roof specialty.
- C. Sample Warranty: For manufacturer's special warranty.

#### **1.5 CLOSEOUT SUBMITTALS**

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

## **1.6 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section; with not less than five years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified in this section; With minimum five years of documented experience.
- C. Source Limitations: Obtain roof specialties approved by manufacturer providing roofing-system warranty specified in Division 7 roofing section.
- D. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and set quality standards for fabrication and installation.
  - 1. Build mockup of typical roof edge as shown on Drawings.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

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

- A. Do not store roof specialties in contact with other materials that might cause staining, denting, or other surface damage. Store roof specialties away from uncured concrete and masonry.
- B. Protect strippable protective covering on roof specialties from exposure to sunlight and high humidity, except to extent necessary for the period of roof-specialty installation.

## **1.8 FIELD CONDITIONS**

- A. Field Measurements: Verify profiles and tolerances of roof-specialty substrates by field measurements before fabrication, and indicate measurements on Shop Drawings.
- B. Coordination: Coordinate roof specialties with flashing, trim, and construction of parapets, roof deck, roof and wall panels, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

## **1.9 WARRANTY**

- A. Roof-Edge Drainage Systems: Manufacturer agrees to repair or replace roof specialties that fail in materials or workmanship within specified warranty period. Warranty includes wind design and uplift requirements specified in Performance Requirements article.
  - 1. Warranty Period: 20 years from Date of Substantial Completion.
- B. Special Warranty on Painted Finishes: Manufacturer agrees to repair finish or replace roof specialties that show evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Delta E units when tested according to ASTM D2244.
    - b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  - 2. Finish Warranty Period: 20 years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 SOURCE LIMITATIONS**

- A. Source Limitations: Obtain roof-edge drainage systems from a single source from a single manufacturer.

### **2.2 PERFORMANCE REQUIREMENTS**

- A. General Performance: Roof specialties shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- C. Gutters and Downspouts: Size for rainfall intensity determined by a storm occurrence of 1 in 10 years in accordance with SMACNA's "Architectural Sheet Metal Manual," and not less than that indicated on Drawings.

### **2.3 MATERIALS**

- A. Aluminum Sheet: ASTM B209, alloy as standard with manufacturer for finish required, with temper to suit forming operations and performance required.
- B. Aluminum Extrusions: ASTM B221, alloy and temper recommended by manufacturer for type of use and finish indicated, finished as follows:
- C. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653 G90 coating designation.

### **2.4 ROOF-EDGE SPECIALTIES**

- A. Sloped Roof Ridge Vent: Manufacturer's standard metal ridge vent for slope-to-slope roofs with standing-seam metal roof panels; in section lengths not exceeding 12 feet, with concealed anchorage.
  - 1. Basis of Design Product: Subject to compliance with requirements, provide Metal-Era; Hi-Perf Ridge Vent – Slope to Slope Standing Seam Version: [www.metalera.com](http://www.metalera.com), or a comparable product from one of the following:
    - a. Architectural Products Co.: [www.archprod.com](http://www.archprod.com).
    - b. ATAS International, Inc.: [www.atas.com](http://www.atas.com).
    - c. Hickman Edge Systems, LLC: [www.hickmanedgesystems.com](http://www.hickmanedgesystems.com).
    - d. Petersen Aluminum Corp.: [www.pac-clad.com](http://www.pac-clad.com).
    - e. Southern Aluminum Finishing Co, Inc.(SAF); [www.saf.com](http://www.saf.com).
  - 2. Ridge Vent Cover Material: Formed aluminum sheet, 0.050 inch thick.
    - a. Surface: Smooth, flat finish.
  - 3. Cover Plates at Joints: Same material as ridge vent covers.
  - 4. Concealed Z Brackets: Continuous. Galvanized steel, 0.040 inch (20 gage).
  - 5. Intermediate Spacers: Formed aluminum sheet, 0.050 inch thick; spaced 12 inches on center.

6. Vent Screens: Expanded aluminum sheet, 0.050 inch thick.
    - a. Minimum Net Free Area: 18 square inches, minimum, per linear foot.
  7. Finish: Fluoropolymer
    - a. Color: Custom color to match standing seam metal roof panels; refer to Section 07 4113 – Metal Roof Panels.
      - 1) Design Intent: Gray.
  8. Accessories: Provide endcaps, splice plates, deflectors, fasteners and all other related hardware required for a complete installation
- B. Vented Fascia (Sloped Roof): Manufacturer's standard metal vented fascia for sloped roof edge at vented nailbase; in section lengths not exceeding 12 feet, with concealed anchorage and vented openings.
1. Basis of Design Product: Subject to compliance with requirements, provide Metal-Era; Hi-Perf Vented Fascia for Vented Nailbase: [www.metalera.com](http://www.metalera.com), or a comparable product from one of the following:
    - a. Architectural Products Co.: [www.archprod.com](http://www.archprod.com).
    - b. ATAS International, Inc.: [www.atas.com](http://www.atas.com).
    - c. Hickman Edge Systems, LLC: [www.hickmanedgesystems.com](http://www.hickmanedgesystems.com).
    - d. Petersen Aluminum Corp.: [www.pac-clad.com](http://www.pac-clad.com).
    - e. Southern Aluminum Finishing Co, Inc.(SAF); [www.saf.com](http://www.saf.com).
  2. Fascia Cover Material: Formed aluminum sheet, 0.050 inch thick.
    - a. Surface: Smooth, flat finish.
  3. Vent Screen and Bottom Closure: Perforated galvanized steel sheet, 0.028 inch (24 gage) thick.
    - a. Minimum Net Free Area: 9 sq. in. per linear foot and 54 percent, minimum.
  4. Concealed Z Brackets: Formed aluminum sheet, 0.050 inch thick.
  5. Roof Flange and Fascia Backer: Galvanized steel sheet, 0.028 inch (24 gage) thick.
  6. Finish: Fluoropolymer
    - a. Custom color to match standing seam metal roof panels; refer to Section 07 4113 – Metal Roof Panels.
      - 1) Design Intent: Gray.
  7. Accessories: Provide endcaps, splice plates, fasteners and all other related hardware required for a complete installation.

## **2.5 ROOF-EDGE DRAINAGE SYSTEMS**

- A. Gutters and Downspouts:
1. Manufacturers: Subject to compliance with requirements, provide products from one of the following:
    - a. Architectural Products Co.; [www.archprod.com](http://www.archprod.com).
    - b. ATAS International, Inc.; [www.atas.com](http://www.atas.com).
    - c. Hickman Edge Systems, LLC; [www.hickmanedgesystems.com](http://www.hickmanedgesystems.com).

- d. Metal-Era; [www.metalera.com](http://www.metalera.com).
  - e. Petersen Aluminum Corp.: [www.pac-clad.com](http://www.pac-clad.com).
  - f. Southern Aluminum Finishing Co, Inc.(SAF); [www.saf.com](http://www.saf.com).
2. Gutters: Manufactured in uniform section lengths not exceeding 12 feet with matching corner units, ends, outlet tubes, and other accessories. Elevate back edge at least 1 inch above front edge. Furnish flat-stock gutter straps, gutter brackets, expansion joints, and expansion-joint covers fabricated from same metal as gutters.
- a. Aluminum Sheet: 0.063 inch thick.
  - b. Gutter Profile: Style D according to SMACNA's "Architectural Sheet Metal Manual."
  - c. Corners: Factory mitered and continuously welded.
  - d. Gutter Supports: Gutter brackets and spacers with finish matching the gutters in compliance with SMACNA's "Architectural Sheet Metal Manual."
  - e. Gutter Accessories: Continuous screened leaf guard with sheet metal frame.
3. Downspouts: Plain rectangular complete with machine-crimped or mitered elbows, manufactured from the following exposed metal. Furnish with metal hangers, from same material as downspouts, and anchors.
- a. Formed Aluminum: 0.050 inch thick.
4. Finish: Fluoropolymer.
- a. Custom color to match standing seam metal roof panels; refer to Section 07 4113 – Metal Roof Panels.
    - 1) Design Intent: Gray.

## **2.6 MISCELLANEOUS MATERIALS**

- A. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements. Furnish the following unless otherwise indicated:
  - 1. Fasteners for Aluminum: Aluminum or Series 300 stainless steel.
  - 2. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A153/A153M or ASTM F2329.
- B. Elastomeric Sealant: ASTM C920, elastomeric silicone polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.
- C. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type joints with limited movement.
- D. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

## **2.7 FINISHES**

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.



D. Coil-Coated Aluminum Sheet Finishes:

1. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  - a. Two or Three-Coat Fluoropolymer: AAMA 2605. Two or three-coat fluoropolymer finish as required for colors specified containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coats and clear topcoats with suspended mica or metallic flakes as required for colors specified. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  - b. Concealed Surface Finish: Apply pretreatment and manufacturer's standard acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.
- B. Examine walls, roof edges, and parapets for suitable conditions for roof specialties.
- C. Verify that substrate is sound, dry, smooth, clean, sloped for drainage where applicable, and securely anchored.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 INSTALLATION, GENERAL**

- A. Install roof specialties according to manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, underlayments, sealants, and other miscellaneous items as required to complete roof-specialty systems.
  1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
  2. Provide uniform, neat seams with minimum exposure of solder and sealant.
  3. Install roof specialties to fit substrates and to result in weathertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
  4. Torch cutting of roof specialties is not permitted.
  5. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
  1. Coat concealed side of uncoated metal roof specialties with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
  2. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof specialties for waterproof performance.
- C. Expansion Provisions: Allow for thermal expansion of exposed roof specialties.
  1. Space movement joints at a maximum of 12 feet with no joints within 18 inches of corners or intersections unless otherwise indicated on Drawings.

2. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.
- D. Fastener Sizes: Use fasteners of sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.
  1. For wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.
- E. Seal concealed joints with butyl sealant as required by roofing-specialty manufacturer.
- F. Seal joints as required for weathertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 deg F.

### **3.3 INSTALLATION OF ROOF-EDGE SPECIALTIES**

- A. Install cleats, cants, and other anchoring and attachment accessories and devices with concealed fasteners.
- B. Anchor roof edgings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.

### **3.4 INSTALLATION OF ROOF-EDGE DRAINAGE-SYSTEM**

- A. Install components to produce a complete roof-edge drainage system according to manufacturer's written instructions. Coordinate installation of roof perimeter flashing with installation of roof-edge drainage system.
- B. Gutters: Join and seal gutter lengths. Allow for thermal expansion. Attach gutters to firmly anchored gutter supports spaced not more than 24 inches apart. Attach ends with rivets and seal with sealant to make watertight. Slope to downspouts.
  1. Install gutter with expansion joints at locations indicated but not exceeding 50 feet apart. Install expansion-joint caps.
  2. Install continuous leaf guards on gutters with noncorrosive fasteners, removable or hinged to swing open for cleaning gutters.
- C. Downspouts: Join sections with manufacturer's standard telescoping joints. Provide hangers with fasteners designed to hold downspouts securely to walls and 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c.
  1. Connect downspouts to underground drainage system.

### **3.5 CLEANING AND PROTECTION**

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Remove temporary protective coverings and strippable films as roof specialties are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain roof specialties in a clean condition during construction.
- C. Replace roof specialties that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

**END OF SECTION 07 7100**

## **SECTION 07 9200 - JOINT SEALANTS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. This Section includes:
  - 1. Silicone joint sealants.
  - 2. Latex joint sealants.
  - 3. Joint backings and accessories.
- B. Related Sections include the following:
  - 1. Section 08 8000 - Glazing: For glazing sealants.

#### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each joint-sealant product indicated.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch-wide joints formed between two 6-inch-long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- D. Joint-Sealant Schedule: Include the following information:
  - 1. Joint-sealant application, joint location, and designation.
  - 2. Joint-sealant manufacturer and product name.
  - 3. Joint-sealant formulation.
  - 4. Joint-sealant color.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For qualified testing agency, installer, and manufacturer.
- B. Product Test Reports: For each kind of joint sealant, for tests performed by manufacturer and witnessed by a qualified testing agency.
- C. Sample Warranties: For special warranties.

#### **1.5 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 5 years documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section and with at least 5 years of documented experience.

- C. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.
  - 1. In addition, provide other sealant mockups not part of an assembly specified in other Sections when requested by the Architect.
    - a. Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.
    - b. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- D. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

## **1.6 FIELD CONDITIONS**

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

## **1.7 WARRANTY**

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

## **PART 2 - PRODUCTS**

### **2.1 JOINT SEALANTS, GENERAL**

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

## **2.2 PERFORMANCE REQUIREMENTS**

- A. Provide exterior joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.
- B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

## **2.3 SILICONE JOINT SEALANTS**

- A. Silicone, Nonstaining – JS1:
  - 1. ASTM C920, Type S, Grade NS, Class 50; Uses NT, A, G, M and O.
  - 2. Non-Staining: No staining of substrates when tested according to ASTM C1248.
  - 3. Cure Type: Single-component, neutral-curing.
  - 4. Hardness Range: Comply with one of the following:
    - a. 15 to 35, Shore A, when tested in accordance with ASTM C661.
    - b. 25 to 35, Shore A, when tested in accordance with ASTM D2240.
  - 5. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dow Corning Corporation; Dowsil 756 SMS Building Sealant: [www.dow.com](http://www.dow.com).
    - b. Momentive Performance Materials, Inc./GE; SCS9000 SilPruf NB: [www.siliconeforbuilding.com](http://www.siliconeforbuilding.com).
    - c. Pecora Corporation; 890NST: [www.pecora.com](http://www.pecora.com).
    - d. Sika Corporation; Sikasil WS-295 FPS: [www.usa.sika.com](http://www.usa.sika.com).
    - e. Tremco, Inc.; Spectrem 3: [www.tremcosealants.com](http://www.tremcosealants.com).
- B. Silicone, Traffic Grade – JS2:
  - 1. ASTM C920, Type S, Grade NS, Class 100/50; Uses T, M, and O.
  - 2. Cure Type: Single-component, neutral-curing.
  - 3. Hardness Range: Comply with one of the following:
    - a. 5 to 15, Shore A, when tested in accordance with ASTM C661.
    - b. 50 to 85, Shore 00, when tested in accordance with ASTM D2240.
  - 4. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dow Corning; Dowsil NS Parking Structure Sealant: [www.dow.com](http://www.dow.com).
    - b. Pecora Corporation; 311NS: [www.pecora.com](http://www.pecora.com).
    - c. Sika Corporation; Sikasil - 728 NS: [www.usa.sika.com](http://www.usa.sika.com).
    - d. Tremco, Inc.; Spectrem 800: [www.tremcosealants.com](http://www.tremcosealants.com).
- C. Silicone, Self-Leveling – JS3:
  - 1. ASTM C920, Type S, Grade P, Class 100/50; Uses T, M and O.
  - 2. Cure Type: Single-component, neutral-curing.
  - 3. Hardness Range: Comply with one of the following:
    - a. 5 to 20, Shore A, when tested in accordance with ASTM C661.
    - b. 40 to 85, Shore 00, when tested in accordance with ASTM D2240.
  - 4. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dow Corning; Dowsil SL Parking Structure Sealant: [www.dow.com](http://www.dow.com).

- b. Pecora Corporation; 310SL: [www.pecora.com](http://www.pecora.com).
- c. Sika Corporation; Sikasil-728 SL: [www.usa.sika.com](http://www.usa.sika.com).
- d. Tremco, Inc.; Spectrem 900SL: [www.tremcosealants.com](http://www.tremcosealants.com).

D. Silicone, Mildew-Resistant – JS4:

- 1. ASTM C920, Type S, Grade NS, Class 25; Uses NT, A, G, and O.
- 2. Mildew-Resistant: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.
- 3. Cure Type: Single-component, acetoxy or neutral-curing.
- 4. Hardness Range: Comply with one of the following:
  - a. 15 to 35, Shore A, when tested in accordance with ASTM C661.
  - b. 25 to 35, Shore A, when tested in accordance with ASTM D2240.
- 5. Color: Clear.
- 6. Products: Subject to compliance with requirements, provide one of the following:
  - a. Dow Corning; Dowsil 786 Sealant M: [www.dow.com](http://www.dow.com).
  - b. Momentive Performance Materials, Inc./GE; SCS1700 Sanitary: [www.siliconeforbuilding.com](http://www.siliconeforbuilding.com).
  - c. Pecora Corporation; 898NST: [www.pecora.com](http://www.pecora.com).
  - d. Sika Corporation; Sikasil - GP: [www.usa.sika.com](http://www.usa.sika.com).
  - e. Tremco, Inc.; Tremsil 200 with fungicide: [www.tremcosealants.com](http://www.tremcosealants.com).

## 2.4 LATEX JOINT SEALANTS

A. Acrylic Latex – JS5:

- 1. Acrylic latex or siliconized acrylic latex
- 2. ASTM C834, Type OP, Grade NF or Minus 18 Degrees C (0 Degrees F).
- 3. Products: Subject to compliance with requirements, provide one of the following:
  - a. Bostik, Inc.; PWC; [www.bostik.com](http://www.bostik.com).
  - b. Franklin International Inc; Titebond Painter's Plus Caulk: [www.titebond.com](http://www.titebond.com).
  - c. Pecora Corporation; AC-20 +Silicone: [www.pecora.com](http://www.pecora.com).
  - d. Sherwin Williams; 950A Siliconized Acrylic Latex Caulk: [www.sherwin-williams.com](http://www.sherwin-williams.com).
  - e. Tremco, Inc.; Tremflex 834: [www.tremcosealants.com](http://www.tremcosealants.com).

B. Acrylic Latex, Acoustical Sealant – JS6:

- 1. Nonsag, paintable, nonstaining latex sealant. Reduces airborne sound transmission through perimeter joints and openings in wall assemblies.
- 2. ASTM C834
- 3. Products: Subject to compliance with requirements, provide one of the following:
  - a. Franklin International Inc; Titebond GreenChoice Professional Acoustical Smoke & Sound Sealant: [www.titebond.com](http://www.titebond.com).
  - b. PPG Architectural Coatings; Liquid Nails AS-825 Acoustical Sound Sealant: [www.liquidnails.com](http://www.liquidnails.com).
  - c. Pecora Corporation; AC-20 FTR: [www.pecora.com](http://www.pecora.com).
  - d. Pecora Corporation; AIS-919: [www.pecora.com](http://www.pecora.com).
  - e. United States Gypsum Co.; USG Sheetrock Brand Firecode Smoke-Sound Sealant: [www.usg.com](http://www.usg.com).
  - f. United States Gypsum Co.; USG Sheetrock Brand Acoustical Sealant: [www.usg.com](http://www.usg.com).

## **2.5 JOINT-SEALANT BACKING**

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

## **2.6 MISCELLANEOUS MATERIALS**

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

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

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

### **3.2 PREPARATION**

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
  - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
  - 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include, but are not limited to, the following:
    - a. Concrete.
    - b. Masonry.
  - 3. Remove laitance and form-release agents from concrete.

4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include, but are not limited to, the following:
  - a. Metal.
  - b. Glass.
  - c. Porcelain enamel.
  - d. Glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

### **3.3 INSTALLATION OF JOINT SEALANTS**

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



2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile per Figure 8A in ASTM C1193 unless otherwise indicated or recommended by sealant manufacturer.

- a. Use masking tape to protect surfaces adjacent to tooled joints.

### **3.4 CLEANING**

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

### **3.5 PROTECTION**

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

### **3.6 JOINT-SEALANT SCHEDULE**

- A. Horizontal Traffic Surfaces:

1. Exterior Joints.

- a. Joint Sealant: Silicone, Traffic-Grade – JS2 or Silicone Self Leveling – JS3.

- 1) Excludes joints in paved roads, parking lots, walkways, and curbing specified in Division 32.

2. Interior Joints:

- a. Joint Sealant: Silicone, Traffic-Grade – JS2.

- B. Vertical and Horizontal Nontraffic Surfaces:

1. Exterior Joints:

- a. Joint Sealant: Silicone, Nonstaining – JS1.

2. Interior Joints:

- a. Latex Joint Sealant: Acrylic Latex – JS5.

- 1) Joint Locations: All locations except as follows:

- a) Locations where silicone, nonstaining sealants are specified.
- b) Locations where mildew-resistant silicone sealants are specified.
- c) Locations where acoustic sealants are specified.

- b. Silicone Joint Sealant: Silicone, Nonstaining – JS1.
  - 1) Joint Locations:
    - a) Perimeter joints at storefront framing and louvers.
    - b) Other joints as indicated on Drawings.
- c. Mildew-Resistant Joint Sealant: : Silicone, Mildew-Resistant – JS4
  - 1) Joint Locations:
    - a) Joints between plumbing fixtures and adjoining walls, floors, and counters.
    - b) Joints between countertops and walls
    - c) Other joints as indicated on Drawings.
- d. Acoustical Joint Sealant: Acrylic Latex, Acoustical Sealant – JS6
  - 1) Joint Locations:
    - a) Acoustical panel ceilings; refer to Section 09 5113 Acoustical Panel Ceilings.
    - b) Other joints as indicated on Drawings.

**END OF SECTION 07 9200**

## **SECTION 08 1113 – HOLLOW METAL DOORS AND FRAMES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section includes:
  - 1. Hollow metal doors and frames.

#### **1.3 DEFINITIONS**

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

#### **1.4 COORDINATION**

- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.
- B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

#### **1.5 PREINSTALLATION MEETINGS**

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

#### **1.6 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, core descriptions, and finishes.
- B. Shop Drawings: Include the following:
  - 1. Elevations of each door type.
  - 2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
  - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
  - 4. Locations of reinforcement and preparations for hardware.
  - 5. Details of each different wall opening condition.
  - 6. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
  - 7. Details of anchorages, joints, field splices, and connections.
  - 8. Details of accessories.
  - 9. Details of moldings, removable stops, and glazing.
- C. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

## **1.7 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For manufacturer and installer.

## **1.8 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than 5 years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least 5 years of documented experience.

## **1.9 DELIVERY, STORAGE, AND HANDLING**

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

# **PART 2 - PRODUCTS**

## **2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Ceco Door, an Assa Abloy Group company: [www.cecodoor.com](http://www.cecodoor.com).
  - 2. Curries, an Assa Abloy Group company: [www.curries.com](http://www.curries.com).
  - 3. Pioneer Industries, an Assa Abloy Group company: [www.pioneerindustries.com](http://www.pioneerindustries.com).
  - 4. Republic Doors, an Allegion brand: [www.republicdoor.com](http://www.republicdoor.com).
  - 5. Steelcraft, an Allegion brand: [www.allegion.com](http://www.allegion.com).

## **2.2 PERFORMANCE REQUIREMENTS**

- A. Thermally Rated Door Assemblies: Provide door assemblies with U-factor of not more than 0.40 deg Btu/F x h x sq. ft. when tested according with ASTM C1363 or ASTM E1423.
  - 1. Includes all exterior door assemblies.

## **2.3 MATERIALS**

- A. Cold-Rolled Steel Sheet: ASTM A1008, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A1011, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A653, Commercial Steel (CS), Type B.
- D. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.

- E. Glazing: Comply with requirements in Section 08 8000 - Glazing.

## **2.4 INTERIOR STANDARD STEEL DOORS AND FRAMES**

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Extra-Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 3; ANSI/SDI A250.4, Level A.
1. Doors:
    - a. Type: As indicated in the Door and Frame Schedule.
    - b. Thickness: 1-3/4 inches.
    - c. Face: Uncoated steel sheet, minimum thickness of 0.053 inch (16 gage).
    - d. Edge Construction: Model 2, Seamless.
    - e. Edge Bevel: Hinged edge square, and lock edge beveled 1/8 inch in 2 inches.
    - f. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
    - g. Bottom Edges: Close bottom edges of doors with end closures or channels of same material as face sheets.
    - h. Core: Manufacturer's standard.
  2. Frames:
    - a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch (16 gage).
    - b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
    - c. Construction: Full profile welded.
  3. Exposed Finish: Prime.

## **2.5 EXTERIOR STANDARD STEEL DOORS AND FRAMES**

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Exterior doors and frames shall comply with performance requirements of Thermally Rated Door Assemblies.
- C. Extra-Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 3; ANSI/SDI A250.4, Level A.
1. Doors:
    - a. Type: As indicated in the Door and Frame Schedule.
    - b. Thickness: 1-3/4 inches.
    - c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch (16 gage), with minimum A60 (ZF180) coating.
    - d. Edge Construction: Model 2, Seamless.
    - e. Edge Bevel: Hinged edge square, and lock edge beveled 1/8 inch in 2 inches.
    - f. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
    - g. Bottom Edges: Close bottom edges of doors with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
    - h. Core: Polyurethane.

2. Frames:
  - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch (16 gage), with minimum A60 (ZF180) coating.
  - b. Construction: Full profile welded.
3. Exposed Finish: Prime.

## **2.6 FRAME ANCHORS**

- A. Jamb Anchors:
  1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
  2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches of frame height above 7 feet.
  3. Postinstalled Expansion Anchor: Minimum 3/8-inch-diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.
- B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.
- C. Floor Anchors for Concrete Slabs with Underlayment: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at top of flowable underlayment.
- D. Material: ASTM A879, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.
  1. For anchors built into exterior walls, steel sheet complying with ASTM A1008 or ASTM A1011; hot-dip galvanized according to ASTM A153, Class B.

## **2.7 FABRICATION**

- A. Door Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch (19 mm) beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.
- B. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.
  1. Provide countersunk exposed screws and bolts for exposed fasteners unless otherwise indicated.
  2. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
    - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- C. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping according to ANSI/SDI A250.6, the Door Hardware Schedule, and templates.
  1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
  2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.

- D. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
1. Stops and moldings shall accommodate required glazing thicknesses; coordinate with Section 08 8000 – Glazing.
  2. Provide stops and moldings flush with face of door, and with beveled or square stops unless otherwise indicated.
  3. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
  4. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames. Provide loose stops and moldings on inside of hollow-metal doors and frames.
  5. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
  6. Provide stops for installation with countersunk machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

## **2.8 STEEL FINISHES**

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

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

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

### **3.3 INSTALLATION**

- A. Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.
- B. Hollow-Metal Frames: Comply with ANSI/SDI A250.11.
1. Frame Fill:
    - a. Solidly pack mineral-fiber insulation inside frames.

2. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.
    - a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
    - b. Install frames with removable stops located on secure side of opening.
  3. Floor Anchors: Secure with postinstalled expansion anchors.
  4. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
  5. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:
    - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
    - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.
1. Non-Fire-Rated Steel Doors: Comply with ANSI/SDI A250.8.
  2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
  3. Smoke-Control Doors: Install doors according to NFPA 105.
- D. Glazing: Comply with installation requirements in Section 088000 - Glazing, and with hollow-metal manufacturer's written instructions.
1. Secure stops with countersunk machine screws spaced uniformly not more than 9 inches o.c., and not more than 2 inches o.c. from each corner.

### **3.4 REPAIR**

- A. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

**END OF SECTION 08 1113**



## **SECTION 08 3113 – ACCESS DOORS AND FRAMES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section includes:
  - 1. Access doors and frames.

#### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Show fabrication and installation details of access doors and frames for each type of substrate. Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each type of access door and frame and for each finish specified, complete assembly minimum 6 by 6 inches in size.
- D. Product Schedule: For access doors and frames.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For manufacturer and installer.

#### **1.5 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than 5 years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least 5 years of documented experience.

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Acudor; [www.acudor.com](http://www.acudor.com).
  - 2. Babcock-Davis; [www.babcockdavis.com](http://www.babcockdavis.com).
  - 3. JL Industries/Activar Construction Products Group, Inc; [www.activarcpg.com/jl-industries](http://www.activarcpg.com/jl-industries).
  - 4. Karp Associates, Inc; [www.karpinc.com](http://www.karpinc.com).
  - 5. Larsen's Manufacturing Company; [www.larsenmfg.com](http://www.larsenmfg.com).
  - 6. Milcor / Hart & Cooley Inc; [www.milcorinc.com](http://www.milcorinc.com).
  - 7. MIFAB, Inc.; [www.mifab.com](http://www.mifab.com).
  - 8. Nystrom; [www.nystrom.com](http://www.nystrom.com).

## **2.2 MATERIALS**

- A. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A879, with cold-rolled steel sheet substrate complying with ASTM A1008, Commercial Steel (CS), exposed.
- B. Frame Anchors: Same material as door face.
- C. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A153 or ASTM F2329.

## **2.3 ACCESS DOORS AND FRAMES**

- A. Flush Access Doors with Exposed Flanges:
  - 1. Locations: Masonry.
  - 2. Description: Face of door flush with frame, with exposed flange and concealed hinge.
  - 3. Door Size: As indicated on Drawings; otherwise provide in size as required for proper access of items behind access door.
  - 4. Door Material:
    - a. Uncoated Steel Sheet for Door: Nominal 0.060 inch (16 gage), factory primed.
  - 5. Frame Material: Same material, thickness, and finish as door.
  - 6. Hardware:
    - a. Hinge: Concealed, spring type.
    - b. Latch and Lock: Cam latch, screwdriver operated.
- B. Flush Access Doors with Concealed Flanges:
  - 1. Locations: Gypsum board.
  - 2. Description: Face of door flush with frame; with concealed flange for gypsum board installation and concealed hinge.
  - 3. Door Size: As indicated on Drawings; otherwise provide in size as required for proper access of items behind access door.
  - 4. Door Material:
    - a. Uncoated Steel Sheet for Door: Nominal 0.060 inch (16 gage), factory primed.
  - 5. Frame Material: Same material and thickness as door.
  - 6. Hardware:
    - a. Hinge: Concealed, spring type.
    - b. Latch and Lock: Cam latch, screwdriver operated.

## **2.4 FABRICATION**

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.
  - 1. For concealed flanges with drywall bead, provide edge trim for gypsum panels securely attached to perimeter of frames.
- D. Latch and Lock Hardware:
  - 1. Quantity: Furnish number of latches and locks required to hold doors tightly closed.
  - 2. Keys: Furnish two keys per lock and key all locks alike.

## **2.5 FINISHES**

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
  - 1. Factory Primed: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

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

### **3.2 INSTALLATION**

- A. Comply with manufacturer's written instructions for installing access doors and frames.
- B. Set frames accurately in position and attach securely to supports.
- C. Ensure that flush panel door faces align with adjacent finish surfaces.

### **3.3 ADJUSTING**

- A. Adjust doors and hardware, after installation, for proper operation.

**END OF SECTION 08 3113**

## **SECTION 08 3613 – SECTIONAL DOORS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section includes:
  - 1. Insulated sectional overhead doors.

#### **1.3 PREINSTALLATION MEETINGS**

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

#### **1.4 ACTION SUBMITTALS**

- A. Product Data: For each type and size of sectional door and accessory.
  - 1. Include construction details, material descriptions, dimensions of individual components, profile door sections, and finishes.
  - 2. For power-operated doors, include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
- B. Shop Drawings: For each installation and for components not dimensioned or detailed in manufacturer's product data.
  - 1. Include plans, elevations, sections, and mounting details.
  - 2. Include details of equipment assemblies. Indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
  - 4. Include diagrams for power, signal, and control wiring.
- C. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.
  - 1. Include similar Samples of accessories involving color selection.
- D. Samples for Verification: For each type of exposed finish on the following components, in manufacturer's standard sizes:
  - 1. Glazing.
  - 2. Metal for door sections.
  - 3. Hardware.
  - 4. Include similar Samples of accessories involving color selection.
- E. Product Schedule: Use same designations indicated on Drawings.

#### **1.5 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For manufacturer and installer.
- B. Sample Warranties: For special warranties.

## **1.6 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For sectional doors to include in maintenance manuals.
- B. Special warranties.

## **1.7 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than 5 years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least 5 years of documented experience; trained and approved by manufacturer.

## **1.8 WARRANTY**

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

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Basis of Design Product: Subject to compliance with requirements, the design for each sectional door specified is based on the product named. Provide either the named product or a comparable product by one of the following:
  - 1. C.H.I. Overhead Doors; [www.chiohd.com](http://www.chiohd.com).
  - 2. Clopay Building Products; [www.clopaydoor.com](http://www.clopaydoor.com).
  - 3. CornellCookson, Inc.; [www.cornelliron.com](http://www.cornelliron.com).
  - 4. McKeon Door Company; [www.mckeondoor.com](http://www.mckeondoor.com).
  - 5. Overhead Door Corp.; [www.overheaddoor.com](http://www.overheaddoor.com).
  - 6. Raynor Door; [www.raynor.com](http://www.raynor.com)
  - 7. Wayne-Dalton; [www.wayne-dalton.com](http://www.wayne-dalton.com).
- B. Source Limitations: Obtain sectional doors from single source from single manufacturer.
  - 1. Obtain operators and controls from sectional door manufacturer.

## **2.2 PERFORMANCE REQUIREMENTS**

- A. General Performance: Provide sectional doors that comply with performance requirements specified without failure from defective manufacture, fabrication, installation, or other defects in construction and without requiring temporary installation of reinforcing components.
- B. Structural Performance, Exterior Doors: Capable of withstanding the design wind loads.
  - 1. Design Wind Load: As indicated on Drawings but not less than the following:
    - a. Uniform pressure (velocity pressure) of 20 lbf/sq. ft., acting inward and outward.
  - 2. Deflection Limits: Design sectional doors to withstand design wind loads without evidencing permanent deformation or disengagement of door components.
    - a. Deflection of door sections in horizontal position (open) shall not exceed 1/120 of door width.
    - b. Deflection of horizontal track assembly shall not exceed 1/240 of door height.
- C. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.

## **2.3 SECTIONAL-DOOR ASSEMBLY**

- A. Steel Sectional Door: Provide sectional door formed with hinged sections and fabricated so that finished door assembly is rigid and aligned with tight hairline joints; free of warp, twist, and deformation; and complies with requirements in DASMA 102.
  - 1. Basis of Design Product: Clopay Building Products; Architectural Series Model 3208 Series.
- B. Operation Cycles: Door components and operators capable of operating for not less than 50,000 operation cycles. One operation cycle is complete when door is opened from closed position to the open position and returned to closed position.
- C. Air Infiltration: Maximum rate of 0.4 cfm/sq. ft. when tested in accordance with ASTM E283 or DASMA 105.
- D. U-Value: 0.24 Btu/sq. ft. x h x deg F. (R Value of 9.1).
- E. Steel Door Sections: ASTM A653, zinc-coated (galvanized), cold-rolled, commercial steel sheet with G90 zinc coating.
  - 1. Door-Section Thickness: 2 inches.
  - 2. Section Faces:
    - a. Exterior Face: Fabricated from single sheets, not more than 24 inches high; with horizontal meeting edges rolled to continuous, interlocking, keyed, rabbeted, shiplap, or tongue-in-groove, weather- and pinch-resistant seals and reinforcing flange return.
      - 1) Steel Sheet Thickness: 0.022-inch (24 gage) nominal coated thickness.
      - 2) Surface: Manufacturer's standard, embossed.
    - b. Interior Face: Enclose insulation completely within steel exterior facing and interior facing material, with no exposed insulation. Provide the following interior-facing material:
      - 1) Zinc-Coated (Galvanized) Steel Sheet: With minimum nominal coated thickness of 0.016 inch (27 gage).

3. End Stiles: Enclose open ends of sections with channel end stiles formed from galvanized-steel sheet not less than 0.040-inch (20 gage) nominal coated thickness and welded to door section.
4. Intermediate Stiles: Provide intermediate stiles formed from not less than 0.064-inch- (16 gage) thick galvanized-steel sheet, cut to door section profile, and welded in place. Space stiles not more than 48 inches apart.
5. Section Reinforcing: Horizontal and diagonal reinforcement as required to stiffen door and for wind loading. Provide galvanized-steel bars, struts, trusses, or strip steel, formed to depth and bolted or welded in place. Ensure that reinforcement does not obstruct vision lites.
  - a. Bottom Section: Reinforce section with a continuous channel or angle conforming to bottom-section profile and allowing installation of astragal (weatherseal).
  - b. Hardware Locations: Provide reinforcement for hardware attachment.
6. Thermal Insulation: Insulate interior of steel sections.
  - a. Provide manufacturer's standard insulation; use one of the following types indicated below:
    - 1) Board Insulation: Polystyrene or polyurethane, secured to exterior face sheet.
    - 2) Foamed-in-Place Insulation: Polyurethane, foamed in place to completely fill interior of section and pressure bonded to face sheets to prevent delamination under wind load.
  - b. Fire-Resistance Characteristics: Maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, in accordance with ASTM E84.
- F. Track: Manufacturer's standard, galvanized-steel, track system. Provide complete system including brackets, bracing, and reinforcement to ensure rigid support of ball-bearing roller guides.
  1. Material: Galvanized steel, ASTM A653, minimum G60 zinc coating.
  2. Size: As recommended in writing by manufacturer for door size, weight, track configuration and door clearances indicated on Drawings but not less than 2 inches wide.
  3. Track Reinforcement and Supports: Provide galvanized-steel members to support track without sag, sway, and vibration during opening and closing of doors. Slot vertical sections of track spaced 2 inches apart for door-drop safety device.
    - a. Vertical Track: Incline vertical track to ensure weathertight closure at jambs. Provide continuous angle attached to track and wall.
    - b. Horizontal Track: Provide continuous reinforcing angle from curve in track to end of track, attached to track and supported at points by laterally braced attachments to overhead structural members.
- G. Weatherseals: Replaceable, adjustable, continuous, compressible weather-stripping gaskets of flexible vinyl, rubber, or neoprene fitted to bottom and jambs of door. Provide combination bottom weatherseal and sensor edge for bottom seal.
- H. Windows: None; solid panels.
- I. Hardware: Heavy-duty, corrosion-resistant hardware, with hot-dip galvanized, stainless steel, or other corrosion-resistant fasteners, to suit door type.
  1. Hinges: Heavy-duty, galvanized-steel hinges of not less than 0.079-inch (14 gage) nominal coated thickness at each end stile and at each intermediate stile, in accordance with manufacturer's written recommendations for door size.
    - a. Attach hinges to door sections through stiles and rails with bolts and lock nuts or lock washers and nuts. Use rivets or self-tapping fasteners where access to nuts is impossible.
    - b. Provide double-end hinges where required for doors more than 16 ft. wide unless otherwise recommended by door manufacturer in writing.

2. Rollers: Heavy-duty rollers with steel ball bearings in case-hardened steel races, mounted to suit slope of track. Extend roller shaft through both hinges where double hinges are required. Match roller-tire diameter to track width.
    - a. Roller-Tire Material: Manufacturer's standard.
- J. Locking Device:
1. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on single-jamb side, operable from inside only.
  2. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.
- K. Counterbalance Mechanism:
1. Torsion Spring: Adjustable-tension torsion springs complying with requirements of DASMA 102 for number of operation cycles indicated, mounted on torsion shaft.
  2. Cable Drums and Shaft for Doors: Cast-aluminum cable drums mounted on torsion shaft and grooved to receive door-lifting cables as door is raised.
    - a. Mount counterbalance mechanism with manufacturer's standard ball-bearing brackets at each end of torsion shaft.
    - b. Provide one additional midpoint bracket for shafts up to 16 ft long and two additional brackets at one-third points to support shafts more than 16 ft long unless closer spacing is recommended in writing by door manufacturer.
  3. Cables: Galvanized-steel, multistrand, lifting cables with cable safety factor of at least 5 to 1.
  4. Cable Safety Device: Include a spring-loaded steel or bronze cam mounted to bottom door roller assembly on each side and designed to automatically stop door if lifting cable breaks.
  5. Bracket: Provide anchor support bracket as required to connect stationary end of spring to the wall and to level the shaft and prevent sag.
  6. Bumper: Provide spring bumper at each horizontal track to cushion door at end of opening operation.
- L. Electric Door Operator: Electric door operator assembly of size and capacity recommended by door manufacturer for door and operation cycles specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
1. Comply with NFPA 70.
  2. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6; with NFPA 70, Class 2 control circuit, maximum 24 V ac or dc.
  3. Safety: Listed in accordance with UL 325 by a qualified testing agency for commercial or industrial use; moving parts of operator enclosed or guarded if exposed and mounted at 8 ft. or lower.
  4. Usage Classification: Heavy duty, 25 or more cycles per hour and more than 90 cycles per day.
  5. Operator Type: As indicated on Drawings; if not indicated, provide as recommended by door manufacturer for conditions indicated.
  6. Motor: Reversible-type with controller (disconnect switch) for exterior, dusty, wet, or humid motor exposure. Use adjustable motor-mounting bases for belt-driven operators.
    - a. Motor Size: As required to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. and not more than 12 in./sec, without exceeding nameplate ratings or service factor.
    - b. Electrical Characteristics: 115V, single phase.
  7. Limit Switches: Equip motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.



8. Obstruction Detection: Automatic external entrapment protection consisting of automatic safety sensor capable of protecting full width of door opening. Activation of device immediately stops and reverses downward door travel.
    - a. Monitored Entrapment Protection: Photoelectric sensor and electric sensor edge on bottom section designed to interface with door-operator control circuit to detect damage to or disconnection of sensor and complying with requirements in UL 325.
  9. Control Station: Surface mounted, three-button (open, close, and stop) control.
    - a. Operation: Push button.
    - b. Interior-Mounted Unit: Full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
  10. Emergency Manual Operation: Push-up or chain type designed so required force for door operation does not exceed 25 lbf.
  11. Emergency Operation Disconnect Device: Hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
  12. Motor Removal: Design operator so motor can be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.
- M. Metal Finish: Comply with NAAMM/NOMMA's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" for recommendations for applying and designating finishes.
1. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.
    - a. Color and Gloss: As selected by Architect from manufacturer's full and complete range of colors.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

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

#### **3.2 INSTALLATION**

- A. Install sectional doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; in accordance with manufacturer's written instructions.
- B. Tracks:
  1. Fasten vertical track assembly to opening jambs and framing with fasteners spaced not more than 24 inches (610 mm) apart.
  2. Hang horizontal track assembly from structural overhead framing with angles or channel hangers attached to framing by welding or bolting, or both. Provide sway bracing, diagonal bracing, and reinforcement as required for rigid installation of track and door-operating equipment.

- C. Accessibility: Install sectional doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.
- D. Power-Operated Doors: Install in accordance with UL 325.

### **3.3 STARTUP SERVICE**

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Complete installation and startup checks in accordance with manufacturer's written instructions.
  - 2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

### **3.4 ADJUSTING**

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

### **3.5 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain sectional doors.

**END OF SECTION 08 3613**

## **SECTION 08 4113 – ALUMINUM-FRAMED STOREFRONTS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section includes:
  - 1. Aluminum-framed storefront systems.

#### **1.3 PREINSTALLATION MEETINGS**

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

#### **1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For aluminum-framed storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.
  - 1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
  - 2. Include full-size isometric details of each type of vertical-to-horizontal intersection of aluminum-framed storefronts, showing the following:
    - a. Joinery, including concealed welds.
    - b. Anchorage.
    - c. Expansion provisions.
    - d. Glazing.
    - e. Flashing and drainage.
  - 3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
- C. Samples for Verification: For each type of exposed finish. Submit at least three samples of each of the following:
  - 1. Submit three samples for each finish specified, not less than 6 inches square or 6 inches long for linear components.
  - 2. Submit three samples of infill panels for each color and finish, not less than 6 inches square.
- D. Delegated-Design Submittal: For aluminum-framed storefronts indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

## **1.5 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For manufacturer and installer.
- B. Qualification Data: For professional engineer.
- C. Energy Performance Certificates: For aluminum-framed storefronts, accessories, and components, from manufacturer.
  - 1. Basis for Certification: NFRC-certified energy performance values for each aluminum-framed storefront.
- D. Product Test Reports: For aluminum-framed storefronts, for tests performed by manufacturer and witnessed by a qualified testing agency or a qualified testing agency.
- E. Field quality-control reports.
- F. Sample Warranties: For special warranties.

## **1.6 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For aluminum-framed storefronts to include in maintenance manuals.

## **1.7 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than 5 years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least 5 years of documented experience.
- C. Professional Engineer Qualifications: Professional engineer experienced with providing delegated-design engineering services of the kind indicated, including documentation that engineer is licensed in the state in which Project is located.
- D. Testing Agency Qualifications: Qualified in accordance with ASTM E699 for testing indicated and acceptable to Owner and Architect.
- E. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
  - 1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

## **1.8 MOCKUPS**

- A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
  - 1. For each type of aluminum-framed storefront, build mockup of typical wall area as shown on Drawings.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

## **1.9 WARRANTY**

- A. Special Warranty: Manufacturer agrees to repair or replace components of aluminum-framed storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
  1. Failures include, but are not limited to, the following:
    - a. Structural failures, including, but not limited to, excessive deflection.
    - b. Noise or vibration created by wind and thermal and structural movements.
    - c. Deterioration of metals and other materials beyond normal weathering.
    - d. Water penetration through fixed glazing and framing areas.
    - e. Failure of operating components.
  2. Warranty Period: Five years from date of Substantial Completion.
- B. Special Finish Warranty, Anodized Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of anodized finishes within specified warranty period.
  1. Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Delta E units when tested in accordance with ASTM D 2244.
    - b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D 4214.
    - c. Cracking, peeling, or chipping.
  2. Warranty Period: Five years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Thermally Broken Storefront Products:
  1. Basis of Design Product: Subject to compliance with requirements, provide Tubelite Inc, an Apogee Enterprises, Inc. company; 14000 / 14000-I/O Series: [www.tubeliteinc.com](http://www.tubeliteinc.com), or one of the following comparable products:
    - a. EFCO Corporation, an Apogee Enterprises, Inc. company; Series 433: [www.efcocorp.com](http://www.efcocorp.com).
    - b. Kawneer North American, an Arconic company; Trifab VG 451T Framing System: [www.kawneer.com](http://www.kawneer.com) Oldcastle bought Visrtawall
    - c. Oldcastle BuildingEnvelope; Series 3000 Thermal Multiplane: [www.obe.com](http://www.obe.com).
- B. Source Limitations: Obtain all components of aluminum-framed storefront system, including framing and accessories, from single manufacturer.

### **2.2 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design aluminum-framed storefronts.

- B. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
1. Aluminum-framed storefronts shall withstand movements of supporting structure, including, but not limited to, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
  2. Failure also includes the following:
    - a. Thermal stresses transferring to building structure.
    - b. Glass breakage.
    - c. Noise or vibration created by wind and thermal and structural movements.
    - d. Loosening or weakening of fasteners, attachments, and other components.
    - e. Failure of operating units.
- C. Structural Loads:
1. Wind Loads: As indicated on Drawings.
  2. Other Design Loads: As indicated on Drawings.
- D. Deflection of Framing Members Supporting Glass: At design wind load, as follows:
1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans of up to 13 feet 6 inches and to 1/240 of clear span plus 1/4 inch for spans greater than 13 feet 6 inches.
  2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch.
- E. Structural: Test in accordance with ASTM E330 as follows:
1. When tested at positive and negative wind-load design pressures, storefront assemblies do not evidence deflection exceeding specified limits.
  2. When tested at 150 percent of positive and negative wind-load design pressures, storefront assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
  3. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- F. Water Penetration under Static Pressure: Test in accordance with ASTM E331 as follows:
1. No evidence of water penetration through fixed glazing and framing areas when tested in accordance with a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 8 lbf/sq. ft..
- G. Energy Performance: Certified and labelled by manufacturer for energy performance as follows:
1. Thermal Transmittance (U-factor):
    - a. Fixed Glazing and Framing Areas: U-factor for the system of not more than 0.42 Btu/sq. ft. x h x deg F as determined in accordance with NFRC 100.
  2. Air Leakage:
    - a. Fixed Glazing and Framing Areas: Air leakage for the system of not more than 0.06 cfm/sq. ft. at a static-air-pressure differential of 6.24 lbf/sq. ft. when tested in accordance with ASTM E283.

3. Condensation Resistance Factor (CRF):
  - a. Fixed Glazing and Framing Areas: CRF for the system of not less than 60 as determined in accordance with AAMA 1503.
- H. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.
  1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

## **2.3 ALUMINUM-FRAMED STOREFRONT SYSTEMS**

- A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
  1. Storefront System:
    - a. Framing Profile: 2 by 4-1/2 inches, nominal.
    - b. Framing Construction: Thermally broken.
    - c. Glazing System: Retained mechanically with gaskets on four sides.
    - d. Glazing Plane: Front-glazed.
    - e. Finish: Clear anodic finish.
    - f. Fabrication Method: Field-fabricated stick system.
    - g. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
    - h. Steel Reinforcement: As required by manufacturer.
- B. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.
- C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

## **2.4 GLAZING**

- A. Glazing: Refer to Section 08 8000- Glazing.

## **2.5 MATERIALS**

- A. Aluminum Sheet and Plate: ASTM B209.
- B. Aluminum Extruded Bars, Rods, Profiles, and Tubes: ASTM B221.
- C. Aluminum Structural Profiles: ASTM B308/B308M.
- D. Steel Reinforcement:
  1. Structural Shapes, Plates, and Bars: ASTM A36.
  2. Cold-Rolled Sheet and Strip: ASTM A1008.
  3. Hot-Rolled Sheet and Strip: ASTM A1011.
- E. Steel Reinforcement Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods in accordance with recommendations in SSPC-SP COM, and prepare surfaces in accordance with applicable SSPC standard.

## **2.6 ACCESSORIES**

- A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
  - 1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
  - 2. Reinforce members as required to receive fastener threads.
  - 3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system, fabricated from 300 series stainless steel.
- B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
  - 1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A123 or ASTM A153 requirements.
- C. Exposed Flashing and Trim: Aluminum sheet, ASTM B209, alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat surface.
  - 1. Aluminum Sheet Thickness: Not less than 0.032 inches (20 gage).
  - 2. Finish: Match adjacent storefront framing finish.
- D. Concealed Flashing: Dead-soft, 0.018-inch-thick stainless steel, complying with ASTM A240, of type recommended by manufacturer.
- E. Bituminous Paint: Cold-applied asphalt-mastic paint containing no asbestos, formulated for 30-mil thickness per coat.
- F. Rigid PVC Filler.

## **2.7 FABRICATION**

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Fabricate components that, when assembled, have the following characteristics:
  - 1. Profiles that are sharp, straight, and free of defects or deformations.
  - 2. Accurately fitted joints with ends coped or mitered.
  - 3. Physical and thermal isolation of glazing from framing members.
  - 4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
  - 5. Provisions for field replacement of glazing from exterior.
  - 6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- E. Storefront Framing: Fabricate components for assembly using shear-block system or screw-spline system.
  - 1. Provide head and sill receptors as indicated on Drawings and as recommended by manufacturer.



- F. After fabrication, clearly mark components to identify their locations in Project in accordance with Shop Drawings.

## **2.8 ALUMINUM FINISHES**

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

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

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

### **3.2 INSTALLATION, GENERAL**

- A. Comply with manufacturer's written instructions.
- B. Do not install damaged components.
- C. Fit joints to produce hairline joints free of burrs and distortion.
- D. Rigidly secure nonmovement joints.
- E. Install exposed and concealed flashing and trim in accordance with Section 07 6200 – Sheet Metal Flashing and Trim.
- F. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
- G. Seal perimeter and other joints watertight unless otherwise indicated.
- H. Metal Protection:
  - 1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
  - 2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- I. Set continuous sill members and flashing in full sealant bed, as specified in Section 079200 "Joint Sealants," to produce weathertight installation; unless otherwise recommended by aluminum-framed storefront manufacturer.
- J. Install joint filler behind sealant as recommended by sealant manufacturer.
- K. Install components plumb and true in alignment with established lines and grades.

### **3.3 INSTALLATION OF GLAZING**

- A. Install glazing as specified in Section 08 8000 - Glazing.

### **3.4 ERECTION TOLERANCES**

- A. Install aluminum-framed storefronts to comply with the following maximum tolerances:
  - 1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
  - 2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
  - 3. Alignment:
    - a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch wide, limit offset from true alignment to 1/16 inch.
    - b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
    - c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset from true alignment to 1/4 inch.
  - 4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

### **3.5 FIELD QUALITY CONTROL**

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections: Perform the following tests on representative areas of aluminum-framed entrances and storefronts.
  - 1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested in accordance with AAMA 501.2 and shall not show evidence of water penetration.
- C. Aluminum-framed storefronts will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

### **3.6 CLEANING AND PROTECTION**

- A. Remove temporary protective coverings on completion of installation, clean finished surfaces, including removing unused fasteners and related installation materials. Maintain storefront systems in a clean condition during construction.
- B. Replace portions of storefront systems that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

**END OF SECTION 08 4113**

## **SECTION 08 7100 – DOOR HARDWARE**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Furnish all items of Door Hardware specified, scheduled, shown or required herein except those items specifically excluded from this section of the specification.
- B. Related Sections include the following:
  - 1. Section 08 1113 "Hollow Metal Doors and Frames."
  - 2. Section 08 1416 "Flush Wood Doors."
  - 3. Door Schedule on Drawings.

#### **1.3 QUALITY ASSURANCE**

- A. Requirements of Regulatory Agencies:
  - 1. Furnish door hardware to comply with the requirements of laws, codes, ordinances, and regulations of the governmental authorities having jurisdiction where such requirements exceed the requirements of the Specifications.
  - 2. Furnish door hardware to comply with the requirements of the regulations for public building accommodations for physically handicapped persons of the governmental authority having jurisdiction and to comply with Americans with Disabilities Act.
  - 3. Provide hardware for fire-rated openings in compliance with NFPA 80 and local building code requirements. Provide only hardware which has been tested and listed by UL for types and sizes of doors required and complies with requirements of door and door frame labels.
  - 4. Where emergency exit devices are required on fire-rated doors that carry supplementary marking on the doors UL labels indicating "fire door to be equipped with fire exit hardware," provide UL label on exit devices indicating "Fire Exit Hardware".
  - 5. Provide textured surface on the exterior door lever, pull or other operating hardware of doors that lead to hazardous areas (areas that might be dangerous to a blind person) Ex: Loading platforms, boiler rooms, stages, and the like.
- B. Hardware Supplier:
  - 1. Shall be an established firm dealing in contract builder's hardware. Firm shall be a factory authorized distributor for all products required, and shall have in employment an Architectural Hardware Consultant. (AHC), and personnel trained and experienced in preparing Hardware Schedule, issuing templates, ordering, furnishing and servicing door hardware.
  - 2. Supplier shall meet with Owner to determine keying requirements.

C. Pre-installation Meeting:

1. Before hardware installation, Construction Manager shall schedule a door hardware installation seminar be conducted on the installation of door hardware; specifically of locksets, closers, exit devices, overhead stops and coordinators. Manufacturer's representatives of the above products shall conduct seminar. Seminar to be held at job site and attended by installers of door hardware for aluminum, hollow metal and wood doors. Seminar to address proper coordination and installation of hardware, in accordance with hardware schedule for this specific project by using installation manuals, hardware schedule, templates, physical product samples and installation video's.
  - a. Convene one week prior to commencing work of this Section.

D. Manufacturer:

1. Obtain each type of hardware (latch and lock sets, hinges, closers, etc.) from a single manufacturer, although several may be indicated as offering products complying with requirements. Only domestic manufacturers are acceptable.

**1.4 SUBMITTALS:**

A. Hardware Schedule

1. Include the following:
  - a. Preface sheet listing category only and manufacturer's names of items being furnished as follows:

CATEGORY	SPECIFIED	SCHEDULED
Hinges	Manufacturer A	Manufacturer B
Lock sets	Manufacturer X	Manufacturer X
Kick Plates	Open	Manufacturer Z

- b. Hardware Locations.
  - c. Opening Description: Single or pair, number, room locations, hand, active leaf, degree of swing, size, door material, frame material, and UL listing.
  - d. Hardware Description: Quantity, category, product number, fasteners, and finish.
  - e. Headings that refer to the specified Hardware Set Numbers.
  - f. Scheduling Sequence shown in Hardware Sets.
  - g. Product data of each hardware item, and shop drawings where required, for special conditions and specialty hardware.
  - h. U.S. Standard finish symbols or BHMA finish symbols.
2. Product Data:
  - a. Submit, in booklet form using supplier's schedule covers as binders, Product Data of items of hardware listed in supplier's schedule.
  - b. Submit Product Data concurrently with hardware schedule.
3. Inspection Report:
  - a. Submit inspection report specified in Part 2 for closers and exit devices.

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

- A. Label each item of hardware with the appropriate door number and Hardware Schedule heading number, and deliver to the installer so designated by the Construction Manager.

## **1.6 WARRANTIES**

- A. Closers shall carry manufacturer's 30-year warranty against manufacturing defects and workmanship.
- B. Exit devices shall carry manufacturer's 3-year warranty against manufacturing defects and workmanship.
- C. Balance of items shall carry a manufacturer's 1-year warranty against manufacturing defects and workmanship.
- D. During the warranty period, replace defective work, including labor, materials and other costs incidental to the work. Inspect the work within 24 hours after receipt of notice from the Owner. Replace work found to be defective as defined in the Contract Documents.

## **PART 2 - PRODUCT**

### **2.1 PRODUCTS**

- A. General:
  - 1. Furnish each category with the products of only one manufacturer unless specified otherwise; this requirement is mandatory whether various manufacturers are listed or not.
  - 2. Provide the products of manufacturer designated or if more than one manufacturer is listed, the comparable product of one of the other manufacturers listed. Where only one manufacturer or product is listed, "no substitution" is implied.
- B. Hinges:
  - 1. Numbers used are Ives, equal products of McKinney, and Stanley are acceptable.
  - 2. Furnish hinges of class and size indicated in Hardware Sets.
- C. Continuous Hinges:
  - 1. Continuous Gear Hinges: 6063-T6 aluminum alloy, anodized finish (cap on entire hinge painted if specified). Manufacture to template, uncut hinges non-handed, pinless assembly, three interlocking extrusion, full height of door and frame, lubricated polyacetal thrust bearing, fasteners 410 stainless steel plated and hardened. All hinge profiles to be manufactured to template bearing locations, with standard duty bearing configurations at 5-1/8" spacing with a minimum of 16 bearings: and heavy duty at 2-9/16" spacing with a minimum of 32 bearings.
    - a. Length: 1" less than door opening height.
    - b. Furnish fire rated hinges "FR" at labeled opening.
    - c. Fastener 12-24 x 1/2" #3 Phillips keen form self tapping at aluminum and hollow metal doors, 12 x 1/2" #3 Philips, flathead full thread at wood doors.
    - d. Numbers used are Ives, equal products of Stanley, and Select are acceptable.
- D. Electronic Power Transfers
  - 1. Manufacturers:
    - a. Subject to compliance with requirements, provide:
      - 1) Von Duprin EPT2/EPT10; an Allegion company: [www.us.allegion.com](http://www.us.allegion.com).

- b. Or a comparable product from one of the following:
        - 1) Securitron; an Assa Abloy Group company: [www.assaabloydss.com](http://www.assaabloydss.com).
    - 2. Electrified Power Transfer: Provide concealed mortised electric power and data transfer device; provides connection between frame and door with sufficient number and gage of conductors to accommodate function of hardware specified.
      - a. Material: Aluminum or steel.
- E. Flush Bolts
  - 1. Manufacturers:
    - a. Subject to compliance with requirements, provide:
      - 1) Ives; an Allegion company: [www.us.allegion.com](http://www.us.allegion.com).
    - b. Or a comparable product from one of the following:
      - 1) Equal by any BHMA Manufacturer.
  - 2. Flush Bolts: Complying with BHMA A156.16, Grade 1.
    - a. Provide the following:
      - 1) Automatic flush bolts; meets BHMA A156.3.
      - 2) Constant latching flush bolts; meets BHMA A156.3.
      - 3) Manual flush bolts.
    - b. Flush bolt Throw: 3/4 inch, minimum.
    - c. Provide flush bolts in leading edge of inactive door leaves.
      - 1) One top bolt into top of frame and, where indicated, one bottom bolt into floor or threshold.
      - 2) Standard rod length shall be 12 inches. At oversized doors, provide extended rod lengths as required to accommodate actual door heights.
    - d. Dust Proof Strikes:
      - 1) Provide dust proof strikes for bottom bolts.
    - e. Constant Latching Flush Bolts: Automatically latch upon closing of door; manually retracted top bolt, automatically retracted bottom bolt; located on inactive leaf of pair of doors.
    - f. Automatic Flush Bolts: Automatically latch upon closing of door; automatic retraction of bolts when active leaf is opened; located on inactive leaf of pair of doors.
- F. Locksets and Latchsets - Mortise Type:
  - 1. Function numbers are as indicated in Hardware Sets.
    - a. Lockset
      - 1) Sargent 8200 series
    - b. Trim:
      - 1) Sargent LNJ
  - 2. Provide strikes with extended lips where required to protect trim from being marred by latch bolt. Provide strike lips which do not project more than 1/8 inch beyond doorframe trim at single doors and have 7/8 inch lip to center at pairs of 1-3/4 inch doors. Provide wrought box strikes on all locks and latches.
- G. Surface Closers:
  - 1. LCN 4000 Series.
    - a. Surface Mounted: Non-sized, adjustable from size 1 through size 5.
  - 2. Refer to door and frame details and furnish accessories such as drop plates, panel adapters, thick-hub shoes, blade stop spacers and shoe supports as required to install door closers correctly. State degree of door swing in the hardware schedule.
- H. Protection Plates:
  - 1. Furnish .050 inches thick, beveled 4 edges, 8 inch high x door width less 1-1/2 inch at single doors, and less one (1) inch at pairs.
    - a. Where glass or louvers prevent this height, supply with height equal to height of bottom rail less one (1) inch.
    - b. When specified to be installed above surface mounted automatic door bottoms, deduct height of door bottoms.
  - 2. Drill and countersink screw holes for oval head undercut screws. Pan head screws not acceptable.

- I. Wall Stops/Holders:
  - 1. Ives WS33(X) / WS45(x)
    - a. Equal product of any B.H.M.A. member.
  - 2. Furnish with pictorial installation instructions illustrating downward slope of diagonal side.
- J. Cylinders and Keying:
  - 1. Cylinders and keying for all hardware components capable of being locked.
    - a. Furnish cylinders to match existing system. Factory master and grand master key cores to existing system, according to Owner's instructions.
    - b. Supply cylinders with construction cores for use during the construction period.
    - c. Furnish construction master keys as required by Construction Manager.
- K. Seals, Sweeps, Gasketing, Thresholds
  - 1. Provide weather-stripping, and gasketing systems as specified and per architectural details. Match finish of other items.
  - 2. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.
    - a. Zero International
      - a) Equal product of any B.H.M.A. member.
- L. Miscellaneous:
  - 1. Furnish items not categorized in the above descriptions but specified by manufacturers names in the Hardware Sets.
- M. Fasteners:
  - 1. Furnish fasteners of the proper type, size, quantity, and finish. Provide stainless steel fasteners for stainless steel hardware.
  - 2. "TEK" type screws are not acceptable.
  - 3. Use machine screws and expansion shields for attaching hardware to concrete or masonry.
  - 4. Use wall grip inserts at hollow wall construction.
  - 5. Install exit devices with fasteners supplied by exit device manufacturer.
  - 6. Furnish machine screws for attachment to reinforced hollow metal doors and frames and reinforced aluminum doors and frames.
  - 7. Furnish full thread wood screws for attachment to solid wood doors and frames.
  - 8. Attach closers to hollow metal doors with machine screws and to wood doors with wood screws.
  - 9. Furnish sex bolts for closers at lead lined doors or fire rated wood doors without top blocking, unless UL or WH listing requires them.
  - 10. Furnish solid, spanner head, decorative thru-bolts for metal pulls, offset pulls, and free ends of push-pull sets.
- N. Finishes: As indicated in Hardware Sets.
- O. Templates and Hardware Location:
  - 1. Furnish hardware made to template. Supply required templates and hardware locations to the door and frame manufacturers.
  - 2. Furnish metal template to frame/door supplier for continuous hinge.
  - 3. Refer to Locations Article, and coordinate with templates.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

A. General:

1. Install hardware according to manufacturers installation instructions and to manufacturers template dimensions. Attach all items of hardware to doors, frames, walls, etc. with fasteners furnished and required by the manufacturer of the item.
  - a. Reinforced hollow metal doors and frames and reinforced aluminum doors and frames: drill and tap for machine screws.
  - b. Solid wood doors and frames: full thread wood screws. Drill pilot holes before inserting screws.
  - c. Refer to Cylinders and Keying Article regarding replacement of construction cores with final cores.

B. Locations:

1. Dimensions are from finish floor to center line of items.
2. Include this list in Hardware Schedule.

CATEGORY

Hinges  
Flush Bolt Levers  
Lockset Levers  
Exit Device Touchbar

DIMENSION

Door Manufacturer's Standard  
72 inches and 12 inches  
Door Manufacturer's Standard  
Per Template

#### **3.2 ADJUSTING AND DEMONSTRATING**

A. Final Adjustment:

1. Provide the services of a Hardware Supplier's or Manufacturer's Representative to inspect hardware furnished and its installation and adjustment, to make final hardware adjustment.
  - a. Replace units that cannot be adjusted to operate freely and smoothly or as intended for the application made.
2. Instruct the Owner's personnel in adjustment, care and maintenance of hardware.
3. Clean, polish and lubricate hardware.



### 3.3 HARDWARE SETS

#### Hardware Group No. 01

For use on Door #(s):

106.9

Provide each SGL door(s) with the following:











QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	DOOR + HARDWARE	BY MANUFACTURER		B/O
1	EA	SFIC CORE	(AS REQUIRED)	626	

#### Hardware Group No. 02

For use on Door #(s):

101.1                      101.3                      102.1

Provide each SGL door(s) with the following:









QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	224XY EPT		628	IVE
1	EA	POWER TRANSFER	EPT10	 ✎	689	VON
1	EA	ELECTRIFIED LOCK	RX-LC-8271-LNJ		626	SAR
1	EA	SFIC CORE	(AS REQUIRED)		626	
1	EA	SFIC CYLINDER HOUSING	(AS REQUIRED)		626	
1	EA	SURFACE CLOSER	4111 SCUSH MC ST-1586		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	RAIN DRIP	142AA		AA	ZER
1	SET	GASKETING	429AA-S		AA	ZER
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	654A-V3-223		A	ZER
1	EA	DOOR CONTACT	679-05HM	 ✎	BLK	SCE
1	EA	POWER SUPPLY	PROVIDED BY SECURITY CONTRACTOR	 ✎		VON
1	EA	CARD READER	PROVIDED BY SECURITY CONTRACTOR	✎		B/O

DOORS CLOSED AND LOCKED. PRESENTING VALID CREDENTIAL TO READER MOMENTARILY UNLOCKS LOCKSET. FREE EGRESS AT ALL TIMES.

Hardware Group No. 03

For use on Door #(s):  
NOT USED









Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	224XY		628	IVE
1	EA	CLASSROOM LOCK	LC-8237-LNJ		626	SAR
1	EA	SFIC CORE	(AS REQUIRED)		626	
1	EA	SFIC CYLINDER HOUSING	(AS REQUIRED)		626	
1	EA	SURFACE CLOSER	4111 SCUSH MC ST-1586		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	RAIN DRIP	142AA		AA	ZER
1	SET	GASKETING	429AA-S		AA	ZER
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	654A-V3-223		A	ZER
1	EA	DOOR CONTACT	679-05HM	 ✎	BLK	SCE

Hardware Group No. 04

For use on Door #(s):  
106.7 106.8









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	LC-8204-LNJ		626	SAR
1	EA	SFIC CORE	(AS REQUIRED)		626	
1	EA	SFIC CYLINDER HOUSING	(AS REQUIRED)		626	
1	EA	SURFACE CLOSER	4111 SCUSH MC ST-1586		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	RAIN DRIP	142AA		AA	ZER
1	SET	GASKETING	429AA-S		AA	ZER
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	654A-V3-223		A	ZER
1	EA	DOOR CONTACT	679-05HM	 ✎	BLK	SCE

Hardware Group No. 05

For use on Door #(s):  
102.2

Provide each SGL door(s) with the following:






QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		652	IVE
1	EA	POWER TRANSFER	EPT10	 ✎	689	VON
1	EA	ELECTRIFIED LOCK	RX-LC-8271-LNJ		626	SAR
1	EA	SFIC CORE	(AS REQUIRED)		626	
1	EA	SFIC CYLINDER HOUSING	(AS REQUIRED)		626	
1	EA	SURFACE CLOSER	4011 MC		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS33/WS33X		626	IVE
1	EA	GASKETING	488SBK PSA		BK	ZER
1	EA	DOOR CONTACT	679-05HM	 ✎	BLK	SCE
1	EA	POWER SUPPLY	PROVIDED BY SECURITY CONTRACTOR	 ✎		VON
1	EA	CARD READER	PROVIDED BY SECURITY CONTRACTOR		✎	B/O

DOORS CLOSED AND LOCKED. PRESENTING VALID CREDENTIAL TO READER MOMENTARILY UNLOCKS LOCKSET. FREE EGRESS AT ALL TIMES.

Hardware Group No. 06

For use on Door #(s):  
104.1 105.1

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		652	IVE
1	EA	STOREROOM LOCK	LC-8204-LNJ		626	SAR
1	EA	SFIC CORE	(AS REQUIRED)		626	
1	EA	SFIC CYLINDER HOUSING	(AS REQUIRED)		626	
1	EA	SURFACE CLOSER	4011 MC		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS33/WS33X		626	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)		BK	ZER

Hardware Group No. 07

For use on Door #(s):  
101.4






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	FB51T/FB61T (AS REQ.)		630	IVE
1	EA	CLASSROOM LOCK	LC-8237-LNJ		626	SAR
1	EA	COORDINATOR	COR X FL		628	IVE
2	EA	MOUNTING BRACKET	MB		689	IVE
2	EA	SURFACE CLOSER	4111 EDA MCSRI		695	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS		630	IVE
2	EA	WALL STOP/HOLDER	WS45/WS45X		626	IVE
1	EA	GASKETING	488SBK PSA		BK	ZER
1	EA	OVERLAPPING ASTRAGAL	BY DOOR/FRAME MANUFACTURER			B/O
2	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	546A-V3-223		A	ZER

Hardware Group No. 08

For use on Door #(s):  
103.1

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		652	IVE
1	EA	PRIVACY LOCK	LC-V20-8265-LNJ		626	SAR
1	EA	SURFACE CLOSER	4011 MC		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS33/WS33X		626	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)		BK	ZER

**END OF SECTION 08 7100**

## **SECTION 08 8000 - GLAZING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Monolithic glazing.
  - 2. Laminated glazing.
  - 3. Insulating glazing.
  - 4. Miscellaneous glazing materials.

#### **1.3 DEFINITIONS**

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters in accordance with ASTM C1036.
- C. Interspace: Space between lites of an insulating-glass unit.

#### **1.4 COORDINATION**

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances to achieve proper safety margins for glazing retention under each design load case, load case combination, and service condition.

#### **1.5 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Samples:
  - 1. Glass Samples: Submit three samples 12 by 12 inch in size for each glass type.
    - a. Non-insulated types may be 4 by 4 inches in size.
- C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.
- D. Delegated Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by qualified professional engineer responsible for their preparation.

#### **1.6 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer, primary glass manufacturer, and fabricated-glass manufacturer.
- B. Product Certificates: For glass.
- C. Sample Warranties: For special warranties.

## **1.7 QUALITY ASSURANCE**

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
  - 1. NGA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."
  - 2. GANA Publications: "GANA Sealant Manual."
  - 3. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- B. Delegated Design: Engage a qualified professional engineer licensed in the State in which the Project is located to design glazing.
- C. Fabricated-Glass Manufacturer Qualifications: A qualified manufacturer of fabricated glass units who is approved by primary glass manufacturer.
- D. Installer Qualifications: A qualified glazing contractor for this Project who is certified under the North American Contractor Certification Program (NACC) for Architectural Glass & Metal (AG&M) contractors and who employs glazing technicians certified under the Architectural Glass and Metal Technician (AGMT) certification program.
- E. Source Limitations for Glass:
  - 1. Obtain clear float glass from single source from single manufacturer.
  - 2. Obtain tinted and coated glass from single source from single manufacturer.
  - 3. Obtain laminated glass and insulated glazing units from a single source from a single fabricator.
- F. Source Limitations for Glazing Accessories: For each product and installation method, obtain from single source from single manufacturer.
  - 1. Each GL-Type in Glazing Schedule shall be from single source from single manufacturer unless otherwise indicated.
- G. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.
  - 1. Install glazing in mockups specified in the following sections:
    - a. Section 08 4113 - Aluminum-Framed Storefronts.
  - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

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

- A. Protect glazing materials in accordance with manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

## **1.9 FIELD CONDITIONS**

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
  - 1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F.

## **1.10 WARRANTY**

- A. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is obstruction of vision by dust, moisture, or film on interior surfaces of glass.
  - 1. Warranty Period: 10 years from date of Substantial Completion.
- B. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
  - 1. Warranty Period: 10 years from date of Substantial Completion.
- C. Manufacturer's Special Warranty for Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
  - 1. Warranty Period: 10 years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 GLASS MANUFACTURERS**

- A. Float Glass Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Guardian Glass, LLC: [www.guardianglass.com](http://www.guardianglass.com).
  - 2. Pilkington North America Inc: [www.pilkington.com](http://www.pilkington.com).
  - 3. Viracon, Inc: [www.viracon.com](http://www.viracon.com).
  - 4. Vitro Architectural Glass (formerly PPG Industries, Inc.): [www.vitroglazings.com](http://www.vitroglazings.com).
- B. Laminated Glass Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Any of the manufacturers specified for float glass or a fabricator approved by one of the specified float glass manufacturers.
- C. Insulating Glass Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Any of the manufacturers specified for float glass or a fabricator approved by one of the specified float glass manufacturers.

### **2.2 PERFORMANCE REQUIREMENTS**

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

- B. Glass Thickness: Indicated glass thicknesses are minimums. Provide glass that complies with performance requirements and load designs, and is not less than the thickness indicated.
- C. Glass Strength:
  - 1. Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with performance requirements.
  - 2. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with performance requirements.
- D. Glass Distortion Tolerances:
  - 1. Roller Wave: Maximum 0.003 inch from peak to valley within the main body of the sheet and maximum 0.008 inch within 10.5 inches of a leading or trailing edge.
  - 2. Localized Warp: Maximum 0.03 inch over any 12 inch span, but limited to 0.31 inch.
- E. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
  - 1. For monolithic-glass lites, properties are based on units with lites 6 mm thick.
  - 2. For laminated-glass lites, properties are based on products of construction indicated.
  - 3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
  - 4. U-Factors: Center-of-glazing values, in accordance with NFRC 100 and based on most current non-beta version of LBL's WINDOW computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
  - 5. SHGC and Visible Transmittance: Center-of-glazing values, in accordance with NFRC 200 and based on most current non-beta version of LBL's WINDOW computer program.
  - 6. Visible Reflectance: Center-of-glazing values, in accordance with NFRC 300.
- F. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated, including assembly dead loads and live loads, in accordance with local building codes and ASTM E1300.
  - 1. Design Wind Pressures: Determine design wind pressures applicable to Project in accordance with ASCE/SEI 7, and as indicated on Drawings.
  - 2. Probability of Breakage for Glass Sloped:
    - a. Not more than 15 degrees from vertical:
      - 1) Design glass for a probability of breakage not greater than 0.008 (8 lites per 1,000)
    - b. More than 15 degrees from vertical:
      - 1) Design glass for a probability of breakage not greater than 0.001 (1 lite per 1,000).
  - 3. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 the short side length or 1 inch, whichever is less.
  - 4. Thermal Loads (Differential Shading): Design glazing to resist thermal stress breakage induced by differential temperature conditions and limited air circulation within individual glass lites and insulated glazing units.



G. Insulating Glass:

1. Insulating Glass Certification Program: Provide insulating glass units that are certified by the Insulating Glass Certification Council (IGCC).
  - a. Provide permanent markings with appropriate certification label of IGCC on either the spacer or one lite of each insulated unit.

H. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

1. Provide permanent markings on safety-rated glazing in compliance with applicable safety glazing standards, ICC (IBC), local building code and authorities having jurisdiction.
2. Glass indicated to be fully tempered (Kind FT) glass or laminated glass shall comply with safety glazing requirements.

## 2.3 FLOAT GLASS

A. Clear Annealed Float Glass: ASTM C1036, Type I, Class 1 (clear), Quality-Q3.

B. Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

C. Heat-Strengthened Float Glass: ASTM C1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

## 2.4 LAMINATED GLASS

A. Laminated Glass: ASTM C1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

1. Construction: Float glass laminated with a polyvinyl butyral (PVB) interlayer to comply with interlayer manufacturer's written instructions.

a. Unless otherwise indicated:

- 1) Laminated glass shall consist of two plies of clear annealed float glass with a polyvinyl butyral interlayer.
- 2) Glass plies shall be of equal thicknesses.

2. Interlayer:

- a. Material: Polyvinyl butyral.
- b. Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.

- 1) Minimum Thickness: 0.060 inch thick, unless otherwise indicated.

- c. Color: Clear unless otherwise indicated.

3. Laminating Process: Fabricate laminated glass to produce glass free of foreign substances and air pockets.

## **2.5 GLASS COATINGS**

- A. General: Float glass with one or more glass coatings.
- B. Low-E-Coated Glass: Comply with ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on float glass; Kind CV (vision glass) and Kind CS (spandrel glass) as indicated.
  1. Basis-of-Design Product: Vitro Architectural Glass (formerly PPG Industries, Inc.; Solarban 70, or a comparable product from any of the manufacturers specified for float glass.

## **2.6 INSULATING GLASS**

- A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of float glass separated by a dehydrated interspace, qualified in accordance with ASTM E2190.
  1. Interspace Content:
    - a. Air: 100 percent air.
- B. Perimeter Spacer: Warm-edge spacer.
  1. General:
    - a. Material: Manufacturer's standard low conductivity silicone, polymer, stainless steel, or hybrid material.
    - b. Spacer Color: Black or Gray.
    - c. Spacer Width: As required for specified insulating glass unit.
    - d. Edge Seal: Dual-sealed system.
      - 1) Primary Seal: Applied between spacer and glass panes.
      - 2) Secondary Seal: Applied around perimeter of insulated unit.
      - 3) Edge Seal Color: Black.
    - e. Use edge seal materials as recommended by spacer manufacturer and insulating glass manufacturer.
  2. Products: Subject to compliance with requirements provide one of the following systems:
    - a. H.B. Fuller/Kommerling.; Kodispace 4SG: [www.hbfuller.com](http://www.hbfuller.com).
      - 1) Spacer Material: Synthetic rubber (polyisobutylene) with integral desiccant.
      - 2) Primary Seal: Self-bonding spacer.
      - 3) Secondary Seal: Silicone sealant.
    - b. Quanex IG Systems, Inc; Super Spacer TriSeal: [www.quanex.com](http://www.quanex.com).
      - 1) Spacer Material: Silicone foam with integral desiccant and vapor barrier backing.
      - 2) Primary Seal: Polyisobutylene (PIB) sealant with acrylic adhesive inner seal.
      - 3) Secondary Seal: Silicone sealant.
    - c. Technoform Glass Insulation; TGI-Spacer M/SP17: [www.technoform.com](http://www.technoform.com).
      - 1) Spacer Material: Polypropylene top with integral desiccant and stainless steel back.

- 2) Primary Seal: Butyl sealant.
- 3) Secondary Seal: Silicone sealant.

d. Viracon, Inc; Viracon Thermal Spacer (VTS): [www.viracon.com](http://www.viracon.com).

- 1) Spacer Material: Thermoplastic with integral desiccant.
- 2) Primary Seal: Polyisobutylene (PIB) sealant.
- 3) Secondary Seal: Silicone sealant.

e. Vitro Architectural Glass (Formerly PPG); Intercept Spacer System: [www.vitroglazings.com](http://www.vitroglazings.com).

- 1) Spacer Material: Stainless steel.
- 2) Primary Seal: Polyisobutylene (PIB) sealant.
- 3) Secondary Seal: Silicone sealant.

C. Desiccant: Molecular sieve or silica gel, or a blend of both.

## 2.7 GLAZING SEALANTS

A. General:

- 1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
- 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.

B. General Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 25 or 50, Use NT.

- 1. Products: Subject to compliance with requirements, provide one of the following products:
  - a. Dow Corning Corporation; 795 Silicone Building Sealant: [www.dowcorning.com](http://www.dowcorning.com).
  - b. Dow Corning Corporation; 899 Silicone Glazing Sealant: [www.dowcorning.com](http://www.dowcorning.com).
  - c. GE/Momentive Performance Materials, Inc; SCS2800 SilGlaz II: [www.siliconeforbuilding.com](http://www.siliconeforbuilding.com)
  - d. Pecora Corporation: 896: [www.pecora.com](http://www.pecora.com).
  - e. Tremco, Inc.: Spectrem 2: [www.tremcosealants.com](http://www.tremcosealants.com).

2. Color: Black.

## 2.8 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C1281 and AAMA 800 for products indicated below:

- 1. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
- 2. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

- 1. AAMA 810.1, Type 1, for glazing applications in which tape acts as primary sealant.
- 2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

## **2.9 MISCELLANEOUS GLAZING MATERIALS**

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, recommended in writing by manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks:
  - 1. EPDM, silicone, or neoprene with Shore A durometer hardness of 85, plus or minus 5.
  - 2. Type recommended in writing by sealant or glass manufacturer.
- D. Spacers:
  - 1. EPDM, silicone, or neoprene blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated, but not less than 50 to 60 Shore A durometer hardness.
  - 2. Type recommended in writing by sealant or glass manufacturer.
- E. Edge Blocks:
  - 1. EPDM, silicone, or neoprene with Shore A durometer hardness per manufacturer's written instructions.
  - 2. Type recommended in writing by sealant or glass manufacturer.
- F. Glazing Gaskets and Splines: Resilient silicone, EPDM or polyvinyl chloride extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color black
- G. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

## **2.10 FABRICATION OF GLAZING UNITS**

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
  - 1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
    - a. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
- B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.
- C. Grind smooth and polish exposed glass edges and corners.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
  - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
  - 2. Presence and functioning of weep systems.

3. Minimum required face and edge clearances.
4. Effective sealing between joints of glass-framing members.

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

### **3.2 PREPARATION**

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

### **3.3 GLAZING, GENERAL**

- A. Glazing:
  1. Exterior Glass: Unless otherwise indicated, exterior glass shall be insulating-glass units.
    - a. Provide Low-E-coating unless otherwise indicated.
    - b. Provide safety glass where indicated and as required by local building code and authorities having jurisdiction.
  2. Interior Glass: Unless otherwise indicated, all interior glass shall be non-insulated glass units.
    - a. Provide safety glass where indicated and as required by local building code and authorities having jurisdiction.
  3. Exterior doors shall have Low-E-coated insulating-safety glass units; interior vestibule doors shall have non-insulated safety glass.
    - a. Insulating glass shall comply with exterior glass above.
    - b. Non-insulated safety glass shall comply with interior glass above.
- B. Installation Method:
  1. Use one or more of the specified glazing methods as recommended by GANA, glass manufacturer, fabricator, and installer, and as required to comply with performance requirements.
- C. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- D. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- E. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- F. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- G. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

- H. Provide spacers for glass lites where length plus width is larger than 50 inches.
  - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
  - 2. Provide 1/8-inch-minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- I. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and in accordance with requirements in referenced glazing publications.
- J. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- K. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- L. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- M. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended in writing by gasket manufacturer.

### **3.4 TAPE GLAZING**

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until right before each glazing unit is installed.
- F. Apply heel bead of elastomeric sealant as recommended by GANA.
- G. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- H. Apply cap bead of elastomeric sealant over exposed edge of tape as recommended by GANA..

### **3.5 GASKET GLAZING (DRY)**

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended in writing by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended in writing by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

### **3.6 SEALANT GLAZING (WET)**

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

### **3.7 CLEANING AND PROTECTION**

- A. Immediately after installation, remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
  - 1. If, despite such protection, contaminating substances do contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.
- D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

### **3.8 GLAZING SCHEDULE**

- A. GL-1A: Low-E-coated, clear insulating glass.
  - 1. Overall Unit Thickness: 1 inch.
  - 2. Outdoor Lite: Clear annealed float glass.
    - a. Minimum Thickness: 1/4 inch (6 mm).
    - b. Low-E Coating: On 2nd surface.
  - 3. Airspace:
    - a. Width: 1/2 inch.
    - b. Interspace Content: Air.

4. Indoor Lite: Clear annealed float glass.
    - a. Minimum Thickness: 1/4 inch (6 mm).
  5. Performance:
    - a. Winter Nighttime U-Factor: 0.28 maximum.
    - b. Visible Light Transmittance: 64 percent minimum.
    - c. Solar Heat Gain Coefficient: 0.27 maximum.
- B. GL-1B Low-E-coated, clear, insulating safety glass
1. Overall Unit Thickness: 1-1/16 inch.
  2. Outdoor Lite: Clear fully tempered float glass.
    - a. Minimum Thickness: 1/4 inch (6 mm).
    - b. Low-E Coating: On 2nd surface.
  3. Airspace:
    - a. Width: 1/2 inch.
    - b. Interspace Content: Air.
  4. Indoor Lite: Clear laminated float glass.
    - a. Minimum Overall Thickness: 1/4 inch (6 mm).
  5. Safety glazing required.
  6. Performance: Comply with performance requirements of GL-1A
- C. GL2: Clear monolithic glass.
1. Clear annealed float glass.
  2. Minimum Thickness: 1/4 inch (6 mm).
- D. GL-3: Clear non-insulated safety glass.
1. Clear laminated safety glass.
  2. Minimum Overall Thickness: 1/4 inch (6 mm).
  3. Safety glazing required.

**END OF SECTION 08 8000**



## **SECTION 08 9000 - LOUVERS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section includes:
  - 1. Fixed louvers and accessories.

#### **1.3 DEFINITIONS**

- A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.
- B. Horizontal Louver: Louver with horizontal blades (i.e., the axis of the blades are horizontal).
- C. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.

#### **1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.
- B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.
  - 1. Include screens and blank-off panels
- C. Samples for Initial Selection: For each type of metal finish indicated.
- D. Samples for Verification:
  - 1. Include Samples of each type of metal finish indicated to verify finish and color selection, in manufacturer's standard sizes.

#### **1.5 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For manufacturer and installer.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.
- C. Sample Warranties: For manufacturer's special warranties.

## **1.6 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than 5 years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least 5 years of documented experience.
- C. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

## **1.7 FIELD CONDITIONS**

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

## **1.8 WARRANTY**

- A. Special Finish Warranty: Manufacturer agrees to repair or replace components on which finishes fail in materials or workmanship within specified warranty period.
  - 1. Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Hunter units when tested according to ASTM D2244.
    - b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  - 2. Warranty Period: 20 years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Source Limitations: Obtain fixed louvers from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

### **2.2 PERFORMANCE REQUIREMENTS**

- A. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.
  - 1. Wind Loads: Determine loads based on pressures as indicated on Drawings.
    - a. But not less than a uniform pressure of 25 lbf/sq. ft., acting inward or outward.
- B. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
  - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

- D. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

## **2.3 FIXED EXTRUDED-ALUMINUM LOUVERS**

A. Horizontal Drainable-Blade Louver:

1. Products: Subject to compliance with requirements, provide Greenheck Fan Corporation; Model ESD-435: [www.greenheck.com](http://www.greenheck.com), or a comparable product by one of the following
  - a. The Airolite Company: [www.airolite.com](http://www.airolite.com).
  - b. Arrow United Industries: [www.arrowunited.com](http://www.arrowunited.com).
  - c. Construction Specialties, Inc.: [www.c-sgroup.com](http://www.c-sgroup.com).
  - d. Industrial Louvers, Inc.: [www.industriallouvers.com](http://www.industriallouvers.com).
  - e. Ruskin: [www.ruskin.com](http://www.ruskin.com).
2. Louver and Frame Depth: 6 inches.
3. Sizes: As indicated on Drawings.
4. Blade Profile: Manufacturer's standard blade with drainable gutter.
5. Frame and Blade Nominal Thickness: Not less than 0.080 inch (12 gage) for blades and 0.080 inch (12 gage) for frames.
6. Mullion Type: Semirecessed.
7. Louver Performance Ratings:
  - a. Free Area: Not less than 8.0 sq. ft. for 48-inch-wide by 48-inch-high louver (50 percent).
  - b. Point of Beginning Water Penetration: Not less than 910 fpm.
  - c. Air Performance: Not more than 0.15-inch wg static pressure drop at 1000-fpm free-area intake velocity.
8. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

## **2.4 LOUVER SCREENS**

A. General: Provide screen at each exterior louver.

1. Screen Location for Fixed Louvers: Interior face.
2. Screening Type: Bird screening.

B. Secure screen frames to louver frames with stainless-steel machine screws with heads finished to match louver, spaced a maximum of 6 inches from each corner and at 12 inches o.c.

C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.

1. Metal: Same type and form of metal as indicated for louver to which screens are attached.
2. Finish: Same finish as louver frames to which louver screens are attached.
3. Type:
  - a. At Bird Screens: Non-rewirable, U-shaped frames.

D. Louver Screening for Aluminum Louvers:

1. Bird Screening: Stainless steel, 1/2-inch-square mesh, 0.047-inch wire.

## **2.5 BLANK-OFF PANELS**

- A. Insulated Blank-Off Panels: Laminated panels consisting of an insulating core surfaced on back and front with metal sheets and attached to back of louver.
  - 1. Thickness: 2 inches.
  - 2. Metal Facing Sheets: Aluminum sheet, not less than 0.032-inch nominal thickness.
  - 3. Insulating Core: Extruded-polystyrene foam.
  - 4. Edge Treatment: Trim perimeter edges of blank-off panels with louver manufacturer's standard extruded-aluminum-channel frames, not less than 0.080-inch nominal thickness, with corners mitered and with same finish as panels.
  - 5. Seal perimeter joints between panel faces and louver frames with gaskets or sealant.
  - 6. Panel Finish: Same finish applied to louvers.
  - 7. Attach blank-off panels with clips.

## **2.6 MATERIALS**

- A. Aluminum Extrusions: ASTM B221, Alloy 6063-T5, T-52, or T6.
- B. Aluminum Sheet: ASTM B209, Alloy 3003 or 5005, with temper as required for forming, or as otherwise recommended by metal producer for required finish.
- C. Fasteners: Use types and sizes to suit unit installation conditions.
  - 1. Use Phillips flat-head tamper-resistant screws for exposed fasteners unless otherwise indicated.
  - 2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
  - 3. For color-finished louvers, use fasteners with heads that match color of louvers.
- D. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, fabricated from stainless-steel components, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing according to ASTM E488/E488M conducted by a qualified testing agency.
- E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187.

## **2.7 FABRICATION**

- A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- B. Vertical Assemblies: Where height of louver units exceeds fabrication and handling limitations, fabricate units to permit field-bolted assembly with close-fitting joints in jambs and mullions, reinforced with splice plates.
  - 1. Continuous Vertical Assemblies: Fabricate units without interrupting blade-spacing pattern.
- C. Maintain equal louver blade spacing to produce uniform appearance.
- D. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
  - 1. Frame Type: Channel unless otherwise indicated.
- E. Include supports, anchorages, and accessories required for complete assembly.

- F. Provide vertical mullions of type and at spacings indicated, but not more than is recommended by manufacturer, or 72 inches o.c., whichever is less.
  - 1. Semirecessed Mullions: Where indicated, provide mullions partly recessed behind louver blades, so louver blades appear continuous. Where length of louver exceeds fabrication and handling limitations, fabricate with interlocking split mullions and close-fitting blade splices designed to permit expansion and contraction.
- G. Provide extended sills for recessed louvers.
- H. Join frame members to each other and to fixed louver blades with fillet welds concealed from view, threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

## **2.8 ALUMINUM FINISHES**

- A. Finish louvers after assembly.
- B. High-Performance Organic Finish: Two or Three-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coats and clear topcoat with suspended mica or metallic flakes as required for colors specified. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  - 1. Color and Gloss: Standard color as selected by Architect.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

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

### **3.2 PREPARATION**

- A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

### **3.3 INSTALLATION**

- A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.
- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
- C. Form closely fitted joints with exposed connections accurately located and secured.
- D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- E. Protect unpainted galvanized- and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

- F. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 07 9200 "Joint Sealants" for sealants applied during louver installation.

#### **3.4 ADJUSTING AND CLEANING**

- A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.
- B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.
- C. Restore louvers damaged during installation and construction, so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.
  - 1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

**END OF SECTION 08 9000**

## **SECTION 09 2216 - NON-STRUCTURAL METAL FRAMING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section includes:
  - 1. Non-load-bearing steel framing systems for ceilings.
  - 2. Suspension systems for interior ceilings and soffits.

#### **1.3 ACTION SUBMITTALS**

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

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Manufacturer's Qualification Statement.
- B. Installer's Qualification Statement.

#### **1.5 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least five years of documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum five years documented experience and approved by manufacturer.

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products from one of the following:
  - 1. ClarkDietrich Building Systems: [www.clarkdietrich.com](http://www.clarkdietrich.com).
  - 2. Jaimes Industries Inc.: [www.jaimesind.com](http://www.jaimesind.com).
  - 3. Marino\WARE: [www.marinoware.com](http://www.marinoware.com).
  - 4. MBA Building Supplies, Inc.: [www.mbastuds.com](http://www.mbastuds.com).
  - 5. MRI Steel Framing LLC: [www.mristeel framing.com](http://www.mristeel framing.com).
  - 6. State Building Products; [www.statebp.com](http://www.statebp.com).
  - 7. Telling Industries; [www.buildstrong.com](http://www.buildstrong.com).

## **2.2 PERFORMANCE REQUIREMENTS**

- A. Provide completed assemblies complying with ASTM C840 and GA-216.
- B. Protective Coatings: Equivalent (EQ) coatings are not acceptable; products shall be hot-dip galvanized as indicated.
- C. Embossed (equivalent thickness) steel framing products are not acceptable; products shall be in steel thicknesses indicated.
- D. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.
- E. Horizontal Deflection: For wall and ceiling assemblies, limited to L/240 of the wall height based on horizontal loading of 5 lbf/sq. ft.

## **2.3 FRAMING SYSTEMS**

- A. Framing Members, General: Comply with ASTM C754 for conditions indicated.
  - 1. Steel Sheet Components: Comply with ASTM C645 requirements for steel unless otherwise indicated.
  - 2. Protective Coating: ASTM A653, G40 (Z120), hot-dip galvanized unless otherwise indicated.
- B. Studs and Tracks: ASTM C645.
  - 1. Steel Studs and Tracks:
    - a. Minimum Base-Steel Thickness: 0.030 inch (20 gage).
    - b. Depth: As indicated on Drawings.
- C. Cold-Rolled Channel Bridging: 0.054 inch thick (16 gage), galvanized minimum base-steel thickness, with minimum 1/2-inch-wide flanges.
  - 1. Depth: 1-1/2 inches.
  - 2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.064-inch (16 gage) thick, galvanized steel.
  - 3. At Contractor's option, the following products may be used instead of traditional clip angles:
    - a. Rapid Clips: Friction fit clip design allowing for rapid installation of channel bridging.
      - 1) Minimum Base-Steel Thickness: 0.043 inch (18 gage).
      - 2) Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
        - a) ClarkDietrich Building Systems; Fastbridge Clip: [www.clarkdietrich.com](http://www.clarkdietrich.com).

## **2.4 SUSPENSION SYSTEMS**

- A. Traditional Carrying and Furring Channels System:
  - 1. Locations: All locations except where grid suspension system is indicated or permitted.
  - 2. Tie Wire: ASTM A641, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.



3. Hanger Attachments to Concrete:
    - a. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, AC193, AC58, or AC308 as appropriate for the substrate.
      - 1) Uses: Securing hangers to structure.
      - 2) Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.
      - 3) Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F593, and nuts, ASTM F594.
  4. Wire Hangers: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.
  5. Carrying Channels (Main Runners): Cold-rolled, commercial-steel sheet with a base-steel thickness of 0.030 inch (20 gage) and minimum 1/2-inch-wide flanges.
    - a. Depth: 2-1/2 inches, unless otherwise indicated on Drawings.
  6. Furring Channels (Furring Members):
    - a. Hat-Shaped, Rigid Furring Channels: ASTM C645; galvanized steel sheet members.
      - 1) Minimum Base-Steel Thickness: 0.030inch (20 gage).
      - 2) Depth: 7/8 inch, unless otherwise indicated on Drawings.
    - b. Resilient Furring Channels: ASTM C645; 1/2-inch-deep, galvanized steel sheet members designed to reduce sound transmission.
      - 1) Minimum Base-Steel Thickness: 0.0232 inch (24 gage).
      - 2) Configuration: Asymmetrical.
- B. Grid Suspension System for Gypsum Board Ceilings:
1. Locations:
    - a. Where indicated on Drawings.
    - b. And elsewhere at Contractor's option instead of traditional carrying and furring channels system.
    - c. Not permitted for multi-layer gypsum board systems.
  2. Grid Suspension System for Gypsum Board Ceilings: ASTM C645, direct-hung system composed of main beams and cross-furring members that interlock.
    - a. Manufacturers: Subject to compliance with requirements, provide one of the following products:
      - 1) Armstrong World Industries, Inc.; Drywall Grid System: [www.armstrongceilings.com](http://www.armstrongceilings.com).
      - 2) CertainTeed/Saint-Gobain; Quickspan Locking Drywall Grid System: [www.certainteed.com](http://www.certainteed.com).
      - 3) Rockfon, Part of the Rockwool Group; Chicago Metallic Drywall Grid: [www.rockfon.com](http://www.rockfon.com).
      - 4) USG Corporation: Drywall Suspension System: [www.usg.com](http://www.usg.com).

## **2.5 AUXILIARY MATERIALS**

- A. General: Provide auxiliary materials that comply with referenced installation standards.
  - 1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Neoprene Closure Strips: ASTM D1056, Type 2 (Closed Cell), Class C (neoprene), Grade 2 (5 to 9 psi for 25 percent compression).
  - 1. Color: Black.
  - 2. Thickness: 1/2 inch thick, unless otherwise required.
  - 3. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Williams Products, Inc.; 1040 Series, Type NN1; [www.williamsproducts.net](http://www.williamsproducts.net).
- C. Isolation Strip at Exterior Walls.
  - 1. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size; ASTM D3575.
    - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      - 1) Williams Products, Inc; Everlastic EVA 200; [www.williamsproducts.net](http://www.williamsproducts.net).

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION, GENERAL**

- A. Installation Standard: ASTM C754.
  - 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.
- B. Install framing, suspension systems, and other related accessories and components in accordance with manufacturer's instructions.
- C. Install framing and accessories plumb, square, and true to line, with connections securely fastened.
- D. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- E. Install bracing at terminations in assemblies.
- F. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

### **3.3 INSTALLING FRAMED ASSEMBLIES**

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
  - 1. Install studs at 16 inches o.c. unless otherwise indicated or required by horizontal deflection performance requirements.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.

### **3.4 INSTALLING CEILING SUSPENSION SYSTEMS**

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
  - 1. Hangers: 48 inches o.c.
  - 2. Carrying Channels (Main Runners): 48 inches o.c.
  - 3. Furring Channels (Furring Members): 16 inches o.c.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
  - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
    - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
  - 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
    - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
  - 3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
  - 4. Do not attach hangers to steel roof deck.
  - 5. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
  - 6. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
  - 7. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Lateral/Seismic Bracing: Sway-brace suspension systems with hangers used for support.
- E. Grid Suspension Systems:
  - 1. Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

- F. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

**END OF SECTION 09 2216**

## **SECTION 09 2900 – GYPSUM BOARD**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Gypsum board.
  - 2. Finishing materials.
  - 3. Trim accessories.
  - 4. Acoustic insulation.

#### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: Indicate special details associated with fireproofing and acoustic seals.
  - 1. Include locations of control joints.
- C. Samples: For the following products:
  - 1. Submit three samples of each board type, 4 inches square in size
  - 2. Trim Accessories: Submit three samples of each type of trim, full-size in 4-inch-long lengths.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Manufacturer's Qualification Statement.
- B. Installer's Qualification Statement.

#### **1.5 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least five years of documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum five years documented experience and approved by manufacturer.
- C. Mockups: Build mockups of at least 100 sq. ft. in surface area to demonstrate aesthetic effects and to set quality standards for materials and execution.
  - 1. Build mockups for the following:
    - a. Each level of gypsum board finish indicated for use in exposed locations.
  - 2. Apply or install final decoration indicated, including painting and wallcoverings, on exposed surfaces for review of mockups.
  - 3. Simulate finished lighting conditions for review of mockups.
  - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

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

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

## **1.7 FIELD CONDITIONS**

- A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.
- B. Do not install interior gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, moisture damaged, and mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. Provide completed assemblies complying with ASTM C840 and GA-216.
- B. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.
- C. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.
- D. Horizontal Deflection: For wall assemblies, limited to 1/240 of the wall height based on horizontal loading of 5 lbf/sq. ft.
  - 1. Exception: Limit deflection of walls to receive hard tile surfaces to 1/360 of the wall height based on horizontal loading of 5 lbf/sq. ft.

### **2.2 GYPSUM BOARD, GENERAL**

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

### **2.3 GYPSUM BOARD**

- A. Gypsum Board, Type X: Paper-faced gypsum panels with fire-resistant core; ASTM C1396.
  - 1. Thickness: 5/8 inch.
  - 2. Long Edges: Tapered with paper face wrapping edge.
  - 3. Short Edges: Square cut.
  - 4. Type: Fire resistance rated Type X, UL or WH listed.
  - 5. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corp.; Type X Gypsum Board: [www.certainteed.com](http://www.certainteed.com).
    - b. Georgia-Pacific Gypsum; ToughRock Fireguard X: [www.gp.com](http://www.gp.com).

- c. National Gypsum Company; Gold Bond Brand Fire-Shield Gypsum Board:  
[www.nationalgypsum.com](http://www.nationalgypsum.com).
- d. USG Corporation; Sheetrock Brand Firecode X Panels: [www.usg.com](http://www.usg.com).

## **2.4 TRIM ACCESSORIES**

### **A. Trim: ASTM C1047.**

1. Manufacturers: Subject to compliance with requirements, available manufacturers with products that may be incorporated into the Work include, but are not limited to, the following:
  - a. ClarkDietrich Building Systems: [www.clarkdietrich.com](http://www.clarkdietrich.com).
  - b. Marino\WARE: [www.marinoware.com](http://www.marinoware.com).
  - c. Telling Industries; [www.buildstrong.com](http://www.buildstrong.com).
  - d. Phillips Manufacturing Co: [www.phillipsmfg.com](http://www.phillipsmfg.com).
  - e. USG Corporation: [www.usg.com](http://www.usg.com).
2. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, or paper-faced galvanized-steel sheet.
  - a. At Contractor's option, for Cornerbeads (inside and outside corners), L-Beads, and Arches (curved edges):
    - 1) Material: Impact-resistant composite corner beads consisting of copolymer core, joint tape backing, and surface paper face.
    - 2) Products: Subject to compliance with requirements, provide the following:
      - a) CertainTeed Corp.; No-Coat Drywall Corner: [www.certainteed.com](http://www.certainteed.com).
3. Shapes:
  - a. Cornerbead.
  - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
  - c. L-Bead: L-shaped; exposed long flange receives joint compound.
  - d. Expansion (control) joint.

## **2.5 JOINT TREATMENT MATERIALS**

- ### **A. General: Comply with ASTM C475/C475M.**
- ### **B. Joint Tape: Paper, 2 inches wide, creased for joints and corners.**
1. Manufacturers: Subject to compliance with requirements, provide products from one of the specified gypsum wall board manufacturers.
- ### **C. Joint Compound: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.**
1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
  2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound or drying-type, all-purpose compound.
    - a. Use setting-type compound for installing paper-faced metal trim accessories.
  3. Fill Coat: For second coat, use setting-type, sandable topping compound or drying-type, all-purpose compound.
  4. Finish Coat: For third coat, use setting-type, sandable topping compound or drying-type, all-purpose compound.

## 2.6 AUXILIARY MATERIALS

- A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
  - 1. Adhesives: Subject to compliance with requirements, provide one of the following
    - a. Franklin International, Inc; Titebond GREENchoice Professional Drywall Adhesive; [www.titebond.com](http://www.titebond.com).
    - b. PPG Architectural Coatings; Liquid Nails DWP-24 Drywall Construction Adhesive: [www.liquidnails.com](http://www.liquidnails.com).
- C. Steel Drill Screws: ASTM C1002 unless otherwise indicated.
  - 1. Use screws complying with ASTM C954 for fastening panels to steel members (cold-formed metal framing) from 0.033 to 0.112 inch thick.
- D. Sound-Attenuation Blankets: Produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
  - 1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
  - 2. Acoustic Insulation: Provide one of the following types:
    - a. Mineral Fiber/Rock Wool Batts: ASTM C665; preformed mineral fiber, friction fit type, unfaced.
      - 1) Thickness: 3 inches, unless otherwise indicated.
      - 2) Density: 2.5 pcf.
      - 3) Flame Spread/Smoke Developed: 0/0 per ASTM E84.
      - 4) Products: Subject to compliance with requirements, provide one of the following:
        - a) Johns Manville; Mineral Wool Sound Attenuation Fire Batts (SAFB): [www.jm.com](http://www.jm.com).
        - b) Owens Corning; Thermafiber SAFB (Sound Attenuation Fire Batts): [www.owenscorning.com](http://www.owenscorning.com).
        - c) Rockwool; Safe'n'Sound: [www.rockwool.com](http://www.rockwool.com).
    - b. Fiberglass Batts: ASTM C665; preformed glass fiber, friction fit type, unfaced.
      - 1) Thickness: 3-1/2 inches, unless otherwise indicated.
      - 2) Products: Subject to compliance with requirements, provide one of the following:
        - a) CertainTeed Corporation/Saint-Gobain; NoiseReducer Sound Attenuation Batts: [www.certainteed.com](http://www.certainteed.com).
        - b) Johns Manville; Formaldehyde-Free Fiberglass Insulation: [www.jm.com](http://www.jm.com).
        - c) Knauf Insulation; EcoBatt Insulation with ECOSE Technology: [www.knaufinsulation.com](http://www.knaufinsulation.com).
        - d) Owens Corning Corporation; EcoTouch Sound Attenuation Batts: [www.owenscorning.com](http://www.owenscorning.com).
- E. Acoustical Sealant: As specified in Section 07 9200 – Joint Sealants.



### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION AND FINISHING OF PANELS, GENERAL**

- A. Comply with ASTM C840, GA-216, and manufacturer's instructions.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
  - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft.in area.
  - 2. Fit gypsum panels around ducts, pipes, and conduits.
  - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch-wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch-wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- J. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

### **3.3 INSTALLATION OF GYPSUM BOARD**

A. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
2. On partitions/walls, apply gypsum panels vertically (parallel to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
  - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
3. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

B. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches (400 mm) minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
2. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

### **3.4 INSTALLATION OF TRIM ACCESSORIES**

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints according to ASTM C840 and in specific locations approved by Architect for visual effect. Place control joints consistent with lines of building spaces and as follows:
1. Not more than 30 feet apart on walls and ceilings, unless otherwise indicated.
  2. Submit control joint locations to Architect for approval prior to installation.
- C. Interior Trim: Install in the following locations:
1. Cornerbead: Use at outside corners.
  2. L-Bead: Use at exposed panel edges except where Drawings indicate LC-Beads.

### **3.5 FINISHING GYPSUM BOARD**

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C840:
1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
    - a. Exception: Fire-Rated Construction shall comply with requirements of assembly listing
  2. Level 2: In utility areas, behind cabinetry, and in similar locations that shall not be painted or finished, and at tile backing board to receive tile finish.
  3. Level 4: At areas that will be exposed to view; unless otherwise indicated.

### **3.6 PROTECTION**

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

### **3.7 FIELD QUALITY CONTROL**

- A. Above-Ceiling Observation: Before Contractor installs gypsum board ceilings, Architect will conduct an above-ceiling observation and report deficiencies in the Work observed. Do not proceed with installation of gypsum board until deficiencies have been corrected.
  - 1. Notify Architect seven days in advance of date and time when Project, or part of Project, will be ready for above-ceiling observation.
  - 2. Before notifying Architect, complete the following in areas to receive gypsum board ceilings:
    - a. Installation of 80 percent of lighting fixtures, powered for operation.
    - b. Installation, insulation, and leak and pressure testing of water piping systems.
    - c. Installation of air-duct systems.
    - d. Installation of air devices.
    - e. Installation of mechanical system control wiring.
    - f. Installation of ceiling support framing.

**END OF SECTION 09 2900**

## **SECTION 09 5113 – ACOUSTICAL PANEL CEILINGS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section includes:
  - 1. Acoustical panels.
  - 2. Metal suspension systems.

#### **1.3 PREINSTALLATION MEETINGS**

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

#### **1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Samples for Initial Selection: For components with factory-applied finishes.
- C. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of sizes indicated below:
  - 1. Acoustical Panels: Set of 6-inch-square Samples of each type, color, pattern, and texture.
  - 2. Metal Suspension-System Members, Moldings, and Trim: Set of 6-inch- long Samples of each type, finish, and color.

#### **1.5 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For manufacturer and installer.
- B. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Ceiling suspension-system members.
  - 2. Structural members to which suspension systems will be attached.
  - 3. Method of attaching hangers to building structure.
  - 4. Carrying channels or other supplemental support for hanger-wire attachment where conditions do not permit installation of hanger wires at required spacing.
  - 5. Size and location of initial access modules for acoustical panels.
  - 6. Items penetrating finished ceiling and ceiling-mounted items including, but not limited to, the following:
    - a. Lighting fixtures.
    - b. Diffusers.
    - c. Grilles.
    - d. Speakers.
    - e. Sprinklers.
    - f. Access panels.
    - g. Perimeter moldings.

- C. Product Test Reports: For each acoustical panel ceiling, for tests performed by manufacturer and witnessed by a qualified testing agency or a qualified testing agency.
- D. Evaluation Reports: For each acoustical panel ceiling suspension system and anchor and fastener type, from ICC-ES.

#### **1.6 CLOSEOUT SUBMITTALS**

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

#### **1.7 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Acoustical Ceiling Units: For each type, finish, and color, full-size panels equal to 2 percent of quantity installed but not less than one box.
  - 2. Suspension-System Components: Quantity of each exposed component equal to 2 percent of quantity installed but not less than one box for each type, finish, and color.

#### **1.8 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than 5 years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least 5 years of documented experience.
- C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
  - 1. Build mockup of typical ceiling area in locations directed by Architect.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### **1.9 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver acoustical panels, suspension-system components, and accessories to Project site and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

#### **1.10 FIELD CONDITIONS**

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
  - 1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

## **1.11 WARRANTY**

- A. Special Warranties: Provide the following manufacturer warranties:
1. Acoustic Panel Warranty: Manufacturer agrees to repair or replace panels that fail in materials or workmanship within specified warranty period.
    - a. Failures include, but are not limited to, the following:
      - 1) Sagging acoustical panels.
      - 2) Mold and mildew growth on panels.
    - b. Warranty Period 30 years from date of Substantial Completion.
  2. Metal Suspension Systems: Manufacturer agrees to repair or replace suspension systems that fail in materials or workmanship within specified warranty period.
    - a. Failures include, but are not limited to, the following:
      - 1) Rusting grid members or components.
    - b. Warranty Period 30 years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Acoustic Panels: The design for each acoustic panel specified is based on the product indicated in Color Codes on Drawings. Subject to compliance with requirements, provide either the named product or a comparable product by one of the following:
1. Armstrong World Industries, Inc: [www.armstrongceilings.com](http://www.armstrongceilings.com).
  2. CertainTeed Corporation: [www.certainteed.com](http://www.certainteed.com).
  3. Rockfon North America: [www.rockfon.com](http://www.rockfon.com).
  4. USG Corporation: [www.usg.com](http://www.usg.com).
- B. Metal Suspension Systems: The design for each metal suspension system specified is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the following:
1. Armstrong World Industries, Inc: [www.armstrong.com](http://www.armstrong.com).
  2. CertainTeed Corporation: [www.certainteed.com](http://www.certainteed.com).
  3. Rockfon North America/Chicago Metallic: [www.rockfon.com](http://www.rockfon.com).
  4. USG Corporation: [www.usg.com](http://www.usg.com).
- C. Source Limitations: Obtain each type of acoustical ceiling panel and its supporting suspension system from single source from single manufacturer.

### **2.2 PERFORMANCE REQUIREMENTS**

- A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Flame-Spread Index: Class A according to ASTM E1264.
  2. Smoke-Developed Index: 50 or less.

- B. Antimicrobial Treatment: Manufacturer's standard broad spectrum, antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D3273, ASTM D3274, or ASTM G21 and evaluated according to ASTM D3274 or ASTM G21.

## **2.3 ACOUSTICAL PANELS**

- A. General:
  - 1. Acoustical Panel Standard: Provide manufacturer's standard panels that comply with ASTM E1264.
- B. Acoustical Panels: Refer to Color Codes on Drawings.
  - 1. Drawing Designations: AC Series.

## **2.4 METAL SUSPENSION SYSTEM**

- A. General:
  - 1. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories according to ASTM C635 and designated by type, structural classification, and finish indicated.
- B. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 coating designation; with prefinished 15/16-inch-wide metal caps on flanges.
  - 1. Structural Classification: Intermediate-duty system.
  - 2. Face Design: Flat, flush.
  - 3. Cap Material: Cold-rolled steel or aluminum.
  - 4. Cap Finish: Painted white.
  - 5. Basis-of-Design Product Armstrong World Industries, Inc.; Prelude XL: [www.armstrong.com](http://www.armstrong.com).
- C. Metal Edge Moldings and Trim: Provide edge molding and trim for each metal suspension-system.
  - 1. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.
    - a. Edge moldings shall fit acoustical panel edge details and suspension systems indicated and match width and configuration of exposed runners unless otherwise indicated.
    - b. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
    - c. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.
  - 2. Miscellaneous Moldings: Same material, finish, and color as that used for exposed flanges of suspension-system runners.
    - a. Provide inside and outside prefabricated corner moldings.
    - b. At Bullnose Corners: Provide radius corner moldings to match bullnose radius of adjacent walls.

## **2.5 ACCESSORIES**

- A. Attachment Devices: Size for five times the design load indicated in ASTM C635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
  - 1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing according to ASTM E488 or ASTM E1512 as applicable, conducted by a qualified testing and inspecting agency.
    - a. Type: Cast-in-place or postinstalled expansion anchors.
    - b. Corrosion Protection: Carbon-steel components zinc plated according to ASTM B633, Class SC 1 (mild) service condition.
- B. Wire Hangers, Braces, and Ties: Provide wires as follows:
  - 1. Zinc-Coated, Carbon-Steel Wire: ASTM A641, Class 1 zinc coating, soft temper.
  - 2. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C635, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 0.106-inch-diameter wire.
- C. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.
- D. Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.
- E. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed with 0.04-inch-thick, galvanized-steel sheet complying with ASTM A653, G90 (Z275) coating designation; with bolted connections and 5/16-inch-diameter bolts.

## **2.6 ACOUSTICAL ACCESSORIES**

- A. Acoustical Sealant: As specified in Section 07 9200 - Joint Sealants.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
- B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders unless otherwise indicated, and comply with layout shown on reflected ceiling plans.
- B. Layout openings for penetrations centered on the penetrating items.



### 3.3 INSTALLATION

- A. Install acoustical panel ceilings according to ASTM C636 and manufacturer's written instructions.
- B. Suspend ceiling hangers from building's structural members and as follows:
  - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
  - 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
  - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
  - 4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structure or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
  - 5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
  - 6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
  - 7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
  - 8. Do not attach hangers to steel deck tabs.
  - 9. Do not attach hangers to steel deck. Attach hangers to structural members.
  - 10. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
  - 11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
- C. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
  - 1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
  - 2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends. Miter corners accurately and connect securely.
  - 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
  - 4. Corners:
    - a. At Bullnose Corners: Provide prefabricated radius corner moldings to match bullnose radius of walls.
    - b. At Square Corners: Provide prefabricated corner moldings.
    - c. At Other Angles Corners: Overlap perimeter moldings.
- D. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

- E. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide precise fit.
  - 1. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
  - 2. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
  - 3. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
  - 4. Install clips in areas indicated; space according to panel manufacturer's written instructions unless otherwise indicated.

### **3.4 ERECTION TOLERANCES**

- A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet, non-cumulative.
- B. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 1/8 inch in 12 feet, non-cumulative.

### **3.5 CLEANING**

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.
- B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

**END OF SECTION 09 5113**

## **SECTION 09 6513 – RESILIENT BASE AND ACCESSORIES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section includes:
  - 1. Resilient wall base.

#### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for toilet compartments.
- B. Samples for Initial Selection: For each type of product indicated.
- C. Samples for Verification: For each type of product indicated and for each color, texture, and pattern required in manufacturer's standard-size Samples, but not less than 12 inches long.
- D. Product Schedule: For resilient base and accessory products. Use same designations indicated on Drawings.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For manufacturer and installer.

#### **1.5 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Resilient Wall Base: Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, profile, and size installed.

#### **1.6 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than 5 years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least 5 years of documented experience.
- C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
  - 1. Coordinate mockups in this Section with mockups specified in other Sections.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

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

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).

## **1.8 FIELD CONDITIONS**

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive resilient products during the following periods:
  1. 48 hours before installation.
  2. During installation.
  3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Install resilient products after other finishing operations, including painting, have been completed.

## **PART 2 - PRODUCTS**

### **2.1 RESILIENT BASE**

- A. Resilient Base: ASTM F1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).
  1. Drawing Designations: B Series.
  2. Manufacturers: The design for each resilient base is based on the product indicated in Color Codes on Drawings. Subject to compliance with requirements, provide either the named product or a comparable product by one of the following:
    - a. Armstrong Flooring Inc.: [www.armstrongflooring.com](http://www.armstrongflooring.com).
    - b. Mannington Mills, Inc./Burke Flooring: [www.manningtoncommercial.com](http://www.manningtoncommercial.com).
    - c. Johnsonite, a Tarkett Company: [www.johnsonite.com](http://www.johnsonite.com).
    - d. Nora Systems, Inc.: [www.nora.com](http://www.nora.com)
    - e. Roppe Corp: [www.roppe.com](http://www.roppe.com).
    - f. Tarkett Company: [commercial.tarkett.com](http://commercial.tarkett.com).
  3. Style and Location:
    - a. Style A - Straight: Provide in areas with carpet unless otherwise indicated; and where indicated on Drawings.
    - b. Style B - Cove: Provide in areas with hard surface floor coverings, unless otherwise indicated; and where indicated on Drawings.
  4. Thickness: 0.125 inch.
  5. Height: 4 inches.
  6. Lengths: Coils in manufacturer's standard length.
  7. Outside Corners: Job formed.
  8. Inside Corners: Job formed.
  9. Colors: Equal to colors indicated in Color Codes on Drawings.

## **2.2 INSTALLATION MATERIALS**

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
  - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
  - 1. Installation of resilient products indicates acceptance of surfaces and conditions.

### **3.2 PREPARATION**

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- C. Do not install resilient products until materials are the same temperature as space where they are to be installed.
  - 1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.
- D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

### **3.3 RESILIENT BASE INSTALLATION**

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.

- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Job-Formed Corners:
  - 1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
    - a. Bend around corners; form without producing discoloration (whitening) at bends.
  - 2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
    - a. Miter corners to minimize open joints.

### **3.4 CLEANING AND PROTECTION**

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Perform the following operations immediately after completing resilient-product installation:
  - 1. Remove adhesive and other blemishes from surfaces.
- C. Protect resilient products from marks, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

**END OF SECTION 09 6513**

## **SECTION 09 6723 – RESINOUS FLOORING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section includes:
  - 1. Resinous flooring for vehicular traffic.

#### **1.3 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Before installing resinous flooring, meet with installer, manufacturer's technical representative, Owner, Architect, consultants, and other concerned entities.
    - a. Notify participants at least seven days before conference.
  - 2. Review the following:
    - a. Manufacturer's written instructions for substrate preparation and environmental conditions affecting resinous flooring installation.
    - b. Manufacturer's written instructions for installing resinous flooring systems.
    - c. Details of integral cove bases.
    - d. Protection measures for adjacent construction and installed flooring, floor drainage requirements, curbs, base details, and so forth.

#### **1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include manufacturer's technical data, installation instructions, and recommendations for each resinous flooring component required.
- B. Shop Drawings: For resinous flooring.
  - 1. Include details for treating substrate joints and cracks, flashings, deck penetrations, and other termination conditions that are not included in manufacturer's product data.
- C. Samples for Initial Selection: For each type of exposed finish.
- D. Samples for Verification: For each type of exposed finish, prepared on rigid backing.
  - 1. Provide stepped Samples on backing to illustrate buildup of resinous flooring.

#### **1.5 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer and manufacturer.

- B. Product Certificates: For each resinous flooring component.
- C. Material Test Reports: For each resinous flooring system, by a qualified testing agency
- D. Field quality-control reports.
- E. Sample Warranty: For manufacturer's warranty.

#### **1.6 CLOSEOUT SUBMITTALS**

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

#### **1.7 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with not less than 5 years of documented experience.
- B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer, with not less than 5 years of documented experience.
- C. Mockups: Build mockups to set quality standards for materials and execution.
  - 1. Build mockup for each type of resinous flooring and substrate.
    - a. Size: 96 inch square floor area to demonstrate surface preparation, joint and crack treatment, thickness, texture, color, and standard of workmanship.
    - b. Include 96-inch length of integral cove base with inside and outside corner
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

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

- A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.

#### **1.9 FIELD CONDITIONS**

- A. Environmental Limitations: : Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring installation.
- B. Concrete substrate shall be properly cured for a minimum of 30 days.
- C. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring installation.
- D. Close spaces to traffic during resinous flooring installation and for 24 hours after installation unless manufacturer recommends a longer period.
- E. Do not install resinous flooring until items that penetrate flooring have been installed.



## **1.10 WARRANTY**

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace resinous flooring that fails in materials or workmanship within specified warranty period.
  - 1. Warranty Period: One year from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. Material Compatibility: Provide primers; base coat, intermediate coat, and topcoat; and accessory materials that are compatible with one another and with substrate under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

### **2.2 MANUFACTURERS**

- A. Basis of Design: Subject to compliance with requirements, provide Stonhard, Inc.; Stonclad GS/HT4 System: [www.stonhard.com](http://www.stonhard.com), or a comparable product from one of the following:
  - 1. Crossfield Products Corp.: [www.crossfieldproducts.com](http://www.crossfieldproducts.com).
  - 2. Dex-O-Tex: [www.dex-o-tex.com](http://www.dex-o-tex.com).
  - 3. Dur-A-Flex, Inc.: [www.dur-a-flex.com](http://www.dur-a-flex.com).
  - 4. Key Resin Company: [www.keyresin.com](http://www.keyresin.com).
  - 5. MBCC Group, Master Builders Solutions: [www.master-builders-solutions.com](http://www.master-builders-solutions.com).
  - 6. The Sherwin-Williams Company, General Polymers: [www.sherwin-williams.com](http://www.sherwin-williams.com).
  - 7. Sika Corp.: [www.sika-usa.com](http://www.sika-usa.com).
  - 8. Tennant Coatings: [www.tennantcoatings.com](http://www.tennantcoatings.com).
  - 9. Tnemec, Inc.: [www.tnemec.com](http://www.tnemec.com)
- B. Source Limitations:
  - 1. Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from single manufacturer. Obtain secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from manufacturer recommended in writing by manufacturer of primary materials.

### **2.3 RESINOUS FLOORING SYSTEMS**

- A. Resinous Flooring System – RF-01
  - 1. Troweled epoxy mortar system consisting of the following:
    - a. Primer.
    - b. Mortar base.
    - c. Intermediate (body) coat with broadcast aggregates.
    - d. Top coat (sealer).
  - 2. System Characteristics:
    - a. Color: As selected by Architect from manufacturer's full range.
      - 1) Design Intent: Gray.
    - b. Wearing Surface: Textured for slip resistance.

- c. Overall System Thickness: 1/8 inch, minimum.
- 3. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested in accordance with test methods indicated:
  - a. Compressive Strength: 10,000 psi minimum in accordance with ASTM C579.
  - b. Tensile Strength: 1750 psi minimum in accordance with ASTM C307.
  - c. Flexural Strength: 4000 psi minimum in accordance with ASTM C580.
  - d. Flexural Modulus of Elasticity:  $2 \times 10^6$  psi minimum in accordance with ASTM C580.
  - e. Hardness: 85 to 90, Shore D, in accordance with ASTM D2240.
  - f. Impact Resistance: 160 in/lbs minimum in accordance with ASTM D2794.
  - g. Abrasion Resistance: 0.1 gm maximum weight loss in accordance with ASTM D4060.
  - h. Water Absorption: 0.2 percent maximum in accordance with ASTM C413..
  - i. Critical Radiant Flux: 0.45 W/sq. cm or greater in accordance with NFPA 253.
  - j. Flammability: Self-extinguishing in accordance with ASTM D635.
  - k. Chemical Resistances: Equal to Stonhard, Inc.; Stonkote HT4 product.
- 4. Components:
  - a. Primer: Type recommended in writing by resinous flooring manufacturer for substrate and resinous flooring system indicated.
    - 1) Dry Film Thickness: As recommended by primer manufacturer.
  - b. Mortar Base:
    - 1) Troweled, multi-component, epoxy mortar.
      - a) Aggregates: Manufacturer's standard.
      - b) Thickness: 1/8 inch, minimum.
    - 2) Product: Equal to Stonhard, Inc.; Stonclad GS.
  - c. Intermediate (Body) Coat: Two-component, 100 percent solids, epoxy with broadcast aggregate.
    - 1) Broadcast Aggregates: As recommended in writing by resinous flooring manufacturer for substrate and service conditions indicated.
    - 2) Wet Film Thickness: 4 mils, excluding aggregate.
    - 3) Product: Equal to Stonhard, Inc.; Stonkote HT4.
  - d. Top Coat (Sealer): Two-component, 100 percent solids, epoxy.
    - 1) Wet Film Thickness: 4 mils.
    - 2) Finish: Gloss.
    - 3) Product: Equal to Stonhard, Inc.; Stonkote HT4.
- B. Accessories and Related Materials: Provide as recommended by resinous flooring manufacturer for a complete installation.
  - 1. Patching and Fill Material: As recommended by resinous flooring manufacturer.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, surface smoothness, and other conditions affecting performance of resinous flooring work.
- B. Verify that substrates are visibly dry and free of moisture.
  - 1. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
    - a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours unless otherwise recommended by resinous flooring manufacturer.
    - b. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement unless otherwise recommended by resinous flooring manufacturer.
  - 2. Alkalinity and Adhesion Testing: Perform tests recommended in writing by resinous flooring manufacturer. Proceed with installation only after substrate alkalinity is not less than 6 or more than 8 pH unless otherwise recommended in writing by flooring manufacturer,
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of resinous flooring work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.
  - 1. Begin resinous flooring application only after substrate construction and penetrating work have been completed.
  - 2. Begin resinous flooring application only after minimum concrete-curing and -drying period recommended in writing by resinous flooring manufacturer has passed and after substrates are dry.
  - 3. Application of resinous flooring indicates acceptance of surfaces and conditions.

### **3.2 PREPARATION**

- A. Clean and prepare substrates according to manufacturer's written instructions to produce clean, dust-free, dry substrate for resinous flooring application. Remove projections, fill voids, and seal joints if any, as recommended in writing by resinous flooring manufacturer.
- B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.
  - 1. Roughen concrete substrates as follows:
    - a. Unless resinous flooring manufacturer recommends in writing against mechanically abrading, mechanically abrade surface to a uniform profile acceptable to resinous flooring manufacturer in accordance with SSPC-SP 13/NACE No. 6.
      - 1) Concrete Surface Profile of 3 or greater in accordance with ICRI Technical Guideline No. 310.2R, unless manufacturer's written instructions are more stringent.
  - 2. Repair damaged and deteriorated concrete in accordance with resinous flooring manufacturer's written instructions.

- C. Patching and Filling: Use patching and fill material to fill holes and depressions in substrates in accordance with resinous flooring manufacturer's written instructions.
  - 1. Control Joint Treatment: Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring in accordance with resinous flooring manufacturer's written instructions.
- D. Terminations: At resinous flooring terminations and edges, cut continuous grooved recesses into concrete to chase edges of resinous flooring in accordance with resinous flooring manufacturer's instructions.

### **3.3 INSTALLATION**

- A. Apply components of resinous flooring system in accordance with manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness specified.
  - 1. Resinous Materials: Mix components and prepare materials in accordance with resinous flooring manufacturer's written instructions
  - 2. Coordinate installation of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
  - 3. Cure resinous flooring components in accordance with manufacturer's written instructions. Prevent contamination during installation and curing processes.
  - 4. Expansion and Isolation Joint Treatment: At substrate expansion and isolation joints, comply with resinous flooring manufacturer's written instructions.
- B. Primer: Apply primer over prepared substrate at spreading rate recommended in writing by manufacturer.
- C. Troweled Mortar Base: Apply troweled mortar in thickness specified for flooring system. Hand or power trowel and grout to fill voids. When mortar base is cured, remove trowel marks and roughness using method recommended in writing by manufacturer.
- D. Intermediate (Body) Coat Apply intermediate coat over mortar base at spreading rate recommended in writing by manufacturer.
  - 1. Uniformly broadcast aggregate into coating in accordance with manufacturer's written instructions.
    - a. After coat dries, sweep away excess aggregate.
- E. Top Coat (Sealer): Apply top coat over intermediate coat at spreading rate recommended in writing by manufacturer, and to produce wearing surface specified.
- F. Field-Formed Integral Cove Base: Apply cove base mix to wall surfaces before applying flooring coats. Apply in accordance with resinous flooring manufacturer's written instructions and details, including those for taping, mixing, priming, troweling, sanding, and top coating of cove base. Round internal and external corners.
  - 1. Integral Cove Base: 4 inches high, unless otherwise indicated on Drawings.

### **3.4 FIELD QUALITY CONTROL**

- A. Final Resinous Flooring Inspection: Arrange for resinous flooring manufacturer's technical personnel to inspect installation on completion.
  - 1. Notify Architect or Owner 48 hours in advance of date and time of inspection.
- B. Prepare test and inspection reports.

**3.5 PROTECTING AND CLEANING**

- A. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.

**END OF SECTION 09 6723**

## **SECTION 09 9100 - PAINTING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Exterior painting.
  - 2. Interior painting.
  - 3. Dryfall coatings.
- B. Related Requirements:
  - 1. Section 09 9600 – High-Performance Coatings, for epoxy paint.

#### **1.3 DEFINITIONS**

- A. Conform to ASTM D16 for interpretation of terms used in this section
- B. DFT: Dry film thickness, measured in mils.
- C. WFT: Wet film thickness, measured in mils.
- D. Mils: One one-thousandth of an inch. Used to measure thickness of coating films.

#### **1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product. Include preparation requirements and application instructions. Include the following:
  - 1. Indicate VOC content.
  - 2. Manufacturer's name, product name and/or catalog number, and general product category.
    - a. Example of general product categories:
      - 1) Interior finish coat - latex, eggshell.
      - 2) Exterior primer for ferrous metal.
  - 3. For each paint system and substrate, indicate which paint products are to be used.
    - a. Examples:
      - 1) Interior latex eggshell system for gypsum board:
        - a) Primer: Name of specific product provided.
        - b) Finish Coats: Name of specific product provided.

- 2) Exterior latex semigloss system for ferrous metals.
  - a) Primer: Name of specific product provided.
  - b) Finish Coats: Name of specific product provided.
4. Use same designations indicated on Drawings and Schedules.
- B. Samples: Submit 3 paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating each color and finish specified.
  1. Paint color submittals will not be considered until color submittals for major materials not to be painted, such as masonry and storefront finishes, have been approved.

#### **1.5 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For installer and manufacturer.
- B. Paint Compatibility Certificates:
  1. For Steel: From manufacturers of field-applied primers and top coats, certifying material compatibility with one another and shop-applied primers.

#### **1.6 MAINTENANCE MATERIAL SUBMITTALS**

- A. Paint Maintenance Manual: Submit coating maintenance manual including:
  1. Finish schedule showing where each product, color, and finish was used.
  2. Product technical data sheets.
  3. Material safety data sheets (MSDS).
  4. Care and cleaning instructions.
  5. Touch-up procedures.
  6. Repair of painted and finished surfaces.
- B. Color Chips: After final approval of all colors, submit color chips of all coatings used with manufacturer's name, product, and mix formulation of each color, finish, and coating for the purpose of future re-ordering of coatings.
  1. Color chips shall be at least six (6) inches square.
  2. Include in Paint Maintenance Manual.
- C. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  1. Paint Products: 2 percent of that installed, but not less than 1 gal. of each material, color, and finish applied.

#### **1.7 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum 5 years documented experience.

- B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum 5 years documented experience.
  - 1. Only qualified journeypersons, as defined by local jurisdiction, shall be engaged in painting work. Apprentices may be employed provided they work under the direct supervision of a qualified journeyperson in accordance with trade regulations.
- C. Mockups: Apply mockups of each paint system indicated for each substrate, color, finish, and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
    - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft..
      - 1) Include mock-up for each dryfall paint system and color.
    - b. Doors and Frames: Provide mock-up samples of one complete door and frame.
    - c. Railings and Other Lineal Materials: Provide mock-up samples of at least 8 lineal feet.
    - d. Other Items: Architect will designate items or areas required.
  - 2. Shop-primed surfaces to be re-primed. For each shop-primed surface, prepare substrate and apply a test patch prior to applying paint to entire fabrication:
    - a. After cleaning and preparing, apply a test patch of primer/paint and allow to dry for 7 days.
    - b. After 7 days, test primer/paint adhesion using method recommended by paint manufacturer.
    - c. Do not proceed with work until adhesion test is approved by Architect.
  - 3. Galvanized surfaces. For each galvanized surface, prepare substrate and apply a test patch prior to applying paint to entire fabrication:
    - a. After cleaning and preparing, apply a test patch of primer/paint and allow to dry for 7 days.
    - b. After 7 days, test primer/paint adhesion using method recommended by paint manufacturer.
    - c. Do not proceed with work until adhesion test is approved by Architect.
  - 4. Final approval of color selections will be based on mockups.
    - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
  - 5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 6. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

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

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



## **1.9 FIELD CONDITIONS**

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures of less than 5 deg F above the dew point; or to damp or wet surfaces.
  - 1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.
- C. Apply paint only to dry, clean, and adequately prepared surfaces in areas where dust is no longer generated by construction activities such that airborne particles will not affect the quality of finished surfaces.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Source Limitations:
  - 1. Provide paint and coating products from same manufacturer, unless otherwise specified.
  - 2. Obtain block fillers and primers for each coating system from the same manufacturer as the finish coats, unless otherwise specified.
  - 3. Exceptions shall be permitted, provided approval of Architect is obtained using specified procedures for substitutions.
- B. Paint Manufacturers - General: For each paint type specified in Part 2, provide one of the products listed, subject to compliance with requirements. Products shall be from one of the following:
  - 1. Benjamin Moore: Benjamin Moore & Co.: [www: benjaminmoore.com](http://www.benjaminmoore.com).
  - 2. PPG: PPG Industries, Inc., Architectural Coatings: [www.ppgpaints.com](http://www.ppgpaints.com).
  - 3. Sherwin-Williams: The Sherwin-Williams Company: [www: sherwin-williams.com](http://www.sherwin-williams.com).

### **2.2 PAINT MATERIALS, GENERAL**

- A. Material Compatibility:
  - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  - 2. For each coat in a paint system, products shall be recommended in writing by top coat manufacturers for use in paint system and on substrate indicated.
  - 3. Shop-applied Primer Compatibility for Steel: Field-applied primers and top coats shall be compatible with one another and shop-applied primers. Refer to Division 05 sections for shop-applied primers for steel.
- B. VOC Content:
  - 1. Comply with the following:
    - a. Michigan Department of Environment, Great Lakes, and Energy's (EGLE) air pollution rules, Part 6: Emission Limitations and Prohibitions – Existing Sources of Volatile Organic Compound Emissions.

- b. Ozone Transport Commission (OTC), Model Rule for Architectural and Industrial Maintenance (AIM) Coatings; as referenced in EGLE's air pollution rules, Part 6.
  - 1) OTC Phase II.
- 2. Content Limits:
  - a. The following paint and coating categories are as defined by OTC, Model Rule for Architectural and Industrial Maintenance (AIM ) Coatings. Paints and coatings shall comply with the following VOC content limits unless stricter limits are required by authorities having jurisdiction:
    - 1) Flat Coatings: 50g/L.
    - 2) Non-flat Coatings: 100g/L.
    - 3) Non-flat High Gloss Coatings: 150g/L.
    - 4) Dry Fog (Dryfall) Coatings: 150g/L.
    - 5) Industrial Maintenance Coatings: 250g/L.
    - 6) Primers, Sealers, and Undercoaters: 100g/L.
    - 7) Specialty Primers, Sealers, and Undercoaters: 100g/L.
    - 8) Rust Preventative Coatings: 250g/L.
    - 9) Zinc Rich Primers: 340g/L.
- C. Supply each paint material in quantity required to complete entire project's work from a single production run.
- D. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.
- E. Paint Finishes: Gloss (sheen) levels.
  - 1. Paint finishes shall be defined by the paint's gloss (sheen) level according to ASTM D523, using 60 and 85 degree geometry. Paint finish gloss levels shall be as follows:
    - a. Level 1 – Flat (Matte): Comply with both of the following:
      - 1) 60 Degrees: Value not more than 5 units.
      - 2) 85 Degrees: Value not more than 10 units.
    - b. Level 2 – Velvet: Comply with both of the following:
      - 1) 60 Degrees: Value not more than 10 units.
      - 2) 85 Degrees: Value between 10 and 35 units.
    - c. Level 3 – Eggshell: Comply with both of the following:
      - 1) 60 Degrees: Value between 10 and 25 units.
      - 2) 85 Degrees: Value between 10 and 35 units.
    - d. Level 4 – Satin: Comply with both of the following:
      - 1) 60 Degrees: Value between 20 and 35 units.
      - 2) 85 Degrees: Value not less than 35 units.
    - e. Level 5 – Semigloss:
      - 1) 60 Degrees: Value between 35 and 70 units.

- f. Level 6 – Gloss:
      - 1) 60 Degrees: Value between 70 and 85 units.
    - g. Level 7 – High Gloss:
      - 1) 60 Degrees: Value more than 85 units.
  - 2. Product names are not acceptable for paint finish identification.
  - 3. For Part 2 of this Section paint finishes shall be defined as follows:
    - a. Flat Finish: Complying with ASTM D523 Level 1.
    - b. Low Luster Finish: Complying with ASTM D523 Level 2, 3 or 4.
    - c. Semigloss Finish: Complying with ASTM D523 Level 5.
    - d. Gloss Finish: Complying with ASTM D523 Level 6 or 7.
  - 4. Where paint finishes are not specified, provide finish as selected by Architect.
- F. Colors: As indicated in Room Finish Schedule on Drawings or, if not indicated, to match Architect's samples.
- 1. Tint each coat including intermediate coats, one-half shade lighter than succeeding coat, with final top coat as indicated color.
  - 2. Provide tinted deep tone primers at deep tone colors, and as recommended by paint manufacturer.

## **2.3 EXTERIOR PAINTS**

- A. General:
- 1. Unless otherwise indicated, each exterior paint system consists of the following:
    - a. Primer: One coat based on substrate material.
    - b. Top Coats: Two coats based on required finish and substrate material.
  - 2. Required Finishes: For each paint system, provide paint finishes as follows unless otherwise indicated:
    - a. All exterior paint systems: Semigloss.
- B. Exterior Paint Systems - Latex
- 1. Primers:
    - a. Primer for aluminum, ferrous metal, and galvanized steel: Rust-inhibitive acrylic/latex primer, water-based.
      - 1) Benjamin Moore; Ultra Spec HP Acrylic Metal Primer HP04; DFT 1.7 to 2.3 mils.
      - 2) PPG; Pitt-Tech Plus Int./Ext. DTM Industrial Primer 4020PF; DFT 2.2 to 3.5 mils.
      - 3) Sherwin Williams; Pro Industrial Pro-Cryl Universal Primer B66 Series; DFT 1.9 to 3.8 mils.

2. Top Coats:

a. Semigloss Finish: Acrylic/latex paint, water-based.

1) Finish coats for all surfaces except metals:

- a) Benjamin Moore; Ultra Spec EXT Gloss Finish N449; DFT 1.5 mils.
- b) PPG; Speedhide Exterior 100% Acrylic Semi-Gloss 6-900XI Series; DFT 1.4 mils.
- c) Sherwin-Williams; SuperPaint Exterior Latex Gloss A84 Series; DFT 1.5 mils.

2) Finish coats for aluminum, ferrous metal, and galvanized steel:

- a) Benjamin Moore; Ultra Spec HP D.T.M. Acrylic Semi-Gloss Enamel HP29; DFT 1.8 to 2.5 mils.
- a) PPG; Pitt-Tech Plus EP DTM Acrylic Semi-Gloss 90-1610 Series; DFT 2.0 to 4.0 mils.
- b) Sherwin-Williams; Pro Industrial DTM Acrylic Semi-Gloss, B66 Series; DFT 2.4 to 4.0 mils.

**2.4 INTERIOR PAINTS**

A. General:

1. Unless otherwise indicated, each interior paint system consists of the following:

- a. Primer: One coat based on substrate material.
- b. Intermediate Coats: One coat, if indicated, based on substrate material.
- c. Top Coats: Two coats, one if intermediate coat was applied, based on required finish and substrate material.

2. Required Finishes: For each paint system, provide paint finishes as follows unless otherwise indicated:

- a. Ceilings, Soffits and Ceiling Drops: Flat finish.
- b. Gypsum Board (except at ceilings):
  - 1) Semigloss Finish: Storage rooms, janitor closets, electrical rooms, mechanical rooms, closets, and similar non-public areas.
  - 2) Low Luster Finish: Public areas.
- c. Masonry: Semigloss finish.
- d. Metals: Semigloss finish.
- e. Insulated Piping and Insulated Ductwork: Finish to match surface it is mounted on unless otherwise indicated.

B. Interior Paint Systems - Latex.

1. Primers:

a. Block Filler/primer for concrete masonry units: Acrylic/latex block filler, water-based.

- 1) Benjamin Moore; Ultra Spec Hi-Build Masonry Block Filler 571; DFT 8.5 to 11.0 mils.
- 2) PPG; Speedhide Interior/Exterior Masonry Hi Fill Latex Block Filler 6-15XI; DFT 8.0 mils.
- 3) Sherwin Williams; Pro Industrial Heavy Duty Block Filler B42 Series; DFT 9.08.0 to 10.5 mils.

- b. Primer for aluminum, ferrous metal, and galvanized steel: Rust-inhibitive acrylic/latex primer, water-based.
    - 1) Benjamin Moore; Ultra Spec HP Acrylic Metal Primer HP04; DFT 1.7 to 2.3 mils.
    - 2) PPG; Pitt-Tech Plus Int./Ext. DTM Industrial Primer 4020PF; DFT 2.2 to 3.5 mils.
    - 3) Sherwin Williams; Pro Industrial Pro-Cryl Universal Primer B66 Series; DFT 1.9 to 3.8 mils.
  - c. Primer for gypsum board: Acrylic/latex primer, water-based.
    - 1) Benjamin Moore; Super Hide Zero VOC interior Latex Primer 354; DFT 1.3 mils.
    - 2) PPG; Speedhide Zero Interior Zero VOC & Low Odor Primer 6-4900XI; DFT 1.4 mils.
    - 3) Sherwin Williams; ProMar 200 Zero V.O.C. Interior Latex Primer, B28W02600; DFT 1.0 mils.
  - d. Primer for insulated piping and insulated ductwork: Acrylic/latex stain-blocking primer/sealer with high adhesion, water-based.
    - 1) Benjamin Moore; Insl-X Prime All Multi-Surface Latex Primer Sealer AP-1000; DFT 1.3 mils.
    - 2) PPG; Seal Grip Gripper Interior/Exterior 100% Acrylic Latex Primer 17-921XI Series; DFT 1.6 mils.
    - 3) Sherwin Williams; PrepRite ProBlock Interior-Exterior Latex Primer-Sealer B51-600 Series; DFT 1.4 mils.
2. Intermediate Coats: Provide intermediate coats only where indicated below for specific manufacturers, finishes and substrate materials.
- a. Low Luster Finishes:
    - 1) Intermediate coats for aluminum, ferrous metal, and galvanized steel:
      - a) Benjamin Moore; Ultra Spec HP D.T.M. Acrylic Low Luster Enamel HP25; DFT 1.8 to 2.5 mils.
3. Top Coats:
- a. Semigloss Finish: Acrylic/latex paint, water-based.
    - 1) Finish coats for all surfaces except metals:
      - a) Benjamin Moore; Super Hide Interior Latex Semi-Gloss 298; DFT 1.2 to 1.4 mils.
      - b) PPG; Speedhide Zero Interior Latex Semi-Gloss 6-5510 Series; DFT 1.5 mils.
      - c) Sherwin-Williams; ProMar 200 Zero V.O.C. Interior Latex Gloss B21-12650 Series; DFT 1.4 mils.
    - 2) Finish coats for aluminum, ferrous metal, and galvanized steel:
      - a) Benjamin Moore; Ultra Spec HP D.T.M. Acrylic Semi-Gloss Enamel WH29; DFT 2.3 mils.
      - b) PPG; Pitt-Tech Plus EP DTM Acrylic Semi-Gloss 90-1610 Series; DFT 2.0 to 4.0 mils.
      - c) Sherwin-Williams; Pro Industrial DTM Acrylic Semi-Gloss B66 Series; DFT 2.4 to 4.0 mils.

- b. Low Luster Finish: Acrylic/latex paint, water-based.
  - 1) Finish coats for all surfaces except metals:
    - a) Benjamin Moore; Super Hide Interior Latex Low Sheen Eggshell 296; DFT 1.3 to 1.5 mils.
    - b) PPG; Speedhide Zero Interior Latex Paint Satin 6-5410 Series; DFT 1.4 mils.
    - c) Sherwin-Williams; ProMar 200 Zero V.O.C. Interior Latex Eg-Shel B20 Series; DFT 1.8 mils.
  - 2) Finish coats for aluminum, ferrous metal, and galvanized steel:
    - a) Benjamin Moore; Super Hide Interior Latex Eggshell 297; DFT 1.3 to 1.4 mils.
    - b) PPG; Pitt-Tech Plus EP DTM Acrylic Satin 90-1710 Series; DFT 2.0 to 4.0 mils.
    - c) Sherwin-Williams; Pro Industrial DTM Acrylic Eg-Shel B66 Series; DFT 2.5 to 4.0 mils.
- c. Flat Finish: Acrylic/latex paint, water-based.
  - 1) Finish coats for all surfaces:
    - a) Benjamin Moore; Super Hide Interior Latex Flat 295; DFT 1.4 to 1.5 mils.
    - b) PPG; Speedhide Zero Interior -Latex Paint Flat 6-5110 Series; DFT 1.2 mils.
    - c) Sherwin Williams; ProMar 200 Zero V.O.C. Interior Latex Flat B30-2600 Series; DFT 1.4 mils.

## 2.5 DRYFALL COATINGS

### A. General:

- 1. Unless otherwise indicated, each interior dryfall coating system consists of the following:
  - a. Primer: One coat based on substrate material.
  - b. Top Coats: One or two coats as recommended by dryfall coating manufacturer and based on required finish.
- 2. Required Finishes: For each interior dryfall coating system, provide paint finishes as follows unless otherwise indicated:
  - a. All dryfall coating systems: Flat.

### B. Interior Dryfall Paint Systems - Flat, Latex:

- 1. Primers:
  - a. Primer for concrete: Acrylic/latex dryfall paint, water-based.
    - 1) Benjamin Moore; Latex Dry Fall Flat 395; DFT 1.4 to 2.6 mils
    - 2) PPG; Speedhide Super Tech WB Interior Latex Dry-Fog Flat 6-725XI; DFT 2.0 mils.
    - 3) Sherwin Williams; Pro Industrial Waterborne Acrylic Dryfall Flat B42 Series; DFT 1.5 to 2.3 mils
  - b. Primer for ferrous metal and aluminum: Rust-inhibitive acrylic/latex primer, water-based:
    - 1) Benjamin Moore; Ultra Spec HP Acrylic Metal Primer HP04; DFT 1.7 to 2.3 mils.
    - 2) PPG; Pitt-Tech Int./Ext. DTM Industrial Primer, 90-712 Series; DFT 2.0 to 3.0 mils.

- 3) Sherwin Williams; Pro Industrial Pro-Cryl Universal Primer B66 Series; DFT 1.9 to 03.8 mils.
    - c. Primer for galvanized steel: Acrylic/latex dryfall paint, water-based.
      - 1) Benjamin Moore; Latex Dry Fall Flat 395; DFT 1.4 to 2.6 mils
      - 2) PPG; Speedhide Super Tech WB Interior Latex Dry-Fog Flat 6-725XI; DFT 2.0 mils.
      - 3) Sherwin Williams; Pro Industrial Waterborne Acrylic Dryfall Flat B42 Series; DFT 1.5 to 2.3 mils
  2. Top Coats:
    - a. Flat Finish: Acrylic/latex dryfall paint, water-based.
      - 1) Benjamin Moore; Latex Dry Fall Flat 395; DFT 1.4 to 2.6 mils
      - 2) PPG; Speedhide Super Tech WB Interior Latex Dry-Fog Flat 6-725XI; DFT 2.0 mils.
      - 3) Sherwin Williams; Pro Industrial Waterborne Acrylic Dryfall Flat B42 Series; DFT 1.5 to 2.3 mils

## **2.6 ACCESSORY MATERIALS**

- A. Accessory Materials: Provide cleaning materials, preparation materials, and miscellaneous materials required to properly prepare and apply paints and coatings.
  1. Includes materials required for marking fire and smoke assemblies

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

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

### **3.2 PREPARATION**

- A. Comply with manufacturer's written instructions and recommendations applicable to substrates and paint systems indicated.
- B. Protect adjacent surfaces not to be painted.

- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
  - 1. For coatings applied over previously painted surfaces, test application to check for lifting and other adhesion problems. Perform test in an isolated area where practicable.
  - 2. Remove incompatible coatings and primers or apply barrier tie coat as recommended by paint manufacturer and as required to produce paint systems indicated.
- D. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
  - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
- F. Steel Substrates - Unpainted or Unprimed: Remove rust, loose mill scale, and any other surface contamination. Clean using methods recommended in writing by paint manufacturer but not less than the following:
  - 1. SSPC-SP 6 - Commercial Blast Cleaning.
- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Sand and scrape to remove loose primer and rust. Feather edges of remaining primer to make inconspicuous.
  - 1. Clean using methods recommended in writing by paint manufacturer.
  - 2. Before applying finish coats, applicator/installer shall re-prime entire shop-primed item with steel primer specified in this section.
- H. Galvanized-Metal Substrates: Remove passivation coating/rinse, grease and oil residue from galvanized metal to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints. Clean using methods recommended in writing by paint manufacturer but not less than ASTM D6386, ASTM D7396, and the following:
  - 1. Remove surface contamination and oils in accordance with SSPC-SP 1 - Solvent Cleaning.
  - 2. Remove loose paint, rust, and other debris according to SSPC-SP 2 - Hand Tool Cleaning.
  - 3. Lightly profile galvanized surfaces and remove zinc oxide and zinc hydroxide layers in accordance with SSPC-SP16 – Brush-Off/Sweep Blast Cleaning.
  - 4. Apply paint within 1 hour of cleaning and preparation.
- I. Aluminum Substrates: Remove loose surface oxidation. Clean using methods recommended in writing by paint manufacturer but not less than the following:
  - 1. SSPC-SP 1 - Solvent Cleaning.
- J. Repair of Existing Gypsum Board:
  - 1. Fill hairline cracks, small holes, and imperfections with filler compound and sand smooth.

### **3.3 APPLICATION - GENERAL**

- A. Apply paints and coatings according to manufacturer's written instructions.
  - 1. Use applicators and techniques suited for paint and substrate indicated.



- B. Provide smooth, opaque coatings of uniform finish, color, appearance, and coverage without brush marks, runs, sags, laps, ropiness, holidays, spotting, cloudiness, or other surface imperfections.
- C. Terminate paint in neat lines; cut in sharp lines and color breaks.
- D. Apply paint products to properly prepared surfaces.
  - 1. Do not apply coatings over dirt, rust, scale, grease, moisture, or other conditions detrimental to application of coatings.
- E. Primers:
  - 1. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.
  - 2. Apply first coat of primer to surfaces as soon as practical after preparation and before subsequent surface deterioration.
  - 3. Re-prime shop-primed surfaces.
- F. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer.
  - 1. Sand between coats as recommended by manufacturer; before applying next coat clean surfaces of loose particles and use tack cloth to remove any remaining dust and particles just prior to applying next coat.
- G. Provide completed work matching approved samples for color, finish, texture, coverage and quality of work.
  - 1. Remove, refinish, or repaint work not complying with requirements.
- H. Number of Coats: Each paint system in Part 2 specifies a number of coats. This is the minimum number required.
  - 1. If undercoats, stains, or other imperfections are visible after final coat of paint, apply additional coats until paint is of uniform finish, color, and appearance without defects or imperfections.
- I. Minimum Coating Thickness: Provide dry film thickness for each coating as indicated, but not less than that recommended by the coating manufacturer.
  - 1. Number of coats and film thicknesses required are same regardless of application method.
  - 2. Ensure edges, corners, crevices, welds, and exposed fasteners receive dry film thickness equivalent to that of flat surfaces.

### **3.4 DRYFALL APPLICATION**

- A. Dryfall overspray may adhere to hot surfaces; protect hot equipment and surfaces not intended to be painted from overspray.

### **3.5 SURFACES TO BE PAINTED**

- A. General: Paint all exposed surfaces except where indicated not to be painted or where listed in "Surfaces Not to Be Painted" Article in this section.
  - 1. The term "exposed" includes areas visible through permanent and built-in fixtures when they are in place.
  - 2. If surface, material, or item is not specifically mentioned, paint in same manner, color, and sheen as similar surfaces, materials, or items, regardless of whether indicated or not.
  - 3. Paint surfaces that are cut and patched including, but not limited to, cutting and patching to permit installation of electrical services, piping, and ductwork.

B. Exposed Ceilings:

1. Paint entire exposed ceiling area including, but not limited to, deck, miscellaneous steel, hangers, fasteners, and miscellaneous items and hardware, unless otherwise indicated.
2. Paint the following mechanical and electrical items unless otherwise indicated:
  - a. Insulated piping, pipe hangers, and supports
  - b. Ductwork, insulated ducts, and supports.
  - c. Conduit, fittings and junction boxes:
3. Do not paint sprinkler heads and other factory finished fire protection components.

C. Equipment and Furniture:

1. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces.
2. Paint surfaces to be concealed behind permanently installed fixtures, equipment, and furnishings, using primer only, prior to installation of permanent item.

D. Registers and Grilles: Paint interior surfaces of ducts, for a minimum of 18 inches or beyond sight line, whichever is greater, with a flat black (non-reflecting) paint.

E. Access Panels: Paint back sides of access panels and removable or hinged covers to match exposed surfaces.

F. Doors:

1. Exterior Doors: Finish doors on tops, bottoms, and all four edges the same as exterior faces.
2. Interior Doors: Finish doors on tops, bottoms, and all four edges the same as face of non-secured side.

G. Panelboards for Service Panels, Telephone, and Other Electrical Equipment:

1. Paint both sides and all edges of plywood before installation.
  - a. Color and Finish: Gray, semigloss, unless otherwise indicated.

H. Mechanical and Electrical:

1. This Section includes painting of all mechanical, fire protection, and electrical items.
  - a. Do not paint sprinkler heads and polished fire protection components.
  - b. Do not paint insulated pipe, duct work or equipment before insulation is applied.
2. Piping, Insulated Piping, Pipe Hangers, and Supports:
  - a. In finished/public areas, paint exposed piping the same color and finish as surface it is mounted on unless otherwise indicated.
  - b. In utility areas, paint exposed piping according to piping color coding scheme; otherwise paint the same color and finish as surface it is mounted on unless otherwise indicated.
  - c. Paint all exposed pipe hangers and supports the same color and finish as surface it is mounted on unless otherwise indicated.
  - 1) Any portion of hangers and supports encompassing the actual pipe shall be painted to match the pipe color and finish.

3. Ductwork, Insulated Ducts, and Supports:
  - a. In finished/public areas, paint exposed ductwork and supports the same color and finish as surface it is mounted on unless otherwise indicated.
  - b. In utility areas, paint exposed ductwork according to color coding scheme; otherwise paint the same color and finish as surface it is mounted on unless otherwise indicated.
  - c. Paint all exposed hangers and supports the same color and finish as surface it is mounted on unless otherwise indicated.
    - 1) Any portion of hangers and supports encompassing the actual ductwork shall be painted to match the ductwork color and finish.
4. Electrical Conduit, Fittings and Junction Boxes:
  - a. In finished/public areas, paint exposed conduit, fittings and junction boxes same color and finish as surface it is mounted on unless otherwise indicated.
  - b. In utility areas, paint exposed conduit, fittings and junction boxes according to color coding scheme; otherwise paint the same color and finish as surface it is mounted on unless otherwise indicated.
5. Mechanical and Electrical Equipment:
  - a. Exterior Equipment: Paint all equipment exposed to the weather.
    - 1) Do not paint factory-finished equipment unless otherwise indicated.
  - b. Paint shop-primed mechanical and electrical equipment same color and finish as surface it is mounted on unless otherwise indicated.
  - c. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
  - d. Paint interior surfaces of convactor and baseboard heating cabinets to match face panels.

### 3.6 SURFACES NOT TO BE PAINTED

- A. Do not paint or finish the following unless otherwise indicated:
  1. Factory-finished items; factory-primed items are not considered factory-finished.
  2. Items indicated to receive other finish.
  3. Items indicated to remain naturally finished.
  4. Fire rating labels.
  5. Equipment serial number and capacity labels.
  6. Operating parts of equipment.
  7. Aluminum components.
  8. Polished and brushed stainless steel items.
  9. Metal flashings.
  10. Brick.
  11. Decorative concrete masonry units.
  12. Cast-in-place concrete.
  13. Floors.
  14. Surfaces concealed by suspended ceilings.
  15. Concealed piping, ductwork, and conduit.
  16. Surfaces within pipe and duct spaces.
  17. Acoustical materials.

### 3.7 IDENTIFICATION AND COLOR CODING

#### A. Mechanical and Electrical Identification and Color Coding:

1. Refer to Divisions 21, 22, 23, and 26 for color coding scheme and identification of mechanical and electrical services; if no identification is provided, paint as follows:
  - a. Color Coding Scheme and Identification:
    - 1) Piping: None; paint to match surface on which it is mounted unless otherwise indicated.
    - 2) Ductwork: None; paint to match surface on which it is mounted unless otherwise indicated.
    - 3) Conduit: None; paint to match surface on which it is mounted unless otherwise indicated.

### 3.8 FIELD QUALITY CONTROL

#### A. Subject to the opinion of the Architect, paint shall be rejected and considered unacceptable for any of the following reasons:

1. Lacking minimum dry film thicknesses.
2. Poor coverage at rivet heads, plate edges, lap joints, crevices, pockets, and corners.
3. Damage from touching, or disturbing paint in any other manner, before sufficiently dry.
4. Damage from application to moist surfaces or damage caused by inadequate protection from the weather.
5. Damage or contamination of paint from blown contaminants including but not limited to dust.
6. Paint shall be rejected if any of the following are evident under natural lighting for exterior surfaces and final lighting source, including daylighting, for interior surfaces:
  - a. Visible defects are evident on vertical surfaces when viewed at normal viewing angles from a distance of not less than 48 inches.
  - b. Visible defects are evident on horizontal surfaces when viewed at normal viewing angles from a distance of not less than 48 inches.
  - c. Visible defects are evident on ceiling, soffit and other overhead surfaces when viewed at normal viewing angles from a distance of not less than 48 inches.

#### B. Visible defects are defined as follows:

1. Brush and roller marks, streaks, laps, runs, sags, drips, heavy stippling, hiding or shadowing by inefficient application methods, skipped or missed areas, and foreign materials in paint coatings.
2. When the final coat on any surface exhibits a lack of uniformity of color, finish, texture, and hiding across full surface area.

#### C. Rejected paint shall be repaired or replaced at the expense of the Contractor.

1. Small affected areas shall be touched up.
2. Large affected areas shall be repainted.
3. Small and large areas shall be as defined by the Architect.
4. Areas without sufficient dry film thickness shall be repainted.
5. Paint runs and sags shall be removed by scraper or sanding and repainted.

### 3.9 CLEANING AND PROTECTION

#### A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

1. Do not clean equipment with free-draining water. Prevent solvents, thinners, cleaners, and other contaminants from entering waterways, sanitary and storm drain systems, and ground.

2. Dispose of contaminants in accordance with requirements of authorities having jurisdiction.
  3. Allow empty paint cans to dry before disposal.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

**END OF SECTION 09 9100**

## **SECTION 09 9600 - HIGH-PERFORMANCE COATINGS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. High performance coatings - non-traffic surfaces.
  - 2. Heavy duty high performance coatings for metals.

#### **1.3 DEFINITIONS**

- A. Conform to ASTM D16 for interpretation of terms used in this section
- B. DFT: Dry film thickness, measured in mils.
- C. WFT: Wet film thickness, measured in mils.
- D. Mils: One one-thousandth of an inch. Used to measure thickness of coating films.

#### **1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product. Include preparation requirements and application instructions. Include the following:
  - 1. Indicate VOC content.
  - 2. Manufacturer's name, product name and/or catalog number, and general product category.
    - a. Example of general product categories:
      - 1) Interior finish coat - latex, eggshell.
      - 2) Exterior primer for ferrous metal.
  - 3. For each high-performance coating system and substrate, indicate which products are to be used.
    - a. Examples:
      - 1) Interior Waterborne Acrylic Epoxy Paint for Concrete Masonry Units:
        - a) Primer: Name of specific product provided.
        - b) Finish Coats: Name of specific product provided.
      - 2) Interior High Performance Coating for Structural Steel.
        - a) Primer: Name of specific product provided.
        - b) Intermediate Coat: Name of specific product provided.
        - c) Top Coat: Name of specific product provided.
  - 4. Use same designations indicated on Drawings and Schedules.

- B. Samples: Submit 3 paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating each color and finish specified.
  - 1. High-performance coating color submittals will not be considered until color submittals for major materials not to be painted, such as masonry and storefront finishes, have been approved.

#### **1.5 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For installer and manufacturer.
- B. High Performance Coating Compatibility Certificates:
  - 1. For Steel: From manufacturers of field-applied primers and top coats, certifying material compatibility with one another and shop-applied primers.

#### **1.6 MAINTENANCE MATERIAL SUBMITTALS**

- A. Paint Maintenance Manual: Submit coating maintenance manual including:
  - 1. Finish schedule showing where each product, color, and finish was used.
  - 2. Product technical data sheets.
  - 3. Material safety data sheets (MSDS).
  - 4. Care and cleaning instructions.
  - 5. Touch-up procedures.
  - 6. Repair of painted and finished surfaces.
- B. Color Chips: After final approval of all colors, submit color chips of all coatings used with manufacturer's name, product, and mix formulation of each color, finish, and coating for the purpose of future re-ordering of coatings.
  - 1. Color chips shall be at least six (6) inches square.
  - 2. Include in Paint Maintenance Manual.
- C. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Coating Products: 2 percent of that installed, but not less than 1 gal. of each material, color, and finish applied.

#### **1.7 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum 5 years documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum 5 years documented experience.
  - 1. Only qualified journeypersons, as defined by local jurisdiction, shall be engaged in high-performance coating work. Apprentices may be employed provided they work under the direct supervision of a qualified journeyperson in accordance with trade regulations.

- C. Mockups: Apply mockups of each coating system indicated for each substrate, color, finish, and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
    - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft.
    - b. Doors and Frames: Provide mock-up samples of one complete door and frame.
    - c. Railings and Other Lineal Materials: Provide mock-up samples of at least 8 lineal feet.
    - d. Other Items: Architect will designate items or areas required.
  2. Shop-primed surfaces to be re-primed. For each shop-primed surface, prepare substrate and apply a test patch prior to applying paint to entire fabrication:
    - a. After cleaning and preparing, apply a test patch of primer/paint and allow to dry for 7 days.
    - b. After 7 days, test primer/paint adhesion using method recommended by paint manufacturer.
    - c. Do not proceed with work until adhesion test is approved by Architect.
  3. Galvanized surfaces. For each galvanized surface, prepare substrate and apply a test patch prior to applying paint to entire fabrication:
    - a. After cleaning and preparing, apply a test patch of primer/paint and allow to dry for 7 days.
    - b. After 7 days, test primer/paint adhesion using method recommended by paint manufacturer.
    - c. Do not proceed with work until adhesion test is approved by Architect.
  4. Final approval of color selections will be based on mockups.
    - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
  5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  6. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

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

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

#### **1.9 FIELD CONDITIONS**

- A. Apply coatings only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures of less than 5 deg F above the dew point; or to damp or wet surfaces.
1. Work may continue during inclement weather if surfaces and areas to be coated are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.
- C. Apply coatings only to dry, clean, and adequately prepared surfaces in areas where dust is no longer generated by construction activities such that airborne particles will not affect the quality of finished surfaces.



## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Source Limitations:
  - 1. Provide coating products for each system from same manufacturer, unless otherwise specified.
  - 2. Obtain block fillers and primers for each coating system from the same manufacturer as the finish coats, unless otherwise specified.
  - 3. Exceptions shall be permitted, provided approval of Architect is obtained using specified procedures for substitutions.
- B. High Performance Coating Manufacturers: For each coating specified in Part 2, provide one of the products listed, subject to compliance with requirements. Products shall be from one of the following:
  - 1. Benjamin Moore: Benjamin Moore & Co.: [www.benjaminmoore.com](http://www.benjaminmoore.com).
  - 2. Carboline Company [www.carboline.com](http://www.carboline.com).
  - 3. PPG: PPG Industries, Inc., Architectural Coatings: [www.ppgpaints.com](http://www.ppgpaints.com).
  - 4. Sherwin-Williams: The Sherwin-Williams Company: [www.sherwin-williams.com](http://www.sherwin-williams.com).
  - 5. Tnemec: Tnemec Company Inc.: [www.tnemec.com](http://www.tnemec.com).

### **2.2 HIGH-PERFORMANCE COATINGS, GENERAL**

- A. Provide high performance coatings where indicated on Drawings; otherwise provide paints as specified in Section 09 9100 - Painting.
- B. Material Compatibility:
  - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  - 2. For each coat in a paint system, products shall be recommended in writing by top coat manufacturers for use in paint system and on substrate indicated.
  - 3. Shop-applied Primer Compatibility for Steel: Field-applied primers and top coats shall be compatible with one another and shop-applied primers. Refer to Division 05 sections for shop-applied primers for steel.
- C. VOC Content:
  - 1. Comply with the following:
    - a. Michigan Department of Environment, Great Lakes, and Energy's (EGLE) air pollution rules, Part 6: Emission Limitations and Prohibitions – Existing Sources of Volatile Organic Compound Emissions.
    - b. Ozone Transport Commission (OTC), Model Rule for Architectural and Industrial Maintenance (AIM) Coatings; as referenced in EGLE's air pollution rules, Part 6.
      - 1) OTC Phase II.

2. Content Limits:

- a. The following paint and coating categories are as defined by OTC, Model Rule for Architectural and Industrial Maintenance (AIM ) Coatings. Paints and coatings shall comply with the following VOC content limits unless stricter limits are required by authorities having jurisdiction:

- 1) Flat Coatings: 50g/L.
- 2) Non-flat Coatings: 100g/L.
- 3) Non-flat High Gloss Coatings: 150g/L.
- 4) Dry Fog (Dryfall) Coatings: 150g/L.
- 5) Industrial Maintenance Coatings: 250g/L.
- 6) Primers, Sealers, and Undercoaters: 100g/L.
- 7) Specialty Primers, Sealers, and Undercoaters: 100g/L.
- 8) Rust Preventative Coatings: 250g/L.
- 9) Zinc Rich Primers: 340g/L.

- D. Supply each coating material in quantity required to complete entire project's work from a single production run.
- E. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.
- F. Coating Finishes: Gloss (sheen) levels.

1. Coating finishes shall be defined by the coating's gloss (sheen) level according to ASTM D523, using 60 and 85 degree geometry. Coating finish gloss levels shall be as follows:

- a. Level 1 – Flat (Matte): Comply with both of the following:

- 1) 60 Degrees: Value not more than 5 units.
- 2) 85 Degrees: Value not more than 10 units.

- b. Level 2 – Velvet: Comply with both of the following:

- 1) 60 Degrees: Value not more than 10 units.
- 2) 85 Degrees: Value between 10 and 35 units.

- c. Level 3 – Eggshell: Comply with both of the following:

- 1) 60 Degrees: Value between 10 and 25 units.
- 2) 85 Degrees: Value between 10 and 35 units.

- d. Level 4 – Satin: Comply with both of the following:

- 1) 60 Degrees: Value between 20 and 35 units.
- 2) 85 Degrees: Value not less than 35 units.

- e. Level 5 – Semigloss:

- 1) 60 Degrees: Value between 35 and 70 units.

- f. Level 6 – Gloss:

- 1) 60 Degrees: Value between 70 and 85 units.

- g. Level 7 – High Gloss:
  - 1) 60 Degrees: Value more than 85 units.
- 2. Product names are not acceptable for coating finish identification.
- 3. For Part 2 of this Section coating finishes shall be defined as follows:
  - a. Flat Finish: Complying with ASTM D523 Level 1.
  - b. Low Luster Finish: Complying with ASTM D523 Level 2, 3 or 4.
  - c. Semigloss Finish: Complying with ASTM D523 Level 5.
  - d. Gloss Finish: Complying with ASTM D523 Level 6 or 7.
- 4. Where coating finishes are not specified, provide finish as selected by Architect.
- G. Colors: As indicated in Room Finish Schedule on Drawings or, if not indicated, to match Architect's samples.
  - 1. For opaque coatings, tint each coat including intermediate coats, one-half shade lighter than succeeding coat, with final top coat as indicated color.

## **2.3 INTERIOR HIGH PERFORMANCE COATINGS - NON-TRAFFIC SURFACES**

- A. General:
  - 1. Unless otherwise indicated, each high performance coating system consists of the following:
    - a. Primer: One coat based on substrate material.
    - b. Top Coats: Two coats based on required finish and substrate material.
  - 2. Required Finishes: For each high performance coating, provide paint finishes as follows unless otherwise indicated:
    - a. All High performance coatings: Semigloss.
  - 3. Excludes the following:
    - a. High performance coatings for metals at locations indicated in "Heavy Duty High Performance Coatings for Metals" Article below.
- B. Interior High Performance Systems – Non-Traffic Surfaces.
  - 1. Primers:
    - a. Block Filler/primer for concrete masonry units: Acrylic/latex block filler, water-based.
      - 1) Benjamin Moore: Ultra Spec Hi Build Masonry Block Filler 571; DFT 8.5 to 11.3 mils.
      - 2) Carboline; Sanitle 100; DFT 6.0 to 12.0 mils.
      - 3) PPG: Speedhide Interior/Exterior Masonry Hi Fill Latex Block Filler 6-15; DFT 7.0 mils.
      - 4) Sherwin Williams: Loxon Acrylic Block Surfacer LX01 Series; DFT 8.8 mils.
    - b. Primer for aluminum, ferrous metal, and galvanized steel: Rust-inhibitive acrylic/latex primer, water-based.
      - 1) Benjamin Moore; Ultra Spec HP Acrylic Metal Primer HP04 ; DFT 1.7 to 2.3 mils.
      - 2) Carboline; Carbocrylic 3358; DFT 2.0 to 3.0 mils.
      - 3) PPG; Pitt-Tech Plus 4020 PF; DFT 2.2 to 3.5 mils.
      - 4) Sherwin Williams; Pro Industrial Pro-Cryl Universal Primer B66 Series; DFT 1.9 to 3.8 mils.

- c. Primer for insulated piping and insulated ductwork: Acrylic/latex stain-blocking primer/sealer with high adhesion, water-based.
  - 1) Benjamin Moore; Insul-X Prime All Multi-Surface Latex Primer Sealer AP-1000; DFT 1.3 mils.
  - 2) Carboline; Sanitile 120; DFT 1.0 to 2.0 mils.
  - 3) PPG; Seal Grip Gripper Interior/Exterior 100% Acrylic Latex Primer 17-921XI Series; DFT 1.6 mils.
  - 4) Sherwin Williams; PrepRite ProBlock Interior-Exterior Latex Primer-Sealer B51-600 Series; DFT 1.4 mils.
- 2. Top Coats:
  - a. Semigloss Finish: Single or multi component, waterbased, acrylic epoxy.
    - 1) Finish coats for all surfaces:
      - a) Benjamin Moore; Corotech Pre-Catalyzed Waterborne Epoxy Semi-Gloss V341; DFT 1.5 to 1.9 mils
      - b) Carboline; Sanitile 255 - Semi-Gloss; DFT 2.0 to 3.0 mils.
      - c) PPG; Aquapon WB EP Semi-Gloss 98E Series; DFT 2.0 to 3.0 mils.
      - d) Sherwin Williams; Pro Industrial Pre-Catalyzed Waterbased Epoxy Semi-Gloss K46 Series; DFT 1.5 mils.

## **2.4 HEAVY DUTY HIGH PERFORMANCE COATINGS FOR METALS**

### **A. General:**

- 1. Unless otherwise indicated, each high performance coating system consists of the following:
  - a. Primer: One coat based on substrate material.
  - b. Intermediate Coats: One coat.
  - c. Top Coats: One coat based on required finish.
- 2. Required Finishes: For each high performance coating system, provide paint finishes as follows unless otherwise indicated:
  - a. All high performance coating systems: Semigloss.
- 3. Includes interior and exterior high performance coatings for the following:
  - a. Exposed exterior steel lintels.
  - b. The following miscellaneous non-structural ferrous metal and galvanized metal:
    - 1) Steel framing at overhead doors.
    - 2) All other miscellaneous metal items indicated to be coated with high performance coatings shall be coated in accordance with "Interior High Performance Coatings - Non-Traffic Surfaces" Article above.

B. Coating Systems.

1. Primers:

a. Zinc-rich primer.

- 1) Locations: Provide at the following areas for non-galvanized steel:
  - a) Exterior locations.
  - b) Wet areas.
- 2) Primer: Single or multi-component; organic zinc-rich; polyamide epoxy, thermoplastic resin, or aromatic urethane.
  - a) Carboline; Carbozinc 859; DFT 3.0 to 5.0 mils.
  - b) PPG; Amercoat 68 HS; DFT 2.0 to 5.0 mils.
  - c) Sherwin Williams; Zinc Clad 4100 Organic Zinc-Rich Epoxy Primer; DFT 3.0 to 5.0 mils.
  - d) Tnemec; Hydro-Zinc Series 94-H2O; DFT 2.5 to 3.5 mils.

b. Epoxy primer.

- 1) Locations: Provide at the following areas:
  - a) Galvanized steel.
  - b) Non-galvanized steel where zinc-rich primer is not required.
- 2) Primer: Two-component rust inhibitive, high solids, epoxy.
  - a) Carboline; Carboguard 890; DFT 4.0 to 6.0 mils.
  - b) PPG; Sigmafast 278; DFT 3.0 to 10.0 mils.
  - c) Sherwin Williams; Protective and Marine Coatings, Macropoxy 5000 Penetrating Epoxy Primer/Sealer B58 Series; DFT 1.0 to 2.0 mils.
  - d) Tnemec; Protuff Mastic Series 132; DFT 4.0 to 8.0 mils.

2. Intermediate Coats:

a. Intermediate Coats: Two component, rust inhibitive, high solids, polyamide or amine, epoxy.

- 1) Carboline; Carboguard 890; DFT 4.0 to 6.0 mils.
- 2) PPG; Amerlock 2; DFT 4.0 to 8.0 mils.
- 3) Sherwin Williams; Protective and Marine Coatings Macropoxy 646 Fast Cure Epoxy B58 Series; DFT 5.0 to 10.0 mils.
- 4) Tnemec; Hi-Build Epoxoline II Series V69; DFT 4.0 to 6.0 mils.

3. Top Coats:

a. Semigloss finish: Two component, aliphatic acrylic polyurethane.

- 1) Carboline; Carbothane 133 MC; DFT 3.0 to 5.0 mils.
- 2) PPG; Pitthane Ultra LS 95-8900 Series; DFT 2.0 to 4.0 mils.
- 3) Sherwin Williams; Protective and Marine Coatings Hi-Solids Polyurethane 250 Acrylic Polyurethane Semi-gloss B65 Series; DFT 3.0 to 5.0 mils.
- 4) Tnemec; Endura-Shield Series 1095; DFT 2.0 to 5.0 mils.

## **2.5 ACCESSORY MATERIALS**

- A. Accessory Materials: Provide cleaning materials, preparation materials, and miscellaneous materials required to properly prepare and apply coatings.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

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

### **3.2 PREPARATION**

- A. Comply with manufacturer's written instructions and recommendations applicable to substrates and paint systems indicated.
- B. Protect adjacent surfaces not to be painted.
- C. Clean substrates of substances that could impair bond of coatings, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
  - 1. For coatings applied over previously painted surfaces, test application to check for lifting and other adhesion problems. Perform test in an isolated area where practicable.
  - 2. Remove incompatible coatings and primers or apply barrier tie coat as recommended by paint manufacturer and as required to produce paint systems indicated.
- D. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
  - 1. After completing coating operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- E. Masonry Substrates: Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
- F. Steel Substrates - Unpainted or Unprimed: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:
  - 1. SSPC-SP 6 - Commercial Blast Cleaning.

- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Sand and scrape to remove loose primer and rust. Feather edges of remaining primer to make inconspicuous.
  - 1. Clean using methods recommended in writing by paint manufacturer but not less than the following:
    - a. SSPC-PA 1.
  - 2. Before applying finish coats, applicator/installer shall re-prime entire shop-primed item with steel primer specified in this section.
- H. Galvanized-Metal Substrates: Remove passivation coating/rinse, grease and oil residue from galvanized metal to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints. Clean using methods recommended in writing by paint manufacturer but not less than ASTM D6386, ASTM D7396, and the following:
  - 1. Remove surface contamination and oils in accordance with SSPC-SP 1 - Solvent Cleaning.
  - 2. Remove loose paint, rust, and other debris according to SSPC-SP 2 - Hand Tool Cleaning.
  - 3. Lightly profile galvanized surfaces and remove zinc oxide and zinc hydroxide layers in accordance with SSPC-SP16 – Brush-Off/Sweep Blast Cleaning.
  - 4. Apply paint within 1 hour of cleaning and preparation.
- I. Aluminum Substrates: Remove loose surface oxidation. Clean using methods recommended in writing by paint manufacturer but not less than the following:
  - 1. SSPC-SP 1 - Solvent Cleaning.
  - 2. Where required or recommended by coating manufacturer, lightly abrade uniformly to create a surface profile acceptable to coating manufacturer.
- J. Repair of Existing Gypsum Board:
  - 1. Fill hairline cracks, small holes, and imperfections with filler compound and sand smooth.

### **3.3 APPLICATION - GENERAL**

- A. Apply coatings according to manufacturer's written instructions.
  - 1. Use applicators and techniques suited for paint and substrate indicated.
- B. Provide smooth, opaque coatings of uniform finish, color, appearance, and coverage without brush marks, runs, sags, laps, ropiness, holidays, spotting, cloudiness, or other surface imperfections.
- C. Terminate coatings in neat lines; cut in sharp lines and color breaks.
- D. Apply coating products to properly prepared surfaces.
  - 1. Do not apply coatings over dirt, rust, scale, grease, moisture, or other conditions detrimental to application of coatings.
- E. Primers:
  - 1. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.
  - 2. Apply first coat of primer to surfaces as soon as practical after preparation and before subsequent surface deterioration.
  - 3. Re-prime shop-primed surfaces.

- F. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer.
  - 1. Sand between coats as recommended by manufacturer; before applying next coat clean surfaces of loose particles and use tack cloth to remove any remaining dust and particles just prior to applying next coat.
- G. Provide completed work matching approved samples for color, finish, texture, coverage and quality of work.
  - 1. Remove, refinish, or repaint work not complying with requirements.
- H. Number of Coats: Each coating system in Part 2 specifies a number of coats. This is the minimum number required.
  - 1. If undercoats, stains, or other imperfections are visible after final coating is applied, apply additional coats until paint is of uniform finish, color, and appearance without defects or imperfections.
- I. Minimum Coating Thickness: Provide dry film thickness for each coating as indicated, but not less than that recommended by the coating manufacturer.
  - 1. Number of coats and film thicknesses required are same regardless of application method.
  - 2. Ensure edges, corners, crevices, welds, and exposed fasteners receive dry film thickness equivalent to that of flat surfaces.

### 3.4 **SURFACES TO BE COATED**

- A. Refer to Section 09 9100 - Painting

### 3.5 **SURFACES NOT TO BE COATED**

- A. Refer to Section 09 9100 - Painting

### 3.6 **IDENTIFICATION AND COLOR CODING**

- A. Refer to Section 09 9100 - Painting.

### 3.7 **FIELD QUALITY CONTROL**

- A. Subject to the opinion of the Architect, coatings shall be rejected and considered unacceptable for any of the following reasons:
  - 1. Lacking minimum dry film thicknesses.
  - 2. Poor coverage at rivet heads, plate edges, lap joints, crevices, pockets, and corners.
  - 3. Damage from touching, or disturbing coatings in any other manner, before sufficiently dry.
  - 4. Damage from application to moist surfaces or damage caused by inadequate protection from the weather.
  - 5. Damage or contamination of coatings from blown contaminants including, but not limited to, dust.
  - 6. Coatings shall be rejected if any of the following are evident under natural lighting for exterior surfaces and final lighting source, including daylighting, for interior surfaces:
    - a. Visible defects are evident on vertical surfaces when viewed at normal viewing angles from a distance of not less than 48 inches.
    - b. Visible defects are evident on horizontal surfaces when viewed at normal viewing angles from a distance of not less than 48 inches.
    - c. Visible defects are evident on ceiling, soffit and other overhead surfaces when viewed at normal viewing angles from a distance of not less than 48 inches.



- B. Visible defects are defined as follows:
  - 1. Brush and roller marks, streaks, laps, runs, sags, drips, heavy stippling, hiding or shadowing by inefficient application methods, skipped or missed areas, and foreign materials in paint coatings.
  - 2. When the final coat on any surface exhibits a lack of uniformity of color, finish, texture, and hiding across full surface area.
- C. Rejected coatings shall be repaired or replaced at the expense of the Contractor.
  - 1. Small affected areas shall be touched up.
  - 2. Large affected areas shall be repainted.
  - 3. Small and large areas shall be as defined by the Architect.
  - 4. Areas without sufficient dry film thickness shall be repainted.
  - 5. Paint runs and sags shall be removed by scraper or sanding and repainted.

### **3.8 CLEANING AND PROTECTION**

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

**END OF SECTION 09 9600**

## **SECTION 10 2213 – WIRE MESH PARTITIONS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Standard-duty wire mesh partitions.
  - 2. Swing doors.

#### **1.3 DEFINITIONS**

- A. Intermediate Crimp: Wires pass over one and under the next adjacent wire in both directions, with wires crimped before weaving and with extra crimps between the intersections.

#### **1.4 PREINSTALLATION MEETINGS**

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

#### **1.5 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, details, and attachments to other work.
  - 2. Indicate clearances required for operation of doors.
- C. Delegated Design Submittals: For wire mesh partitions indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- D. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for units with factory-applied color finishes.
- E. Samples for Verification: 12-by-12-inch panel constructed of specified frame members and wire mesh. Show method of finishing members at intersections.

#### **1.6 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For manufacturer, installer, and delegated design engineer.
- B. Welding certificates.

#### **1.7 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For wire mesh partition hardware.

## **1.8 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 5 years documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section and with at least 5 years of documented experience.
- C. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1, "Structural Welding Code - Steel."
  - 2. AWS D1.3, "Structural Welding Code - Sheet Steel."

## **1.9 DELIVERY, STORAGE, AND HANDLING**

- A. Package wire mesh items as required to prevent damage.
  - 1. Deliver wire mesh items with cardboard protectors on perimeters of panels and doors and with posts wrapped to provide protection during transit and Project-site storage. Use vented plastic.

## **1.10 FIELD CONDITIONS**

- A. Field Measurements: Verify actual dimensions of construction contiguous with wire mesh units by field measurements before fabrication.

# **PART 2 - PRODUCTS**

## **2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Acorn Wire & Iron Works: [www.acornwire.com](http://www.acornwire.com).
  - 2. American Woven Wire Corporation: [www.americanwirecorp.com](http://www.americanwirecorp.com)
  - 3. Central Wire and Iron: [www.centralwireandiron.com](http://www.centralwireandiron.com).
  - 4. Indiana Wire Products, Inc.: [www.indianawireproducts.com](http://www.indianawireproducts.com).
  - 5. SpaceGuard Products: [www.spaceguardproducts.com](http://www.spaceguardproducts.com).
  - 6. Standard Wire & Steel Works: [www.standardwiresteel.com](http://www.standardwiresteel.com).
  - 7. WireCrafters, LLC: [www.wirecrafters.com](http://www.wirecrafters.com).

## **2.2 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design wire mesh units.
- B. Structural Performance: Wire mesh units shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.
  - 1. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft. at any location on a panel.
  - 2. Total load of 200 lbf applied uniformly over each panel.
  - 3. Concentrated load and total load need not be assumed to act concurrently.
- C. Regulatory Requirements: Comply with applicable provisions in the United States Access Board's ADA-ABA Accessibility Guidelines and ICC A117.1 for doors and gates designated as accessible.

## **2.3 MATERIALS**

- A. Steel Wire: ASTM A510.

- B. Steel Plates, Channels, Angles, and Bars: ASTM A36.
- C. Steel Pipe: ASTM A53, Schedule 40, unless another weight is indicated or required by structural loads.
- D. Steel Tubing: ASTM A500, cold-formed structural-steel tubing or ASTM A513, Type 5, mandrel-drawn mechanical tubing.
- E. Steel Sheet: Cold-rolled steel sheet, ASTM A1008, Commercial Steel, Type B.
- F. Panel-to-Panel Fasteners: Manufacturer's standard steel bolts, nuts, and washers.
- G. Post-Installed Anchors: Capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.
  - 1. Material for Interior Locations: Carbon-steel components are zinc plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.

## **2.4 STANDARD-DUTY WIRE MESH PARTITIONS**

- A. Mesh: 0.135-inch-diameter, intermediate-crimp steel wire woven into 1-1/2-inch diamond mesh.
- B. Vertical Panel Framing: 1-1/4-by-5/8-by-0.080-inch cold-rolled, C-shaped steel channels with holes for 1/4-inch-diameter bolts not more than 12 inches o.c.
- C. Horizontal Panel Framing: 1-by-1/2-by-1/8-inch cold-rolled steel channels.
- D. Horizontal Panel Stiffeners: Two cold-rolled steel channels, 3/4 by 3/8 by 1/8 inch, bolted or riveted toe to toe through mesh; or one 1-by-1/2-by-1/8-inch cold-rolled steel channel with wire mesh woven through channel.
- E. Top Capping Bars: 2-1/4-by-1-inch cold-rolled steel channels.
- F. Posts for 90-Degree Corners: 1-1/4-by-1-1/4-by-1/8-inch steel angles or square tubes with holes for 1/4-inch-diameter bolts aligning with bolt holes in vertical framing; with floor anchor clips.
- G. Line Posts: 3-inch-by-4.1-lb or 3-1/2-by-1-1/4-by-0.127-inch steel channels; with 1/4-inch steel base plates.
- H. Three-Way Intersection Posts: 1-1/4-by-1-1/4-by-1/8-inch steel tubes or channels, with holes for 1/4-inch-diameter bolts aligned for bolting to adjacent panels.
- I. Four-Way Intersection Posts: 1-1/4-by-1-1/4-by-1/8-inch steel tubes, with holes for 1/4-inch-diameter bolts aligned for bolting to adjacent panels.
- J. Floor Shoes: Metal, not less than 2 inches high; sized to suit vertical framing, drilled for attachment to floor, and with setscrews for leveling adjustment.
- K. Swinging Doors: Fabricated from same mesh as partitions, with framing fabricated from 1-1/4-by-1/2-by-1/8-inch steel channels or 1-1/4-by-5/8-by-0.080-inch cold-rolled, C-shaped steel channels, banded with 1-1/4-by-1/8-inch flat steel bar cover plates on four sides, and with 1/8-inch thick angle strike bar and cover on strike jamb.
  - 1. Hinges: Full-surface type, 3-by-3-inch steel, three per door; bolted, riveted, or welded to door and jamb framing.
  - 2. Padlock Lug: Mortised into door framing and enclosed with steel cover.
  - 3. Cylinder Lock: Mortise type with manufacturer's standard cylinder; operated by key outside and lever inside.

L. Accessories:

1. Adjustable Filler Panels: 0.060-inch- thick, steel sheet; capable of filling openings from 2 to 12 inches.
2. Wall Clips: Manufacturer's standard, steel sheet; allowing up to 1 inch of adjustment.

## 2.5 FABRICATION

- A. General: Fabricate wire mesh items from components of sizes not less than those indicated. Use larger-sized components as recommended by wire mesh item manufacturer. Furnish bolts, hardware, and accessories required for complete installation with manufacturer's standard finishes.

1. Fabricate wire mesh items to be readily disassembled.
2. Welding: Weld corner joints of framing and grind smooth, leaving no evidence of joint.

- B. Fabricate wire mesh partitions with cutouts for pipes, ducts, beams, and other items indicated. Finish edges of cutouts to provide a neat, protective edge.

1. Mesh:
  - a. Weld or securely clinch mesh to framing.
2. Framing:
  - a. Provide horizontal stiffeners as indicated or, if not indicated, as required by panel height and as recommended by wire mesh partition manufacturer. Weld horizontal stiffeners to vertical framing.
  - b. Fabricate three- and four-way intersections using intersection posts.
  - c. Fabricate partition and door framing with slotted holes for connecting adjacent panels.
3. Fabricate wire mesh partitions with 3 to 4 inches of clear space between finished floor and bottom horizontal framing.
4. Doors: Align bottom of door with bottom of adjacent panels.
  - a. For doors that do not extend full height of partition, provide transom over door, fabricated from same mesh and framing as partition panels.
5. Hardware Preparation: Mortise, reinforce, drill, and tap doors and framing as required to install hardware.

## 2.6 STEEL AND IRON FINISHES

- A. Finish: Provide one of the following:

1. Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard enamel finish, suitable for use indicated, with a minimum dry film thickness of 2 mils.
  - a. Color and Gloss: As selected by Architect from manufacturer's full range.
2. Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard baked-on powder-coat finish, suitable for use indicated, with a minimum dry film thickness of 2 mils.
  - a. Color and Gloss: As selected by Architect from manufacturer's full range.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine floors for suitable conditions where wire mesh items will be installed.
- C. Examine walls to which wire mesh items will be attached for properly located blocking, grounds, and other solid backing for attachment of support fasteners.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION OF WIRE MESH PARTITIONS**

- A. Anchor wire mesh partitions to floor with 3/8-inch-diameter, postinstalled expansion anchors at 12 inches o.c. through floor shoes located at each post and corner. Adjust wire mesh partition posts in floor shoes to achieve level and plumb installation.
- B. Anchor wire mesh partitions to walls at 12 inches o.c. through back corner panel framing and as follows:
  - 1. For concrete and solid masonry anchorage, use expansion anchors.
  - 2. For hollow masonry anchorage, use toggle bolts.
- C. Secure top capping bars to top framing channels with 1/4-inch- diameter, "U" bolts spaced not more than 28 inches o.c.
- D. Provide line posts at locations indicated or, if not indicated, as follows:
  - 1. For partitions that are 7 to 9 ft. high, spaced at 15 to 20 ft. o.c.
  - 2. For partitions that are 10 to 12 ft. high, located between every other panel.
  - 3. For partitions that are more than 12 ft. high, located between each panel.
- E. Install doors complete with door hardware.
- F. Bolt accessories to wire mesh partition framing.

### **3.3 REPAIR**

- A. Repair Painting:
  - 1. Wire brush and clean rust spots, welds, and abraded areas immediately after installation, and apply repair paint with same material as used for shop painting to comply with SSPC-PA 1 requirements for touching up shop-painted surfaces.
    - a. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

### **3.4 ADJUSTING**

- A. Adjust doors to operate smoothly and easily, without binding or warping. Adjust hardware to function smoothly. Verify that latches and locks engage accurately and securely without forcing or binding.

**3.5 PROTECTION**

- A. Remove and replace defective work, including doors and framing that are warped, bowed, or otherwise unacceptable.

**END OF SECTION 10 2213**

## **SECTION 10 2800 – TOILET, BATH, AND LAUNDRY ACCESSORIES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section includes:
  - 1. Toilet accessories.
  - 2. Custodial accessories.

#### **1.3 COORDINATION**

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

#### **1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
  - 2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
- B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
  - 1. Identify locations using room designations indicated on Drawings.
  - 2. Identify accessories using designations indicated on Drawings
- C. Samples for Initial Selection: For each type of finish material indicated.
- D. Samples for Verification: When requested by Architect, for each type of material, color, and finish required, 2 by 2 inches in size:

#### **1.5 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For manufacturer and installer.
- B. Sample Warranty: For manufacturer's special warranties.

#### **1.6 CLOSEOUT SUBMITTALS**

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



## **1.7 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than 5 years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least 5 years of documented experience.

## **1.8 WARRANTY**

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

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Basis of Design:
  - 1. Toilet Accessories: The design for each item specified is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the following:
    - a. American Specialties, Inc, (ASI): [www.americanspecialties.com](http://www.americanspecialties.com).
    - b. Bobrick Washroom Equipment, Inc.: [www.bobrick.com](http://www.bobrick.com).
    - c. Bradley Corporation: [www.bradleycorp.com](http://www.bradleycorp.com).
  - 2. Custodial Accessories: The design for each item specified is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the following:
    - a. American Specialties, Inc, (ASI): [www.americanspecialties.com](http://www.americanspecialties.com).
    - b. Bobrick Washroom Equipment, Inc.: [www.bobrick.com](http://www.bobrick.com).
    - c. Bradley Corporation: [www.bradleycorp.com](http://www.bradleycorp.com).
- B. Source Limitations: Obtain each type of toilet and custodial accessory from single source from single manufacturer.

### **2.2 PERFORMANCE REQUIREMENTS**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Structural Performance: Design accessories and fasteners to comply with the following requirements:
  - 1. Grab Bars: Installed units are able to resist 250 lbf concentrated load applied in any direction and at any point.

### **2.3 MATERIALS**

- A. Stainless Steel: ASTM A240 or ASTM A666, Type 304, 0.031-inch-minimum nominal thickness unless otherwise indicated.

- B. Brass: ASTM B19, flat products; ASTM B16, rods, shapes, forgings, and flat products with finished edges; or ASTM B30, castings.
- C. Steel Sheet: ASTM A1008, Designation CS (cold rolled, commercial steel), 0.036-inch-minimum nominal thickness.
- D. Galvanized-Steel Sheet: ASTM A653, with G60 hot-dip zinc coating.
- E. Galvanized-Steel Mounting Devices: ASTM A153, hot-dip galvanized after fabrication.
- F. Fasteners: Screws, bolts, and other devices of same material as accessory unit, unless otherwise recommended by manufacturer or specified in this Section, and tamper and theft resistant where exposed, and of stainless or galvanized steel where concealed.
- G. Chrome Plating: ASTM B456, Service Condition Number SC 2 (moderate service).
- H. Mirrors: ASTM C1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

## **2.4 FABRICATION**

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

## **2.5 FINISHES**

- A. Stainless Steel: Satin finish, unless otherwise noted.

## **2.6 TOILET ACCESSORIES**

- A. Toilet Paper Dispenser: Owner furnished; Contractor installed.
- B. Paper Towel Dispenser: Owner furnished; Contractor installed.
- C. Soap Dispenser: Owner furnished; Contractor installed.
- D. Sanitary-Napkin Disposal Unit:
  - 1. Description: Hinged disposal door with hinged unit cover and tumbler lock.
  - 2. Mounting: Surface mounted.
  - 3. Operation: Self-closing, disposal door.
  - 4. Capacity: 1/2 gallon.
  - 5. Material: Stainless steel with reusable vinyl waste receptacle liner.
  - 6. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; B-254.
- E. Mirrors:
  - 1. Frame: Stainless steel angle, 0.05 inch thick; with corners welded and ground smooth.
  - 2. Hangers: Manufacturer's standard rigid, tamper and theft resistant.
  - 3. Size: As indicated on Drawings but not less than 24 inches wide by 30 inches high.
  - 4. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; B-290.

F. Grab Bars:

1. Mounting: Flanges with concealed fasteners.
2. Material: Stainless steel with smooth, satin, slip-resistant finish.
3. Outside Diameter: 1-1/2 inches.
4. Configuration and Length: As indicated on Drawings.
5. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; B-6806 Series.

G. Robe Hook - Single:

1. Description: Single-prong unit, rectangular shaped with backplate and concealed fasteners.
2. Material: Stainless steel.
3. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; B-76717.

## 2.7 CUSTODIAL ACCESSORIES

A. Combination Utility Shelf and Mop and Broom Holder:

1. Description: Unit with shelf, hooks, holders, and rod suspended beneath shelf.
2. Length: 36 inches.
3. Hooks: Three.
4. Mop/Broom Holders: Four, spring-loaded, rubber hat, cam type.
5. Material: Stainless steel.
  - a. Shelf: Not less than nominal 0.05 inch (18 gage) thick.
  - b. Rod: Approximately 1/4-inch-diameter.
6. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; B-224.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
1. Remove temporary labels and protective coatings.
- B. Grab Bars: Install to comply with specified structural-performance requirements.

### 3.2 ADJUSTING AND CLEANING

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

**END OF SECTION 10 2800**

## **SECTION 10 4413 – FIRE PROTECTION SPECIALTIES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Fire extinguishers.
  - 2. Fire extinguisher mounting brackets.

#### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Samples for Initial Selection: For each type of exposed finish required.
- C. Samples for Verification: For each type of exposed finish required, prepared on samples 6 by 6 inches square.

#### **1.4 INFORMATIONAL SUBMITTALS**

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

#### **1.5 CLOSEOUT SUBMITTALS**

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

#### **1.6 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section; with not less than five years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified in this section; With minimum five years of documented experience.

#### **1.7 WARRANTY**

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

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Activar Construction Products Group, Inc. - JL Industries: [www.activarcpg.com](http://www.activarcpg.com).
  - 2. Croker Division of Fire-End and Croker Corp.: [www.croker.com](http://www.croker.com).
  - 3. Larsen's Manufacturing Co: [www.larsensmfg.com](http://www.larsensmfg.com).
  - 4. Nystrom, Inc: [www.nystrom.com](http://www.nystrom.com).
  - 5. Potter-Roemer: [www.potterroemer.com](http://www.potterroemer.com).
- B. Source Limitations: Obtain fire extinguishers and accessories from single source from single manufacturer.

### **2.2 PERFORMANCE REQUIREMENTS**

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

### **2.3 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS**

- A. Fire Extinguishers:
  - 1. Valves: Manufacturer's standard.
  - 2. Handles and Levers: Manufacturer's standard.
  - 3. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B.
- B. Multipurpose Dry-Chemical Type in Steel Container: UL-rated 4-A:80-B:C, 10-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.
- C. Finish: Baked polyester powder coat, red color.

### **2.4 MOUNTING BRACKETS**

- A. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or black baked-enamel finish.
- B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.
  - 1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
    - a. Orientation: Vertical.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine fire extinguishers for proper charging and tagging.
  - 1. Remove and replace damaged, defective, or undercharged fire extinguishers.

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

### **3.2 INSTALLATION**

- A. General: Install in accordance with manufacturer's instructions.
  - 1. Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
    - a. Mounting Brackets: Top of fire extinguisher to be at 42 inches above finished floor, unless otherwise indicated on Drawings.
- B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.
  - 1. Identification:
    - a. Apply decals at locations indicated.

### **3.3 ADJUSTING AND CLEANING**

- A. Replace fire extinguishers that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

**END OF SECTION 10 4413**

## **SECTION 12 3216 – MANUFACTURED PLASTIC-LAMINATE-CLAD CASEWORK**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Plastic-laminate-clad casework.
  - 2. Hardware and accessories.
- B. Related Requirements:
  - 1. Section 06 4023 - Interior Architectural Woodwork, for solid surfacing countertops

#### **1.3 DEFINITIONS**

- A. Definitions in the AWI/AWMAC/WI's "Architectural Woodwork Standards" apply to the Work of this Section.

#### **1.4 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.
- B. Keying Conference: Conduct conference at Project site. Incorporate keying conference decisions into final keying requirements.

#### **1.5 COORDINATION**

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that casework can be supported and installed as indicated.

#### **1.6 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: For plastic-laminate-clad casework.
  - 1. Include plans, elevations, sections, and attachments to other work including blocking and reinforcements required for installation.
  - 2. Indicate types and sizes of casework.
  - 3. Indicate manufacturer's catalog numbers for casework.
  - 4. Show fabrication details, including types and locations of hardware.
  - 5. Indicate locations of and clearances from adjacent walls, doors, windows, other building components, and equipment.
- C. Keying Schedule: Include schematic keying diagram, and index each key set to unique designations that are coordinated with the Contract Documents.
- D. Selection Samples: Where colors and finishes are not specified, submit 3 sets of color and finish selection charts or chips.

E. Samples for Verification: For the following:

1. Plastic Laminates: 8 by 10 inches, for each type, color, pattern, and surface finish required.
  - a. Provide one Sample applied to core material with specified edge material applied to one edge.
2. Low Pressure Decorative Laminate: 8 by 10 inches, for each color, pattern, and surface finish.
  - a. Provide one Sample applied to core material with specified edge material applied to one edge.
3. Edge Banding: 6 inches, for each type, color, pattern, and finish required.

F. Base Cabinet Sample: Upon request of Architect, provide one full-size, 16-inch-wide, minimum, finished base cabinet complete with hardware, doors, and drawers but without countertop.

**1.7 INFORMATIONAL SUBMITTALS**

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

**1.8 CLOSEOUT SUBMITTALS**

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

**1.9 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  1. Door Hinges: Equal to two percent of total installed but not less than 8; include associated fasteners.
  2. Door Pulls: Equal to two percent of total installed but not less than 4; include associated fasteners.
  3. Shelf Supports: Equal to two percent of total installed but not less than 12; include associated fasteners.
  4. Door Catches: Equal to two percent of total installed but not less than 4; include associated fasteners.
  5. Drawer Slides: For each type, equal to two percent of total installed but not less than 2 pairs; include associated fasteners.
  6. Locks: For each type, equal to two percent of total installed but not less than 4; include associated fasteners.

**1.10 QUALITY ASSURANCE**

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

**1.11 DELIVERY, STORAGE, AND HANDLING**

- A. Protect finished surfaces during handling and installation with protective covering of polyethylene film or other suitable material.



## **1.12 FIELD CONDITIONS**

- A. Environmental Limitations: Do not deliver or install casework until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during remainder of construction period. Maintain temperature and relative humidity during remainder of construction period in range recommended for Project location by the AWI/AWMAC/WI's "Architectural Woodwork Standards."
- B. Established Dimensions: Where casework is indicated to fit to other construction, establish dimensions for areas where casework is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.
- C. Field Measurements: Where casework is indicated to fit to existing construction, verify dimensions of existing construction by field measurements before fabrication and indicate measurements on Shop Drawings. Provide fillers and scribes to allow for trimming and fitting.
- D. Locate concealed framing, blocking, and reinforcements that support casework by field measurements before enclosing them, and indicate measurements on Shop Drawings.

## **1.13 WARRANTY**

- A. Special Warranty: Manufacturer agrees to repair or replace components of casework that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Delamination of components or other failures of glue bond.
    - b. Warping of components.
    - c. Failure of operating hardware.
  - 2. Warranty Period: Five years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Advanced Cabinet Systems: [www.advancedcabinetsystems.com](http://www.advancedcabinetsystems.com).
  - 2. Case Systems: [www.casesystems.com](http://www.casesystems.com).
  - 3. Flairwood: [www.flairwood.com](http://www.flairwood.com)
  - 4. Stevens Industries, Inc.: [www.stevensind.com](http://www.stevensind.com).
  - 5. Strata Design; [www.stratadesign.com](http://www.stratadesign.com)
  - 6. TMI Systems Design Corporation: [www.tmisystems.com](http://www.tmisystems.com).
- B. Source Limitations: Obtain from single source from single manufacturer.

### **2.2 GENERAL REQUIREMENTS FOR CASEWORK**

- A. Quality Standard: Unless otherwise indicated, comply with the AWI/AWMAC/WI's "Architectural Woodwork Standards" for grades of casework indicated for construction, finishes, installation, and other requirements.
  - 1. Grade: Premium.
- B. Design: Frameless cabinet construction with the following door and drawer-front style:
  - 1. Flush overlay.

- C. Drawings indicate sizes, configurations, and finish materials of manufactured plastic-laminate-clad casework. Provide casework of similar sizes and door and drawer configurations, of same finish materials, and complying with the Specifications

## **2.3 MATERIALS**

- A. Maximum Moisture Content for Lumber: 7 percent for hardwood and 12 percent for softwood.
- B. Hardwood Plywood: HPVA HP-1, particleboard core except where veneer core is indicated.
- C. Softwood Plywood: DOC PS 1.
- D. Particleboard: ANSI A208.1, Grade M-2.
- E. MDF: Medium-density fiberboard, ANSI A208.2, Grade 130.
- F. High Pressure Decorative Laminate (HPDL): High-pressure decorative laminate complying with NEMA LD 3.
- G. Low Pressure Decorative Laminate (LPDL) (Thermally Fused Laminate (TFL)): Particleboard or MDF finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for Test Methods 3.3, 3.4, 3.6, 3.8, and 3.10.
- H. PVC Edgebanding for Plastic Laminate: Rigid PVC extrusions, through color with satin finish, 3.0 mm thick at doors and drawer fronts, 1.0 mm thick elsewhere.

## **2.4 CABINET HARDWARE AND ACCESSORIES**

- A. Hardware, General: Unless otherwise indicated, provide manufacturer's standard, commercial-quality, heavy-duty hardware.
  - 1. Use threaded metal or plastic inserts with machine screws for fastening to particleboard except where hardware is through-bolted from back side.
  - 2. Finishes:
    - a. Exposed Hardware: Provide finish that complies with BHMA A156.18 for BHMA finish number indicated. Unless otherwise indicated, provide the following finish:
      - 1) Satin Chrome: BHMA 626.
    - b. Concealed Hardware: Provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.
- B. Butt Hinges: Five-knuckle hinges, overlay type, complying with ANSI/BHMA A156.9, Grade 1, with antifriction bearings and rounded tips. Provide two hinges for doors less than 48 inches high, and provide three hinges for doors more than 48 inches high.
  - 1. Provide four hinges for tall cabinet doors.
- C. Wire Pulls: Solid aluminum, stainless steel, or chrome-plated brass wire pulls, fastened from back with two screws.
  - 1. Provide two pulls for drawers more than 24 inches wide.
- D. Door Catches: Nylon-roller spring catch or dual, self-aligning, permanent magnet catch. Provide two catches on doors more than 48 inches high.

- E. Door and Drawer Bumpers: Self-adhering, clear silicone rubber.
  - 1. Doors: Provide one bumper at top and bottom of closing edge of each swinging door.
  - 2. Drawers: Provide one bumper on back side of drawer front at each corner.
- F. Drawer Slides: ANSI/BHMA A156.9.
  - 1. General:
    - a. Grade 1: Self-closing, side mounted and extending under bottom edge of drawer.
      - 1) Type: Full extension.
      - 2) Material: Zinc-plated steel with polymer rollers.
    - b. Grade 1HD-100 and Grade 1HD-200: under mounted; full-extension type; zinc-plated-steel ball-bearing slides.
  - 2. For drawers not more than 3 inches high and not more than 24 inches wide, provide Grade 1.
  - 3. For drawers more than 3 inches high, but not more than 6 inches high and not more than 24 inches wide, provide Grade 1, HD-100.
  - 4. For drawers more than 6 inches high or more than 24 inches wide, provide Grade 1, HD-200.
- G. Locks: Keyed locks, cam or bolt type, pin tumbler, steel or brass material
  - 1. Complying with ANSI/BHMA A156.11, Grade 1
  - 2. Provide locks on all doors and drawers.
  - 3. Locks within a room or location shall be keyed alike and different than adjacent rooms and locations.
  - 4. All locks on the Project shall be master keyed.
  - 5. Provide 2 keys for each room or location and three 3 master keys.
- H. Adjustable Shelf Supports: Two-pin-locking plastic shelf rests complying with ANSI/BHMA A156.9, Type B04013 or single-pin metal shelf rests complying with ANSI/BHMA A156.9, Type B04013.
- I. Coat Rods:
  - 1. Rod: Minimum 1 inch diameter steel tube; minimum wall thickness 0.075 inch (14 gage).
  - 2. Brackets: Steel mounting brackets.

## **2.5 PLASTIC-LAMINATE-CLAD CASEWORK**

- A. Plastic-Laminate-Clad Cabinet Construction: As required by referenced quality standard, but not less than the following:
  - 1. Bottoms and Ends of Cabinets, and Tops of Wall Cabinets and Tall Cabinets: 3/4-inch particleboard.
  - 2. Shelves: 3/4-inch-thick particleboard.
    - a. Exception: Use 1-inch-thick material at shelves more than 36 inches wide.
  - 3. Backs of Casework: 1/2-inch-thick particleboard or MDF where exposed, 1/4-inch veneer-core hardwood plywood dadoed into sides, bottoms, and tops where not exposed.
  - 4. Drawer Fronts: 3/4 inch thick, with particleboard or MDF cores.
  - 5. Drawer Sides and Backs: 1/2-inch-thick solid-wood or veneer-core hardwood plywood, with glued dovetail or multiple-dowel joints.
  - 6. Drawer Bottoms: 1/4-inch-thick hardwood plywood glued and dadoed into front, back, and sides of drawers.
    - a. Exception: Use 1/2-inch material for drawers more than 24 inches wide.

7. Doors 48 Inches High or Less: 3/4 inch thick, with particleboard or MDF cores.
8. Doors More Than 48 Inches High: 1-1/8 inches thick, with particleboard cores.

B. Finishes:

1. Exposed Materials:

a. Plastic-Laminate:

1) Grade: VGS.

- a) Exception: Provide HGS at horizontal locations.

2) Colors and Patterns: As indicated in Color Codes on Drawings.

b. Edgebanding: PVC.

1) PVC Edgebanding Color: To match adjacent laminate, unless otherwise indicated.

2. Semiexposed Materials:

- a. Provide plastic laminate of same grade as exposed surfaces for interior faces of doors and drawer fronts and other locations where opposite side of component is exposed.

1) Colors and Patterns: Same as exposed face.

- b. All other semiexposed surfaces: Low pressure decorative laminate (thermally fused laminate) unless otherwise indicated.

1) Colors and Patterns: White, unless otherwise indicated in Color Codes on Drawings.

c. Edgebanding: PVC.

1) PVC Edgebanding Color: To match adjacent laminate, unless otherwise indicated.

3. Concealed Materials:

- a. Plastic Laminate: Grade BKL.

- C. Filler Strips: Provide as needed to close spaces between casework and walls, ceilings, and equipment. Fabricate from same material and with same finish as casework.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

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

**3.2 INSTALLATION**

- A. Grade: Install casework to comply with same quality standard grade as item to be installed.

- B. Install casework level, plumb, and true in line; shim as required using concealed shims. Where casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.
- C. Base Cabinets: Set cabinets straight, level, and plumb. Adjust subtops within 1/16 inch of a single plane. Align similar adjoining doors and drawers to a tolerance of 1/16 inch. Bolt adjacent cabinets together with joints flush, tight, and uniform.
- D. Wall Cabinets: Hang cabinets straight, level, and plumb. Adjust fronts and bottoms within 1/16 inch of a single plane. Fasten cabinets to hanging strips, masonry, framing, wood blocking, or reinforcements in walls and partitions. Align similar adjoining doors to a tolerance of 1/16 inch.
- E. Fasten casework to adjacent units and to masonry, framing, wood blocking, or reinforcements in walls and partitions to comply with the AWI/AWMAC/WI's "Architectural Woodwork Standards."
- F. Install hardware uniformly and precisely. Set hinges snug and flat in mortises unless otherwise indicated. Adjust and align hardware so moving parts operate freely and contact points meet accurately. Allow for final adjustment after installation.
- G. Adjust operating hardware so doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

### **3.3 CLEANING**

- A. Repair or remove and replace defective work as directed on completion of installation.
- B. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.

**END OF SECTION 12 3216**

## **SECTION 12 3661 – SOLID SURFACING COUNTERTOPS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Solid surfacing countertops.

#### **1.3 PREINSTALLATION MEETINGS**

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

#### **1.4 COORDINATION**

- A. Coordinate locations of sinks, service fittings, and other items that will penetrate countertops or backsplashes.

#### **1.5 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: For solid surfacing countertops.
  - 1. Include plans, sections, details, and attachments to other work. Detail fabrication and installation, including field joints.
  - 2. Show locations and sizes of cutouts and holes for items installed in solid surfacing countertops.
  - 3. Show locations and details of joints.
  - 4. Show direction of directional pattern, if any.
- C. Samples for Verification: For the following products:
  - 1. Submit 3 samples of each finish, 4 by 4 inch in size, minimum; illustrating color, finish, and texture.

#### **1.6 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For manufacturer and installer.

#### **1.7 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For solid surface material countertops to include in maintenance manuals.
  - 1. Include data on regular cleaning.

#### **1.8 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least 5 years of documented experience.
- B. Installer/Fabricator Qualifications: Company specializing in performing work of the type specified and with at least 5 years of documented experience.

## **1.9 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver products only after casework and supports on which countertops will be installed has been completed in installation areas.

## **1.10 FIELD CONDITIONS**

- A. Field Measurements: Where countertops are indicated to fit to other construction, verify dimensions of countertops and other construction by field measurements after base cabinets are installed but before countertop fabrication is complete. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

## **PART 2 - PRODUCTS**

### **2.1 SOLID SURFACING**

- A. Solid Surfacing Sheet: 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 and non-porous; no surface coating; color and pattern consistent throughout thickness.
  - 1. Drawing Designation: SS Series.
  - 2. Manufacturers: Subject to compliance with requirements, provide products as indicated in Color Codes on Drawings. Substitutions not permitted.
  - 3. Colors, Patterns, and Finishes: As indicated in Color Codes on Drawings

### **2.2 SUBTOP MATERIALS**

- A. General: Subtops may be fabricated from any of the following materials.
  - 1. Plywood.
  - 2. Particleboard.
  - 3. Medium-density fiberboard.
- B. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.
  - 1. Made with adhesive containing no urea formaldehyde.
- C. Particleboard (Medium Density): ANSI A208.1, Grade M-2; Grade M-2-Exterior Glue at sink locations.
  - 1. Made with binder containing no urea formaldehyde.
- D. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade 130; water resistant MDF with Exterior Glue at sink locations .
  - 1. Made with binder containing no urea formaldehyde.

### **2.3 MISCELLANEOUS MATERIALS**

- A. Adhesive: Product recommended by solid surface material manufacturer.
- B. Sealant for Countertops: Comply with applicable requirements in Section 07 9200 - Joint Sealants, for mildew-resistant silicone sealant.
  - 1. Color: Clear.

## **2.4 FABRICATION**

- A. Fabricate countertops according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WI's "Architectural Woodwork Standards."
  - 1. Grade: Premium.
- B. Configuration: Unless otherwise indicated on Drawings, provide the following:
  - 1. Countertops: 3/4-inch-thick, solid surface material with front edge built up with same material.
    - a. Front: Built up to minimum 1-1/4 inch thick; eased square edge; use marine edge at sinks.
  - 2. Backsplashes: 3/4-inch-thick, solid surface material.
    - a. Profile: Straight, slightly eased at corner.
    - b. Fabricate loose for field assembly.
  - 3. End Splashes: Matching backsplashes.
- C. Joints:
  - 1. Fabricate countertops in one piece, unless size dictates multiple pieces.
    - a. Joint Locations: Not within 18 inches of a sink and not where a countertop section less than 36 inches long would result, unless unavoidable.
    - b. Splined Joints: Accurately cut kerfs in edges at joints for insertion of metal splines to maintain alignment of surfaces at joints where recommended by manufacturer or installer. Make width of cuts slightly more than thickness of splines to provide snug fit.
- D. Cutouts and Holes:
  - 1. Make cutouts for fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.
    - a. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates to receive solid surface material countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. Install countertops level to a tolerance of 1/8 inch in 8 feet, 1/4 inch maximum. Do not exceed 1/64-inch difference between planes of adjacent units.
- B. Refer to Section 06 4023 - Interior Architectural Woodwork, for countertop support brackets.
- C. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.



- D. Secure countertops to subtops with adhesive according to solid surface material manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
- E. Field Joints: Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.
  - 1. Install metal splines in kerfs in countertop edges at joints where recommended by manufacturer or installer. Fill kerfs with adhesive before inserting splines and remove excess immediately after adjoining units are drawn into position.
  - 2. Clamp units to temporary bracing, supports, or each other to ensure that countertops are properly aligned, and joints are of specified width.
- F. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.
- G. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.
  - 1. Seal edges of cutouts in subtops by saturating with varnish.
- H. Apply continuous mildew-resistant silicone sealant along tops of backsplashes and end splashes, sealing gaps between countertops and walls; comply with Section 07 9200 - Joint Sealants.

### **3.3 CLEANING AND PROTECTION**

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

**END OF SECTION 12 3661**

## **SECTION 13 3613 – METAL TOWERS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Metal towers.

#### **1.3 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review materials, installation, protection, and coordination with other work.

#### **1.4 COORDINATION**

- A. Coordinate installation of concrete foundations and anchor bolts embedded in concrete with metal tower installation requirements. Metal tower manufacturer to furnish reactions for design of foundations, tower dimensions, setting drawings, templates, and directions for installing anchor bolts that are to be embedded in concrete.
  - 1. Deliver such items to Project site in time for installation.

#### **1.5 ACTION SUBMITTALS**

- A. Product Data: For each type of product
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for metal towers.
- B. Shop Drawings: Indicate pertinent dimensioning, anchorage methods, and installation details.
  - 1. Include plans, elevations, sections, details, and attachments to other Work.
- C. Delegated-Design Submittal: For metal towers.
  - 1. Include structural calculations signed and sealed by the qualified professional engineer responsible for their preparation demonstrating conformance with structural requirements of the applicable building codes.
    - a. Include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
  - 2. Certify and indicate compliance with performance requirements and codes of authorities having jurisdiction.
- D. Selection Samples: Where colors and finishes are not specified, submit 3 sets of color and finish selection charts or chips.

E. Samples for Verification:

1. Submit 3 samples of each finish, 4 by 4 inch in size, minimum; illustrating color, finish, and texture.

**1.6 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For manufacturer, installer, and professional engineer.
- B. Operation Data: Include normal operation, troubleshooting, and adjusting.
- C. Welding certificates.
- D. Maintenance Data: For metal towers to include in maintenance manuals.
- E. Warranty: Sample of special warranty.

**1.7 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing metal towers as specified in this section, with at least 5 years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least 5 years of documented experience.
- C. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1 - Structural Welding Code - Steel.
  - 2. AWS D1.3 - Structural Welding Code – Sheet Steel.

**1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Package metal tower products and materials as required to prevent damage before installation.

**1.9 WARRANTY**

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace metal tower products and materials that fail in materials or workmanship within manufacturer's standard warranty period.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Metal Towers: Subject to compliance with requirements, provide Educational Steel Products LLC; Custom FWS Model, [www.educationalsteelproducts.com](http://www.educationalsteelproducts.com); or a comparable product from one of the following:
  - 1. Melhart Music Center: [www.melhart.com](http://www.melhart.com).
  - 2. Or approved equal.

**2.2 METAL TOWER DESCRIPTION**

- A. General: Custom, fixed, permanent, steel, metal towers with enclosed stairs and pitched metal roof.
- B. Metal Tower Configuration and Dimensions:
  - 1. Footprint: As indicated on Drawings or, where not indicated, as directed by Architect.

2. Height: As indicated on Drawings or, where not indicated, as directed by Architect; and as follows:
  - a. Minimum Height: 32 feet to underside of roof low point.
3. Number of Levels/Landings: As indicated on Drawings or, where not indicated, as directed by Architect; and as follows:
  - a. Minimum Number of Levels: 2.
- C. Stairs: Enclosed, metal grating stair system as standard with metal tower manufacturer.
  1. Access to stairs shall be secured by a locking gate or door as standard with metal tower manufacturer.
- D. Levels/Landings: Fully railed, metal floor plate platforms as standard with metal tower manufacturer.
- E. Roof: Metal roof system as standard with metal tower manufacturer.

## **2.3 FOUNDATIONS**

- A. Concrete Foundations: Refer to Section 03 3000 – Cast-in-place Concrete.
  1. Reactions for Design of Foundations: Supplied by metal tower manufacturer.
  2. Anchor Bolts: As indicated on anchor bolt layout drawings furnished by metal tower manufacturer and installed by Section 03 3000 – Cast-in-place Concrete.
    - a. Anchor bolts provided by metal tower manufacturer.

## **2.4 PERFORMANCE REQUIREMENTS**

- A. Comply with applicable provisions of the following specifications and documents:
  1. ANSI 360 – Specification for Structural Steel Buildings.
  2. ANSI Manual of Steel Construction: Load and Resistance Factor Design (LRFD).
  3. ANSI 303 – Code of Standard Practice for Steel Buildings and Bridges.
  4. ASCE 7-10 Structural Loads.
  5. RCSC - Specification for Structural Joints Using High-Strength Bolts.
  6. FM Approvals – 4471 - Approval Standard for Class 1 Panel Roofs.
  7. SMACNA - Architectural Sheet Metal Manual.
- B. General Design Loads:
  1. Wind Load: 115 mph, Exposure Category C.
  2. Ground Snow Load: 25 psf.
  3. Occupancy Live Load: 100 psf.
- C. Floodplain Requirements: Design structures to resist the effects of hydrostatic forces and buoyancy due to floodplain elevation.
  1. When in a floodway, structures should resist hydrodynamic and impact forces per FEMA 936 and ASCE 7 10 and its commentary.
- D. Metal Surfaces: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

- E. NAAMM Stair Standard: Comply with NAAMM AMP 510, "Metal Stairs Manual," for Industrial Class, unless more stringent requirements are indicated or required by manufacturer.
- F. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  - 1. Uniform Load: 100 lbf/sq. ft.
  - 2. Concentrated Load: 300 lbf applied on an area of 4 sq. in.
  - 3. Uniform and concentrated loads need not be assumed to act concurrently.
  - 4. Stair Framing: Capable of withstanding stresses resulting from railing and guard loads in addition to loads specified above.
  - 5. Limit deflection to  $L/360$  or 1/4 inch, whichever is less.
- G. Structural Performance of Levels (Balconies) and Landings: Levels and landings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  - 1. Levels and Landings: Uniform load of 125 lbf/sq. ft. or concentrated load of 2000 lbf, whichever produces the greater stress.
  - 2. Limit deflection to  $L/360$  or 1/4 inch, whichever is less.
  - 3. Levels and landings shall be capable of withstanding stresses resulting from railing and guard loads in addition to loads specified above
- H. Structural Performance of Railings and Guards: Railings and guards, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  - 1. Handrails and Top Rails of Guards:
    - a. Uniform load of 50 lbf/ft. applied in any direction.
    - b. Concentrated load of 200 lbf applied in any direction.
    - c. Uniform and concentrated loads need not be assumed to act concurrently.
  - 2. Infill of Guards:
    - a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft.
    - b. Infill load and other loads need not be assumed to act concurrently.
- I. Roof Panels:
  - 1. Roof panels shall support a 200-pound load distributed evenly over a 2-foot square area centered between joists or purlins, without exceeding a panel deflection-to-span ratio of  $1/180$  in a 2-span condition.
  - 2. Roof panels shall support a code prescribed snow load based on a ground snow load of 25psf and modified as required by code.
  - 3. Provide metal roof panels and component materials that comply with requirements in FM Global 4471 as part of a panel roofing system.
    - a. Fire/Windstorm Classification: Class 1A- 90.
    - b. Hail Resistance: SH.
  - 4. Wind Uplift Resistance:
    - a. Calculate wind uplift pressures in accordance with the following:
      - 1) Local codes and authorities having jurisdiction.
      - 2) Recommendations of the metal tower manufacturer.
      - 3) As required for the conditions and roof configurations indicated on Drawings.

- b. Design roofing assemblies to resist wind uplift pressures when tested according to FM Approvals 4474, UL 580, or UL 1897.
- J. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
  - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

## **2.5 MATERIALS**

- A. Structural Framing:
  - 1. W-Shapes: ASTM A992.
  - 2. Channels, Angles, M-Shapes, S-Shapes: ASTM A36.
  - 3. Plates, Shapes, and Bars: ASTM A36.
  - 4. Cold-Formed Hollow Structural Sections: ASTM A500, Grade B structural tubing.
- B. Railings and Guardrails:
  - 1. Tubing: ASTM A500 (cold formed) or ASTM A513, Type 5.
  - 2. Pipe: ASTM A53, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
  - 3. Expanded Metal Infill Panels: ASTM F1267, Type I (expanded) or Type II (expanded and flattened), Class 2 (coated).
- C. Metal Grating and Railing Infill:
  - 1. Expanded Metal Galvanized Steel: ASTM F1267, Class 2, Grade A.
- D. Metal Floor Plate:
  - 1. Abrasive-Surface Floor Plate: Galvanized steel plate with abrasive granules rolled into surface or with abrasive material metallurgically bonded to steel.
    - a. Abrasive coatings shall be equal to Traction Technologies Holdings LLC; SlipNOT, Grade 2 - Medium Abrasive Coating: [www.slipnot.com](http://www.slipnot.com).
- E. Roof Panel Metal Sheet:
  - 1. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755.
    - a. Color: Custom color to match Architect's sample.
- F. Miscellaneous:
  - 1. Galvanized-Steel Sheet: ASTM A653, G90 coating, structural steel, Grade 33, unless another grade is required by design loads.
  - 2. Cast Iron Fittings: Either gray iron, ASTM A48, or malleable iron, ASTM A47, unless otherwise indicated.

## **2.6 FASTENERS AND ANCHORS**

- A. General: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use. Select fasteners for type, grade, and class required.
- B. Fasteners:
  - 1. Steel Fasteners:
    - a. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.
    - b. High-Strength Bolts, Nuts, and Washers: ASTM F3125, Grade A325, Type 3, heavy-hex steel structural bolts; ASTM A563, Grade DH3, heavy-hex carbon-steel nuts; and where indicated, flat washers.
  - 2. Stainless Steel Fasteners:
    - a. Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, ASTM F593; with hex nuts, ASTM F594; and, where indicated, flat washers; Alloy Group 1.
- C. Anchors:
  - 1. General:
    - a. Anchors shall be capable of sustaining, without failure, a load equal to four times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E488, conducted by a qualified independent testing agency.
  - 2. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563; and, where indicated, flat washers.
    - a. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
  - 3. Cast-in-Place Anchors in Concrete: Either threaded or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47 malleable iron or ASTM A27 cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F2329.
  - 4. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.
    - a. Material for Exterior Locations: Alloy Group 1 stainless steel bolts, ASTM F593, and nuts, ASTM F594.

## **2.7 ACCESSORIES**

- A. Mounting Hardware: Provide all related fasteners and hardware required for a complete installation at substrates indicated.
- B. Welding Electrodes: Comply with AWS requirements.
- C. Handrail Wall Brackets: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.
  - 1. Provide type of bracket with flange tapped for concealed anchorage to threaded hanger bolt or predrilled hole for exposed bolt anchorage.
  - 2. Provide 1-1/2 inch clearance from inside face of handrail to finished wall surface
- D. Miscellaneous Trim and Accessories: Provide all trim and accessories required for a complete installation.

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

- 1. Compressive Strength: 5000 psi.

## **2.8 FABRICATION**

- A. Preassemble metal towers in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Provide complete stair assemblies, including metal framing, hangers, struts, railings and guards, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.
- C. Fabricate railings and guards to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of member, post spacings, wall bracket spacing, and anchorage, but not less than that needed to withstand indicated loads.
  - 1. Rails and Posts: 1-1/2-inch-diameter, unless otherwise indicated
  - 2. Infill: Spaced to prohibit the passage of a 4-inch diameter sphere, unless otherwise indicated.
  - 3. Intermediate Rails: 1-1/2-inch-diameter, unless otherwise indicated.
- D. Provide expanded metal gratings and railing infills in material, finish, style, size, thickness, weight, and type indicated or, if not indicated, as recommended by manufacturer for indicated applications and as needed to support indicated loads.
- E. Provide metal floor plate in material, finish, style, size, thickness, weight, and type indicated or, if not indicated, as recommended by manufacturer for indicated applications and as needed to support indicated loads.
- F. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- G. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- H. Form exposed work with accurate angles and surfaces and straight edges.
- I. Weld corners and seams continuously to comply with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- J. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

## **2.9 STEEL FINISHES**

- A. General:
  - 1. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.



2. Galvanizing: Provide hot-dip galvanizing at exterior locations, and elsewhere as indicated.
3. Painted Finishes: In addition to galvanizing, paint structural steel frames and other exposed items as standard with metal tower manufacturer.

a. Colors: Custom colors to match Architect's samples.

**B. Galvanizing**

1. Galvanizing: Hot-dip galvanize steel, including hardware, after fabrication.
  - a. Comply with ASTM A123 for hot-dip galvanized structural steel, railings, and guardrails.
  - b. Comply with ASTM A153 for hot-dip galvanized hardware.
2. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
3. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.
4. For galvanized steel indicated to have a painted finish:
  - a. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.

**C. Painted Finishes:**

1. Prepare galvanized steel Items to be shop primed in accordance with SSPC-SP 16, "Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals."
2. Painting: Immediately after surface preparation, apply primer in accordance with manufacturer's written instructions and in compliance with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
  - a. Primer and Finish Coats: As standard with metal tower manufacturer.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify that foundations and anchor bolt requirements are correct and properly located for metal tower installation.

**3.2 INSTALLATION**

- A. Install metal towers in accordance with manufacturer's instructions and as follows:
  1. Erect structural steel framing system in accordance with the Drawings and shop and erection drawings
  2. Align and attach stairs, landings, and levels in accordance with shop and erection drawings.
  3. Align and attach roof panels in accordance with shop and erection drawings.
- B. Install metal towers level and plumb.
- C. Install railings and guardrails level, plumb, square, true to line; without distortion, warp, or rack.
- D. Install roof systems weathertight.

- E. Field Modifications: Do not make field modifications without written approval of metal tower manufacturer.

### **3.3 ADJUSTING**

- A. Adjust operable elements for smooth operation.

### **3.4 CLEANING**

- A. Clean metal towers in accordance with manufacturer's instructions

### **3.5 CLOSEOUT ACTIVITIES**

- A. Demonstrate proper operation of metal towers to Owner's designated representative.
  - 1. Briefly describe function, operation, and maintenance of each component.

### **3.6 PROTECTION**

- A. Protect installed metal towers from subsequent construction operations.
- B. Protect finishes from damage during construction period. Remove any protective coverings at time of Substantial Completion.
- C. Restore finishes damaged during installation and construction period, so no evidence remains of correction work. Replace materials that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

**END OF SECTION 13 3613**

## **SECTION 14 4513 – VEHICLE SERVICE LIFTS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Vehicle service lifts.

#### **1.3 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination: Coordinate the installation of products specified in this section with size, location and installation of service utilities

#### **1.4 ACTION SUBMITTALS**

- A. Product Data: Provide general construction, material descriptions, finishes, dimensions and details.
- B. Shop Drawings: Indicate pertinent dimensioning, anchorage methods, and installation details.
  - 1. Include plans, elevations, sections, details, and attachments to other Work.
  - 2. Include wiring diagrams of electrical components.
- C. Selection Samples: Where colors and finishes are not specified, submit 3 sets of color and finish selection charts or chips.
- D. Samples for Verification:
  - 1. Submit 3 samples of each finish, 4 by 4 inch in size, minimum; illustrating color, finish, and texture.

#### **1.5 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For manufacturer and installer.
- B. Operation Data: Include normal operation, troubleshooting, and adjusting.
- C. Maintenance Data: Include data on regular cleaning.
- D. Warranty: Sample of special warranty.

#### **1.6 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least 5 years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least 5 years of documented experience.

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

- A. Package vehicle service lift components as required to prevent damage before installation.

## 1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace vehicle service lift components that fail in materials or workmanship within specified warranty period.
1. Warranty Periods:
    - a. Structural Components: 25 years from date of Substantial Completion.
    - b. Power Unit Components: Two years from date of Substantial Completion.
    - c. Hydraulic Cylinders: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 VEHICLE SERVICE LIFTS

- A. Vehicle Service Lifts.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Challenger Lifts; Model CL12A: [www.challengerlifts.com](http://www.challengerlifts.com), or a comparable product from one of the following:
    - a. Champion Distributors, LLC: [www.championautolift.com](http://www.championautolift.com)
    - b. Mohawk Lifts: [www.mowhawklifts.com](http://www.mowhawklifts.com).
    - c. Rotary Lift: [www.rotarylif.com](http://www.rotarylif.com).
  2. Performance Requirements:
    - a. Lift Capacity: 12,000 pounds.
    - b. Lifting Speed: 63 seconds.
    - c. Lifting Height: 84.75 inches.
    - d. Provide ALI Certification.
  3. General: Install lift assembly with all accessories, anchors and fasteners, hardware and components required for a complete assembly and installation.
    - a. Overall Dimensions: As standard with manufacturer.
    - b. Configuration: Two post lift with adjustable lifting arms, and multiple height and width adjustments.
    - c. Type: Synchronized, two-cylinder, hydraulic lift, surface mounted.
    - d. Material: Steel construction as standard with manufacturer.
  4. Electrical Requirements:
    - a. 208-230V, 60Hz, 1Ph.
    - b. Horse Power Rating: 2HP.
  5. Power Unit: As standard with manufacturer including, but not limited to, the following:
    - a. Electric motor.
    - b. Hydraulic pump.
    - c. Oil reservoir.
  6. Controls: As standard with manufacturer, column mounted.
  7. Finish: Powder coat; standard color as selected by Architect.
  8. Accessories:
    - a. Provide vehicle service lift manufacturer's standard frame adapters.
    - b. Provide vehicle service lift manufacturer's standard stack adaptors.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify that electrical service requirements are correct and properly located for vehicle service lifts.

#### **3.2 INSTALLATION**

- A. Install vehicle service lifts in accordance with manufacturer's instructions.
- B. Install vehicle service lifts in locations indicated.
- C. Install vehicle service lifts level and plumb.
- D. Connect vehicle service lifts to electrical service in accordance with manufacturer's instructions.

#### **3.3 SYSTEM STARTUP**

- A. Prepare and start vehicle service lift systems in accordance with manufacturers' instructions and recommendations.
- B. Adjust for proper operation within manufacturer's published tolerances.

#### **3.4 ADJUSTING**

- A. Adjust operable elements for smooth operation.

#### **3.5 CLEANING**

- A. Clean vehicle service lifts in accordance with manufacturer's instructions

#### **3.6 CLOSEOUT ACTIVITIES**

- A. Demonstrate proper operation of vehicle service lifts to Owner's designated representative.
  - 1. Briefly describe function, operation, and maintenance of each component.

#### **3.7 PROTECTION**

- A. Protect installed vehicle service lifts from subsequent construction operations.

**END OF SECTION 14 4513**

## **SECTION 20 0500 – COMMON WORK RESULTS FOR MECHANICAL**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Division 00 Bidding and Contracting Requirements, and Division 01 General Requirements Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes the following:
  - 1. References
  - 2. Quality Assurance
  - 3. System Description
  - 4. Permits and Fees
  - 5. Examination of Drawings and Premises
  - 6. Substitutions
  - 7. Work Under Other Contracts
  - 8. Submittals
  - 9. Work Restrictions, Coordination, Sequencing and Scheduling
  - 10. Conflicting Requirements and Minor Changes in the Work
  - 11. Delivery, Storage and Handling
  - 12. Basic Electrical Requirements and Methods
  - 13. Interoperability
  - 14. Warranties
  - 15. Mechanical Equipment -General
  - 16. Sealing of Openings (Firestopping)
  - 17. Examination of Existing Conditions and Temporary Services
  - 18. Mechanical Demolition Work
  - 19. Cutting and Patching
  - 20. Protection of Installed Construction, Damage to Other Work and Corrections
  - 21. Chases and Recesses
  - 22. Concrete Work, Equipment Foundations and Supports
  - 23. Coordination with Other Trades
  - 24. Assembly of Equipment, Equipment Connections, Installation and Lubrication
  - 25. Touch-up Painting
  - 26. Scaffolding, Rigging, Hoisting, Excavation and Backfilling
  - 27. Accessibility and Access Panels
  - 28. Field Quality Control, Starting, Adjusting and Commissioning
  - 29. Training and Instruction Program
  - 30. Cleaning and Waste Management

#### **1.3 REFERENCES**

- A. The mechanical and physical properties of all materials, and the design, performance characteristics, and methods of construction of all items of equipment, shall be in accordance with the latest issue of the various, applicable Standard Specifications of the following recognized authorities:
  - 1. AABC - Associated Air Balance Council
  - 2. ANSI - American National Standards Institute
  - 3. ASHRAE - American Society of Heating, Refrigerating and Air Conditioning Engineers
  - 4. ASTM - American Society for Testing Materials
  - 5. NEC - National Electrical Code
  - 6. NFPA - National Fire Protection Association
  - 7. NEMA - National Electrical Manufacturer's Association
  - 8. SMACNA - Sheet Metal and Air Conditioning Contractors National Association
  - 9. UL - Underwriters' Laboratories, Inc.

#### 1.4 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this Article establish some of the minimum qualification levels required; Division 01 and individual Specification Sections specify additional requirements.
- B. Code Compliance: Work and equipment shall comply with all latest applicable codes and legislations.
- C. Regulatory Requirements:
  - 1. Ordinances and Codes: Perform all work in accordance with applicable Federal, State and local ordinances and regulations, the Rules and Regulations of ASHRAE, NFPA, SMACNA and UL, unless otherwise indicated.
    - a. Notify the Architect/Engineer before submitting his proposal should any changes in Drawings or Specifications be required to conform to the above codes, rules or regulations. After entering into Contract, make all changes required to conform to above ordinances, rules and regulations without additional expense to the Owner.
    - b. Barrier-Free Regulations: Comply with the requirements of the State of Michigan Handicapped Barrier-Free Regulations and with the Americans with Disabilities Act (ADA).
- D. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those required for this Project.
- E. Instructor Qualifications: A factory-authorized service representative, complying with requirements in "Quality Requirements," experienced in operation and maintenance procedures and training.
- F. Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
  - 1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
    - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
  - 2. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
  - 3. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- G. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections.
- H. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- I. Associated Services: Cooperate with agencies performing required commissioning, tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
  - 1. Access to the Work.
  - 2. Incidental labor and facilities necessary to facilitate tests and inspections.

3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
  4. Facilities for storage and field curing of test samples.
  5. Delivery of samples to testing agencies.
  6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
  7. Security and protection for samples and for testing and inspecting equipment at Project site.
- J. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- K. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.
1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
  2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect/Engineer will determine which products shall be used at no additional cost to the project.
- L. Acceptance of Work: Failure on the part of the A/E to reject shop drawings or to reject Work in progress shall not be interpreted as acceptance of Work not in conformance with Code, Legislation, the Drawings and/or Specifications. Correct Work not in conformance whenever non-conformance is discovered.

#### **1.5 SYSTEM DESCRIPTION**

- A. Design Requirements: Furnish all labor, materials, equipment, technical supervision, and incidental services required to complete, test and leave ready for operation the mechanical systems as specified in the Division 20, 21, 22 and 23 Sections and as indicated on Drawings.
1. The Mechanical Drawings indicate the general design and extent of all equipment, piping and ductwork. Comply with the Drawings as closely as actual construction of the building and the work of other trades permit.

#### **1.6 PERMITS AND FEES**

- A. Give all necessary notices, obtain all permits; pay all government and state sales taxes and fees where applicable, and other costs, including utility connections or extensions in connection with the Project scope of work and expenses for permits, licenses, tests and inspections. File all necessary drawings, prepare all documents and obtain all necessary approvals of all governmental and state departments having jurisdiction, obtain all required certificates of inspections for Project scope of work and deliver a copy to the Architect/Engineer before request for acceptance and final payment for the Project scope of work.
1. Upon completion of the Work, obtain and send certificates of inspections and approvals to the Architect/Engineer.

#### **1.7 EXAMINATION OF DRAWINGS AND PREMISES**

- A. Before submitting Bids, examine the architectural, electrical and other trades' drawings and specifications.
1. Notify Architect/Engineer should any discrepancies occur between them and the mechanical work.
  2. No additional charges will be allowed because of failure to make this examination, or to include all materials and labor required for the Work.



3. Before submitting Bids, examine the premises to determine existing conditions for performing the Work. No additional charges will be allowed because of failure to make this examination or to include all materials and labor to complete the Work.
4. The Architectural Drawings take precedence in all matters pertaining to the building structure, Mechanical drawings in all matters pertaining to Mechanical trades and Electrical drawings in all matters pertaining to Electrical trades installation. However, where there are conflicts or differences between the Drawings for the various trades, report such conflicts or differences to the Architect/Engineer who shall determine the course of action to be taken.

B. Field Measurements:

1. Drawings are not intended to be scaled for roughing-in or to serve as shop drawings. Take all field measurements required for fitting the installation to the building.

**1.8 SUBSTITUTIONS**

- A. Base Bid must be in accordance with materials or products specified. Any exceptions to this must be approved in writing by the Architect/Engineer ten (10) days or more prior to bidding.
1. Voluntary alternates may be submitted for consideration, with listed addition or deduction to the Bid, but will not affect the awarding of the Contract.
  2. Mandatory Alternates: The Contractor shall refer to alternates listed in Division 01 and proposals shall submit price quotations for the alternates that apply to the mechanical work.

**1.9 WORK UNDER OTHER CONTRACTS**

- A. General: Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying work under this Contract. Coordinate the Work of this Contract with work performed under separate contracts.
- B. This Contractor shall be responsible for coordination with piping, equipment, etc., installed in previous Bid Packages. The Contractor shall review the previous bid package drawings and specifications and shall visit the site as part of his/her coordination effort. The Contractor shall also review with the Architect/Engineer, any piping, equipment, and devices that are shown on Bid Package documents but have been purchased and installed under previous bid packages.

**1.10 SUBMITTALS**

- A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that are new at time of installation.
1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
  2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
  3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
  4. Where products are accompanied by the term "as selected," Architect/Engineer will make selection.
  5. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.
  6. Or Equal: Where products are specified by name and accompanied by the term "or equal" or "or approved equal" or "or approved," comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.

B. Product Selection Procedures:

1. Design Basis: The design has been based on the single manufacturer indicated in the contract documents. The Contractor is responsible for verifying prior to submission, that any other manufacturer even though listed complies with dimensional and performance characteristics of the base specified product. Modifications shall be made by the Contractor as part of this contract to accommodate changes to the design basis.
2. Product: Where Specifications name a single product and manufacturer, provide the named product that complies with requirements.
3. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
4. Substitutions: Not allowed.

C. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

D. Conditions for Consideration: Architect/Engineer will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect/Engineer may return requests without action, except to record noncompliance with these requirements:

1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects with project names and addresses and names and addresses of Architect/Engineers and owners, if requested.
5. Samples, if requested.

E. Product List: Submit a list, in tabular form, showing specified products. Include generic names of products required. Include manufacturer's name and proprietary product names for each product.

1. Initial Submittal: Within 30 days after date of commencement of the Work, submit 3 copies of initial product list. Include a written explanation for omissions of data and for variations from Contract requirements.

F. Delegated-Design Services:

1. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of the Contractor by the Contract Documents, the Contractor shall provide products and systems complying with specific performance and design indicated.
  - a. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to the Architect.
2. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file copies of certificate, signed and sealed by the responsible design professional registered in the State where the project is located, for each product and system specifically assigned to the Contractor to be designed or certified by a design professional.
  - a. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

G. Submittal Requirements:

1. The following is in addition to the requirements for submittals in Division 01
2. Material List: Submit a complete list of all materials and equipment, and their manufacturers, for approval by the Architect/Engineer within 15 days after award of contract and prior to submittal of shop drawings.
3. All equipment of the same or similar systems shall be by the same manufacturer
4. Shop Drawings: Prepare shop drawings drawn to scale and submit to the Architect/Engineer for review, following submittal requirements listed in Division 01 and as required by the General Conditions. After the shop drawings are reviewed, they will be stamped and returned for distribution.
5. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
  - a. Identification of products.
  - b. Schedules.
  - c. Compliance with specified standards.
  - d. Notation of coordination requirements.
  - e. Notation of dimensions established by field measurement.
  - f. Relationship and attachment to adjoining construction clearly indicated.
  - g. Seal and signature of professional Architect/Engineer if specified.
6. Submit shop drawings of all sheet metal ductwork with necessary sections, details, dimensions, etc.
  - a. All sheet metal shop drawings shall bear balance agency approval stamp prior to submittal to Architect/Engineer.
7. Submit shop drawings and product data for all equipment, materials, valves, plumbing and heating specialties, pipe hangers, wiring diagrams and control diagrams including but not limited to items indicated below.
8. No apparatus or equipment shall be shipped from stock or fabricated until shop drawings for them have been reviewed by the Architect/Engineer. By the review of shop drawings, the Architect/Engineer does not assume responsibility for actual dimensions or for the fit of completed work in position, nor does such review relieve Mechanical Trades of full responsibility for the proper and correct execution of the work required.
9. Submit shop drawing with all pertinent data and with identification mark number or symbol numbers as specified or scheduled on the Mechanical Drawings.
10. Shop drawings shall be reviewed by the Mechanical Contractor for completeness and accuracy prior to submitting to the Architect/Engineer for review. The shop drawings shall be dated and signed by the Mechanical Contractor prior to submission.
11. Where the shop drawings consist of manufacturer's standard detail drawing or schedules and contain data for a variety of similar equipment, indicate the data pertinent to the equipment furnished for this project only. Standard detail drawings and schedules not clearly indicating which data is associated with this Project shall be returned "Rejected".
12. Where accessories and/or options are specified and do not appear as part of manufacturer's standard detail drawings, state each accessory that is to be provided with the equipment on the standard detail drawings.
13. Partial submittals for equipment will not be permitted. Where partial submittals are transmitted to the Architect/Engineer, they will be returned "Rejected".
14. Plumbing fixture submittals shall be submitted as one (1) package including all fixtures intended to be used for this Project.
15. Submittal Preparation: Shop drawing shall be submitted using the IDS "Submittal Form". Provide one (1) form for each project manual section number. The mechanical contractor shall fill out each submittal following the instructions printed on the back of the submittal form.
16. Submit manufacturer's submittals on all major mechanical systems and/or equipment, including but not limited to all equipment scheduled on drawings and all equipment in all division 20, 21, 22 and 23 specifications.

**1.11 WORK RESTRICTIONS, COORDINATION, SEQUENCING AND SCHEDULING**

- A. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services:
  - 1. Notify Owner and Architect/Engineer not less than 10 days in advance of proposed utility interruptions.
  - 2. Do not proceed with utility interruptions without Owner's and Architect/Engineer's written permission.
- B. Coordination: Each Contractor shall coordinate its construction operations with those of other Contractors and entities to ensure efficient and orderly installation of each part of the Work. Each Contractor shall coordinate its operations with operations, included in different Sections that depend on each other for proper installation, connection, and operation.
  - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
  - 2. Coordinate installation of different components with other Contractors to ensure maximum performance and accessibility for required maintenance, service, and repair.
  - 3. Make adequate provisions to accommodate items scheduled for later installation.
- C. Contractor shall coordinate all final specific utility requirements.
- D. Performance Requirements: Perform all work in a first class and workmanlike manner, in accordance with the latest accepted standards and practices for the Trades involved.
- E. Sequence and schedule work to avoid interference with the work of other Trades. Be responsible for removing and relocating any work which in the opinion of the Owner's Representatives causes interference.
- F. Coordinate mechanical equipment installation with other building components.
- G. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.
- H. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components, as they are constructed.
- I. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning before closing in building.
- J. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.
- K. Coordinate requirements for access panels and doors if mechanical items requiring access are concealed behind finished surfaces. Access panels and doors are specified in Section 08 3113 "Access Doors and Frames."
- L. Coordinate installation of identifying devices after completing covering and painting, if devices are applied to surfaces. Install identifying devices before installing acoustical ceilings and similar concealment.
- M. Action may include a request for additional information, in which case time for response will date from time of receipt of additional information.

#### **1.12 CONFLICTING REQUIREMENTS AND MINOR CHANGES IN THE WORK**

- A. General: If compliance with two or more standards or directives is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer to uncertainties and requirements that are different, but apparently equal, to Architect/Engineer for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect/Engineer for a decision before proceeding.
- C. Architect/Engineer will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time.
- D. Drawings are diagrammatic, the Contractor shall relocate devices a reasonable distance for coordination.
  - 1. A reasonable distance is 15 feet at no additional cost.

#### **1.13 DELIVERY, STORAGE AND HANDLING**

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions and generally accepted construction practice.
- B. Storage and Protection: Provide adequate storage space for all mechanical equipment and materials delivered to the job site under a weather protected enclosure. Location of the space will be designated by the Owner's Representative. Equipment set in place in unprotected areas must be provided with temporary protection.
- C. Storage:
  - 1. Store products to allow for inspection and measurement of quantity or counting of units.
  - 2. Store materials in a manner that will not endanger Project structure.
  - 3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
  - 4. Store cementitious products and materials on elevated platforms.
  - 5. Store foam plastic and plastic piping from exposure to sunlight, except to extent necessary for period of installation and concealment.
  - 6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
  - 7. Protect stored products from damage and liquids from freezing.
  - 8. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.
  - 9. Be responsible for the care and protection of mechanical equipment until it has been fully tested and accepted.
  - 10. Protect materials with permanent factory finish from damage by covering.
  - 11. Protect materials with enamel or glaze surfaces by covering or coating as recommended in "Handling and Care of Enameled Cast Iron Plumbing Fixtures" bulletin, issued by the Plumbing Fixtures Manufacturers Association and as approved.
  - 12. Coat polished or plated metal parts with white petroleum jelly immediately after installation.
  - 13. Protect equipment outlets, pipe and duct openings with temporary plugs or caps.
  - 14. Care and protection of electrical equipment furnished by Mechanical Trades and installed by Electrical Trades shall be the responsibility of the Electrical Trades after receiving equipment from Mechanical.

#### **1.14 BASIC ELECTRICAL REQUIREMENTS AND METHODS**

- A. For Electrical Work provided in Division 20, 21, 22 and 23 Sections, furnish UL Listed components, in accordance with Division 26 and applicable NEMA and NEC (ANSI C 1) requirements. Provide wiring, external to electrical enclosures, in conduit. All electrical work provided by this Contractor shall conform to Division 26 requirements.
- B. Changes Involving Electrical Work: The design of the mechanical systems is based on the equipment specified and scheduled on the Drawings.
  - 1. Where equipment changes are made that involve additional electrical work (larger size motors, additional wiring of equipment, etc.) the Mechanical trades involved shall compensate the electrical trades for the cost of the additional Work required.
- C. Heat-producing or spark-generating electrical devices located within Class I, Division I, Group D areas and Class I, Division II, Group D areas shall bear UL Label rated for the exposure.
- D. For equipment specified in Divisions 20, 21, 22 and 23 and provided with electrical characteristics requirements other than that specified or indicated, include necessary electrical wiring, components and transformer equipment selected to assure maximum efficiency operation.
- E. Provide specialty instrument wiring necessary to operation of a component, assembly or system as part of the work in Divisions 20, 21, 22 and 23.
- F. Coordinate the number of auxiliary N.O. and N.C. contacts to be provided as part of the Work to accommodate equipment and functions specified or indicated as part of the work under these Sections.
- G. Provide electrical work required for the operation of components and assemblies provided as part of the Work in Division 20, 21, 22 and 23 Sections but not specified or indicated as part of the Work in Division 26.
- H. Where "packaged-self-contained" equipment is specified, only one power supply shall be provided to that equipment as a part of the Work under Division 26 Sections, except as otherwise modified or supplemented by the Contract Documents for that item. All other electrical equipment including starters and wiring is part of the Work in Division 26 Sections.
- I. Where "packaged" equipment is specified, one or more power supplies and interconnecting control wiring may be required to provide a complete, operating unit. Any required intercomponent and interassembly power or control wiring shall be provided as part of the Work of Divisions 20, 21, 22 and 23 per the applicable requirements of Division 26.
- J. Mount line voltage (120 VAC) control components specified as part of the Work under Division 20, 21, 22 and 23 Sections for connection as part of the work under Division 26.
- K. Refer to Electrical Drawings and Division 26 for specific information regarding provisions for and arrangement of electrical circuits and components and for interface with Work specified under Divisions 20, 21, 22 and 23.

#### **1.15 INTEROPERABILITY**

- A. Contractor shall review all Drawings and Specifications from all Mechanical and Electrical disciplines and shall coordinate work as necessary to ensure proper coordination and interoperability of all existing and new, networked or interconnected systems, as indicated. Networked/interconnected systems may include, but are not limited to the following:
  - 1. DDC controls provided by the Mechanical Systems Controls Contractor
  - 2. Packaged mechanical unit controls provided by the unit Manufacturer

3. Lighting controls provided by the Electrical Contractor
4. Fire Alarm systems provided by the Electrical Contractor
5. Audio/Visual systems provided by the Electrical Contractor
6. Security systems provided by the Electrical Contractor
7. Site central Operator Interface system

#### **1.16 WARRANTIES**

- A. Warranty: Warranty the mechanical installation to be free from defects and replace or repair, to the satisfaction of the Owner, any part of the mechanical installation which may fail within a period of one year after substantial completion, provided that such failure is due to defects in materials or workmanship or to failure to follow the Contract Documents.
1. File with the Owner any and all warranties from equipment manufacturers and what operating conditions and performance capacities they are based on. Refer to Division 01 Sections.
  2. During this warranty period, correct or replace all defects developing through materials or workmanship immediately as directed by the Architect/Engineer without expense to the Owner; make all such repairs or replacements to the Owner's satisfaction
- B. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
- C. Warranty Start Date: Date of substantial completion.

### **PART 2 - PRODUCTS**

#### **2.1 MECHANICAL EQUIPMENT – GENERAL**

- A. All major items of equipment shall be furnished complete with all accessories normally supplied with the catalog items listed and all other accessories necessary for a complete and satisfactory operating system. All equipment and materials shall be new and shall be standard products of manufacturers regularly engaged in the production of plumbing, heating, ventilating and air conditioning equipment and shall be the manufacturer's latest design.

#### **2.2 SEALING OF OPENINGS (FIRESTOPPING)**

- A. Seal openings around pipes in sleeves and around duct openings through walls, floors and ceilings, and where floors, fire rated walls and smoke barriers are penetrated. (Fiberglass is not acceptable.) Fire and/or smoke barriers shall be UL listed fire and smoke stop fittings and shall have fire rating equal to or greater than the penetrated barrier. Refer to Division 07 Section "Firestop Systems" for additional requirements.
1. Manufacturers:
    - a. 3M
    - b. Hilti
    - c. Tremco
    - d. Manville

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION OF EXISTING CONDITIONS AND TEMPORARY SERVICES**

- A. The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.
  - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utility and system connections.
  - 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
  - 3. Existing Utility Information: Furnish information to local utility and Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Acceptance of Conditions: Examine substrates, areas, and conditions, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
  - 1. Written Report: Where a written report listing conditions detrimental to performance of the Project scope of work is required by other Sections, include the following:
    - a. Description of the Work.
    - b. List of detrimental conditions, including substrates.
    - c. List of unacceptable installation tolerances.
    - d. Recommended corrections.
  - 2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
  - 3. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
  - 4. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
  - 5. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.
- C. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- D. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- E. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect/Engineer. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents.
- F. Provide temporary water and heat service as described in Division 01.
- G. New equipment installed shall not be used for temporary construction use without prior written approval from Owner's representative.



### 3.2 MECHANICAL DEMOLITION WORK

- A. General: Perform mechanical demolition work in a systematic manner. Use such methods as outlined below to complete Work indicated on Drawings.
- B. Obtain approval from the Owner prior to interrupting existing services. All service interruptions shall be at a time suitable to the Owner. Where the Owner approves service interruptions at times resulting in premium time work to this Contractor, this Contractor shall include the premium time in his Base Bid.
- C. Remove existing mechanical equipment, components and materials, including but not limited to piping, air handling units, heating units, plumbing fixtures, pumps, supports and other mechanical items made obsolete by the new work.
  - 1. Where existing equipment is removed, piping shall be capped under floor or behind face of wall.
- D. Work indicated to be removed includes removal of all auxiliary materials, accessories, anchorage, fasteners, and etc., down to bare substrate. No residual materials shall remain from work to be removed. Contractor will use whatever means necessary; including removal of all materials attached or related to those items designated to be removed, as acceptable to Owner and Architect/Engineer, to provided complete and thorough removal of existing work.
- E. Protect existing equipment and installations indicated to remain. If damaged or disturbed in the course of the Work, remove damaged portions and install new products of equal capacity, quality, and functionality.
- F. Work that has been cut or partially removed shall be protected against damage.
- G. Materials salvaged from this work shall not be reused except where reuse is specifically indicated.
- H. Existing fixtures and mechanical equipment removed, not reused and not specifically indicated to be turned over to the Owner shall be legally and properly disposed of off Owner's property.
- I. Existing fixtures and mechanical equipment specifically indicated to be turned over to the Owner shall be carefully disconnected, removed and turned over to the Owner in a storage area as directed by the Owner.
- J. Accessible Work: Remove exposed equipment and installations, indicated to be demolished, in their entirety.
- K. Abandoned Work: Cut and remove buried MEP system materials, equipment, raceways, piping and distribution, indicated to be abandoned in place, 2 inches below the surface of adjacent construction. Cap and patch surface to match existing finish.
- L. Remove demolished materials from Project site.
- M. Remove, store, clean, reinstall, reconnect, and make operational components indicated for relocation.
- N. Field verify all existing MEP system materials, equipment, raceways, piping and distribution to be removed for exact quantities.
- O. Remove all existing MEP system materials, equipment, raceways, piping and distribution located above ceilings and in walls that are not being reused.
- P. Remove all MEP systems and appurtenances, which are to be removed, in their entireties back to the source or source panels.
- Q. Remove all existing MEP system materials, equipment, raceways, piping and distribution located in walls or ceilings being demolished. Abandon no devices that have been disconnected unless specifically noted.

- R. Maintain continuity of all existing MEP devices, and utilization equipment not removed.
- S. Remove, store, protect, and reinstall existing work as required to accommodate alteration indicated.
- T. The existing work to be removed, in general, is as indicated on the Drawings and in this Section, but also includes any materials or work necessary to permit installation of new materials, as approved by Owner and Architect/Engineer.
- U. If systems, equipment, and components to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.
- V. In finished areas, all systems, equipment, and components shall be cut back to a concealed location, i.e., within walls, above ceilings, etc., before capping.

### **3.3 CUTTING AND PATCHING**

- A. See Division 01 for additional requirements. The Contractor shall furnish sketches showing the location and sizes of all openings, chases, etc., required for the installation of Work.
- B. Work under this Division shall include furnishing, locating and setting inserts and/or sleeves required before the floors and walls are built or be responsible for cutting, drilling or chopping where sleeves and inserts were not installed, where wall or floors are existing or not correctly located. The Contractor shall do all drilling required for the installation of hangers.
- C. Exercise extreme caution when core drilling or punching openings in concrete floor slabs in order to avoid cutting or damaging structural members. No structural members or structural slabs/floors shall be cut without the written acceptance of the Structural Engineer and all such cutting shall be done in a manner directed by him.
- D. The drilling or punching of structural members, such as holes through beams or columns, shall not be done without the specific permission of the Architect/Engineer.
- E. Cutting of holes through floors and walls shall be done only at such locations as may be directed by the Architect/Engineer.
- F. Cooperate with the other Contractors so that all cutting and repairing in any given area will be done simultaneously.
- G. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

### **3.4 PROTECTION OF INSTALLED CONSTRUCTION, DAMAGE TO OTHER WORK AND CORRECTIONS**

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.
- C. Protect all mechanical equipment, ductwork and piping from dust, dirt and debris throughout construction
- D. Remove debris from concealed spaces before enclosing the space.
- E. Remove liquid spills promptly.
- F. Where dust would impair proper execution of the Project scope of work, broom-clean or vacuum the entire work area, as appropriate.

- G. Installed Work: Keep installed work clean.
- H. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- I. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- J. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- K. Limiting Exposures: Supervise construction operations to assure that no part of the construction completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.
- L. Mechanical Trades will be responsible for all damage to other Work caused by their Work or through the neglect of their workers.
  - 1. All patching and repairing of any such damaged Work shall be performed by the trades that installed the Work, but the cost shall be paid by the Mechanical Trades.
- M. The cost of corrective work shall be included under the contract.
- N. Repair or remove and replace defective construction.
  - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- O. Restore permanent facilities used during construction to their specified or original condition.
- P. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
- Q. Repair components that do not operate properly. Remove and replace operating components to new condition.
- R. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

### **3.5 CHASES AND RECESSES**

- A. Provide sizes and locations of chases and recesses affecting the mechanical work for provision by general trades.

### **3.6 CONCRETE WORK, EQUIPMENT FOUNDATIONS AND SUPPORTS**

- A. Concrete bases shall be provided by Architectural Trades, the correct size and location shall be by Mechanical Trades. Mechanical Trades shall furnish and locate anchor bolts and sleeves, for installation by Architectural Trades.
- B. Coordinate with Architectural Trades any concrete work required for the mechanical installation. Concrete work shall include housekeeping pads beneath equipment and vibration isolation bases. Concrete work shall be in conformance with Division 03 Specifications.

- C. Furnish foundations and supports for mechanical equipment and materials as required by codes, as listed hereinafter and shown or noted on the Drawings.
- D. Provide necessary inserts, rod, structural steel frames, brackets, platforms, etc., for equipment suspended from ceilings or walls.
- E. Inserts for equipment support shall be lead shield anchors for small work and expansion shields for large work. Wooden plugs will not be allowed. Do not use metal roof decking and cellular floors for supporting equipment.

### **3.7 COORDINATION WITH OTHER TRADES**

- A. Install Work so as to avoid interferences with the Work of other trades. Be responsible for removing and relocating any work that, in the opinion of the Owner's Representative, causes interferences.
- B. Should construction conditions prevent the installation of mechanical equipment at locations shown on the drawings, minor deviations may be permitted and shall be as directed by the Architect/Engineer and shall be made without additional cost to Owner.

### **3.8 ASSEMBLY OF EQUIPMENT, EQUIPMENT CONNECTIONS, INSTALLATION AND LUBRICATION**

- A. The Contract Drawings and Specifications indicate items to be purchased and installed which are noted by a manufacturer's name, catalog number and/or brief description.
- B. The catalog number may not designate all the accessory parts and appurtenances required for the particular use or function.
- C. Arrange with the manufacturer for the purchase of all items required for the complete installation and efficient operation.
- D. Connections to equipment, fixtures, etc., shall be made in accordance with the shop drawings and rough-in measurements furnished by the manufacturers of the particular equipment furnished. Any and all additional connections not shown on the Drawings but called for by the equipment manufacturer's shop drawings or required for the successful operation of the particular equipment furnished shall be installed as part of this Contract at no additional charge to the Owner.
- E. All fittings connecting to equipment on piping 2-1/2 inches and above in size, shall be flanged, standard weight pattern with flat machine face provided with ring gaskets.
- F. All fittings connecting to equipment on piping 2 inches and below in size, shall be made with unions.
- G. All piping connections to pumps and other equipment shall be installed without strain at the pipe connection of the equipment.
  - 1. When directed, remove the bolts in flanged connections or disconnect piping to demonstrate that piping has been so connected.
- H. Brass couplings shall be used to connect dissimilar metals (such as steel and copper) to prevent electrolytic action.
- I. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
  - 1. Make vertical work plumb and make horizontal work level.
  - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
  - 3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.

- 4. Maintain minimum headroom clearance as indicated by Architect/Engineer in spaces without a suspended ceiling.
- J. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- K. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- L. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- M. Tools and Equipment: Do not use tools or equipment that produces harmful noise levels.
- N. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- O. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.
  - 1. All equipment and piping not supported from the building structural steel shall not exceed a combined load of 7 psf when supported from the metal deck/slab. Any condition that may exceed this limit shall be reviewed and approved by the Architect/Engineer and Structural Engineer before installation.
  - 2. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect/Engineer and/or to allow for proper access.
  - 3. Allow for building movement, including thermal expansion and contraction.
  - 4. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- P. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.
- Q. Provide all oil for the operation of the equipment until substantial completion. Contractor shall be held responsible for all damage to bearings while the equipment is being operated by him up to the date of acceptance of the equipment. Protect all bearings and shafts during installation and thoroughly grease the steel shafts to prevent corrosion. All motors and other equipment shall be provided with covers as required for proper protection during construction.

### **3.9 TOUCH-UP PAINTING**

- A. In general, no painting is required by Mechanical Trades other than touch-up of factory-finished mechanical equipment.
- B. All factory finished mechanical equipment shall be cleaned at completion of the job. Equipment showing rust or mars shall be thoroughly cleaned and sanded, prime coated and touched up with enamel of color to match original finish.

### **3.10 SCAFFOLDING, RIGGING, HOISTING, EXCAVATION AND BACKFILLING**

- A. Coordinate with Architectural Trades any concrete work required for the mechanical installation. Concrete work shall include housekeeping pads beneath equipment and vibration isolation bases. Concrete work shall be in conformance with Division 03 Specifications.

- B. The Contractor shall furnish all scaffolding, rigging, hoisting and services necessary for erection and delivery into the premises any equipment and apparatus furnished under this Division. Remove same from premises when no longer required.
- C. It is the responsibility of the Contractor to coordinate sizes, depths, fill and bedding requirements and any other excavation work required under this Division.
- D. Furnish excavating and backfilling to install work specified in the Mechanical Division. Refer to Mechanical Drawings and Division 31 Section "Earthwork" for methods and materials.
- E. Provide all pumping and well pointing required to keep mechanical excavations dry.

### **3.11 ACCESSIBILITY AND ACCESS PANELS**

- A. The Contractor shall be responsible for the sufficiency of the size of shafts and chases, the adequate thickness of partitions, and the adequate clearance in double partitions and hung ceilings for the proper installation of the Work.
- B. Locate all equipment which must be serviced, operated or maintained in fully accessible positions. Access doors shall be furnished for accessibility. Minor deviations from the Drawings may be made to allow better accessibility, but changes of magnitude or which involve extra cost shall not be made without the acceptance of the Architect/Engineer.
- C. Locate all equipment which must be serviced, operated or maintained in fully accessible positions. Equipment shall include, but not be limited to: motors, controllers, coil, valves, switchgear, drain points, etc. Access doors shall be furnished if required for better accessibility. Minor deviations from the Drawings may be made to allow better accessibility, but changes of magnitude or which involve extra cost shall not be made without the acceptance of the Architect/Engineer.
- D. Furnish access doors as required to make accessible all valves, controls, coils, motors, air vents, filters, motorized dampers, electrical boxes and other equipment installed by Mechanical trades or as required by Code. Refer to Division 08 for the type of access doors required. Refer to drawings and specifications for the type of access door to be provided at the outside air intake duct.
- E. Access doors in walls, ceilings, floors, etc., shall be field coordinated. It is the responsibility of the Contractor to coordinate and provide information regarding the sizes and quantities of access doors required for his work. The Contractor shall arrange his work in such a manner as to minimize the quantity of access doors required, such as grouping shutoff valves in the same area. Where possible, locate valves in already accessible areas, such as lay-in ceilings, etc.
- F. On a clean set of prints, the Contractor shall mark in red pencil the location of each required access door, including its size and fire rating (if any), and shall submit the print to the Architect/Engineer for review before access doors are purchased or installed.
- G. Upon completion of the Project, the Contractor shall physically demonstrate that all equipment and devices installed have been located and/or provided with adequate access panels for repair, maintenance and/or operation. Any equipment not so furnished shall be relocated or provided with additional access panels by the installing Contractor at no additional cost to the Owner.

### **3.12 FIELD QUALITY CONTROL, STARTING, ADJUSTING AND COMMISSIONING**

- A. Tests and Inspection: When the systems are completed, operate equipment as directed by Architect/Engineer. Replace all faulty equipment. Make necessary adjustments before final acceptance.
  - 1. Perform all tests required by State, City, County and/or other agencies having jurisdiction.
  - 2. Provide all materials, equipment, etc., and labor required for tests.

- B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- C. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.
- D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Manufacturer's Field Service: Provide a factory-authorized service representative to inspect field-assembled components and equipment installation, comply with qualification requirements in "Quality Requirements."
- F. Perform the commissioning activities as outlined in the Division 01 Section "Commissioning" and other requirements of the Contract Documents.
- G. Each Contractor shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities including, but not limited to, the following:
  - 1. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
  - 2. Cooperate with the CxA for resolution of issues recorded in the Issues Log.
  - 3. Attend commissioning team meetings held on a weekly basis.
  - 4. Integrate and coordinate commissioning process activities with construction schedule.
  - 5. Review and accept construction checklists provided by the CxA.
  - 6. Complete paper or electronic construction checklists as Work is completed and provide to the Commissioning Authority on a weekly basis.
  - 7. Review and accept commissioning process test procedures provided by the Commissioning Authority.
  - 8. Complete commissioning process test procedures.
- H. Refer to related information in other sections for additional requirements.
- I. Maintenance Materials: Retain all portable and detachable portions of the installation such as keys, tools, manuals, etc., until the completion of the work and then turn them over to the Owner and obtain itemized receipt. This receipt shall be attached to the "Final Application" for payment.

### **3.13 TRAINING AND INSTRUCTION PROGRAM**

- A. Program Structure: In addition to Division 01 and individual section requirements, develop an instruction program that includes individual training modules for each system and equipment not part of a system.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. Provide instruction for the following modules.
  - 1. Basis of System Design and Operational Requirements
  - 2. Documentation
  - 3. Emergencies
  - 4. Adjustments
  - 5. Troubleshooting
  - 6. Maintenance
  - 7. Repairs

- C. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
- D. Video Record: Training shall be recorded as digital video.

**3.14 CLEANING AND WASTE MANAGEMENT**

- A. Keep premises free from accumulation of waste materials and rubbish. At completion of work remove all rubbish from and about the building and leave the mechanical systems clean and ready for use.
- B. Close and tightly seal all partly used containers and store protected in well-ventilated, fire-safe area at moderate temperature. Deliver to reuse and/or recycle facilities if not removed from site for Contractor's reuse.
- C. Separate and recycle waste materials in accordance with the Waste Management Plan and to the maximum extent possible.
- D. Separate metal waste, packaging, and all other materials in accordance with the Waste Management Plan and place in designated areas for recycling or reuse.
- E. Check with manufacturer for recycling options. Most manufacturers take back scrap and unused portions for resale or manufacturing into new product.

**END OF SECTION 20 0500**



## **SECTION 20 0513 – COMMON MOTOR REQUIREMENTS FOR MECHANICAL**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section includes general requirements for single-phase and three-phase, general-purpose, horizontal, small and medium, squirrel-cage induction motors and single-phase, fan/pump-duty, horizontal, small and medium, electronically commutated, permanent magnet (EC) motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

#### **1.3 DEFINITIONS**

- A. Factory-Installed Motor: A motor installed by motorized-equipment manufacturer as a component of equipment.
- B. Field-Installed Motor: A motor installed at Project site and not factory installed as an integral component of motorized equipment.

#### **1.4 SUBMITTALS**

- A. Product Data for Field-Installed Motors: For each type and size of motor, provide nameplate data and ratings; shipping, installed, and operating weights; mounting arrangements; size, type, and location of winding terminations; conduit entry and ground lug locations; and information on coatings or finishes.
- B. Shop Drawings for Field-Installed Motors: Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Include the following:
  - 1. Each installed unit's type and details.
  - 2. Complete NEMA nameplate electrical data including design type, insulation, service factor, and efficiency
  - 3. Diagrams of power and control wiring. Provide schematic wiring diagram for each type of motor and for each control scheme.
  - 4. Bearing type, L10 life, and seal construction (open, single, or double shielded).
  - 5. Certification that electronic VFD driven motors comply with NEMA MG-1 Part 31.
  - 6. Ground ring and ceramic bearing details as applicable
- C. Coordination Drawings: Floor plans showing dimensioned layout, required working clearances, and required area above and around field-installed motors. Show motor layout, mechanical power transfer link, driven load, and relationship between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.
- D. Test Reports: Written reports from testing procedures outlined in Part 3.
- E. Operation and Maintenance Data: For field-installed motors to include in emergency, operation, and maintenance manuals.

## **1.5 QUALITY ASSURANCE**

- A. Reference Standards: Products in this section shall be built, tested, and installed in compliance with the following quality assurance standards; latest editions, unless noted otherwise:
  - 1. NFPA 70: National Electrical Code.
  - 2. NEMA Standards Publication MG 1 (2011): Motors and Generators.
  - 3. ABMA 9: American Bearings Manufacturers Association, Load Ratings and Fatigue Life for Ball Bearings
  - 4. UL 1004: Motors, Electric
- B. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.
- C. Source Limitations: Obtain field-installed motors of a single type through one source from a single manufacturer.
- D. Product Options for Field-Installed Motors: Drawings indicate size, profiles, and dimensional requirements of motors and are based on the specific system indicated.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- F. Comply with NFPA 70.

## **1.6 COORDINATION**

- A. Coordinate features of motors, installed units, and accessory devices. Provide motors that are:
  - 1. Compatible with the following:
    - a. Motor controllers
    - b. Magnetic controllers
    - c. Multispeed controllers
    - d. Reduced-voltage controllers
  - 2. Designed and labeled for use with variable frequency drives as applicable, and suitable for use throughout speed range without overheating.
  - 3. Matched to torque and horsepower requirements of the load.
  - 4. Matched to ratings and characteristics of supply circuit and required control sequence.
  - 5. Ambient and environmental conditions of installation location
- B. Coordinate motor support with requirements for driven load; access for maintenance and motor replacement; installation of accessories, belts, belt guards; and adjustment of sliding rails for belt tensioning.
- C. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Provide products of the following manufacturers:
  - 1. Reliance Electric
  - 2. Baldor Electric Company
  - 3. General Electric

4. U. S. Electric Motors
5. Marathon Electric
6. Toshiba Corp

## **2.2 MOTOR GENERAL REQUIREMENTS**

- A. Comply with NEMA MG 1 unless otherwise indicated.
- B. Motor requirements apply to factory-installed and field-installed motors except as follows:
  1. Different ratings, performance, or characteristics for a motor are specified in another Section.
  2. Manufacturer for a factory-installed motor requires ratings, performance, or characteristics, other than those specified in this Section, to meet performance specified.
  3. Motor Connections: Multiple power connections not allowed.
- C. Motors Less Than 1/2 HP: Single-phase
- D. Motors 1/2 HP and Larger: Three-phase.
- E. Frequency Rating: 60 Hz, alternating current.
- F. Voltage rating of motor shall be determined by voltage of circuit to which motor is connected:
  1. 120 V Circuit: 115 V motor rating.
  2. 208 V Circuit: 200 V motor rating.
  3. 240 V Circuit: 230 V motor rating.
  4. 480 V Circuit: 460 V motor rating.
- G. Service Factor: 1.15 for open drip-proof motors; 1.0 for totally enclosed motors and inverter duty motors.
- H. Duty: Continuous duty at ambient temperature of 105 deg F and at altitude of 3,300 feet above sea level.
- I. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.
- J. Motors shall be NEMA Design B.
- K. Provide Class B insulation, unless noted otherwise.
- L. All disconnects and other electrical accessories shall comply with Division 26 requirements
- M. Motors shall be nominal 1,800 rpm, unless noted otherwise.

## **2.3 SINGLE-PHASE MOTORS**

- A. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- B. Use shaded pole motors only for motors smaller than 1/20 HP.
- C. Provide automatic reset type thermal over-load protection.
- D. Bearings: Sealed or regreasable ball or sleeve bearings, suitable for the radial and thrust loading of the application.

- E. Furnish with sliding base/slotted mounting holes adequate for proper belt tensioning and alignment of motor or motor/load.
- F. Nameplates may be printed-type glued to the motor.

## **2.4 SINGLE-PHASE EC MOTORS**

- A. Motors equal to or smaller than 1 HP shall be Electronically Commutated (EC) type, to suit starting torque and requirements of specific motor applications.
- B. Bearings: Pre-lubricated, antifriction ball bearings suitable for radial and thrust loading.
- C. Motors: Internal motor circuitry shall convert AC power supplied to the fan to DC power to operate the motor. Motor shall be speed controllable down to 20 percent of full speed (80 percent turndown). Motor shall be a minimum of 85 percent efficient at all speeds.
  - 1. Variable speed, 0 - 2,000 RPM.
  - 2. Adjustable delay profile.
  - 3. 0 - 10 volt input signal.
  - 4. Output signal.
  - 5. Programmable ramp rate.
  - 6. Soft start.
  - 7. Remote controller.
  - 8. Moisture resistant.
  - 9. Insulation: Class H.
  - 10. Enclosure: Class 2, IP44.
  - 11. Integrated motor protection (electronically protected).
  - 12. UL 778, 1004-1, 508C.
  - 13. CAN/CSA C22.2 #108, #100, #107.1.
  - 14. EMC (89/366 EEC): EN 61000.
  - 15. LVD (73/23/EC): EN 60335-1, EN 60335-2-51.
  - 16. Machine Safety (98/37/EC): EN ISO 12100.

## **2.5 THREE-PHASE MOTORS**

- A. Description: NEMA MG 1, Design B, medium induction motor
- B. Enclosure: Open Drip Proof (ODP) unless noted otherwise in equipment specifications or schedules, and as suitable for service and application.
- C. Motor Efficiency: Nominal (nameplate) full load efficiency and corresponding minimum efficiency shall be equal to or greater than that stated in NEMA MG-1 (2011) Table 12-12 – Full Load Efficiencies of 60hz NEMA Premium Efficient Electric Motors - 600 volts or Less.
  - 1. “Premium Efficient” for all motors 1 hp and larger, including those furnished as part of equipment specified in equipment sections. The Contractor shall confirm utility company minimum requirements for incentive programs and provide motors with efficiencies that meet or exceed the most stringent between NEMA MG-1 and utility company incentive program requirements. The Contractor, at no extra charge to the Owner, shall replace any motor that does not meet the utility company’s incentive program. The efficiency and/or “NEMA Premium Efficiency” shall be displayed on the motor nameplate and clearly indicated on the equipment shop drawings submitted for approval.

- D. Motors less than 3 HP: Steel or cast iron motor frames, cast aluminum, cast iron, or steel end plates, steel or cast iron terminal box, copper windings. Motor nameplates shall be steel, engraved-type, riveted to motor.
  - 1. Bearings: Regreasable with relief plugs, pre-lubricated ball bearings suitable for radial and thrust loading of the application, with grease fittings, selected for a minimum L-10 bearing life of 26,280 hours, for belted and direct drive.
- E. Motors 3 HP and above: cast iron motor frame and mounting feet, cast iron end plates (bells), steel or cast iron terminal box, copper windings. Motor nameplates shall be stainless steel engraved type, riveted to the motor.
  - 1. Bearings shall be regreasable with relief plugs, pre-lubricated ball bearings suitable for radial and thrust loading of the application, with grease fittings. Rated for an L-10 life of 40,000 hours (belted) or 130,000 hours (direct connected).
- F. Bearing life calculations shall be per ABMA 9, and for belted applications shall be based on the maximum external side load limits for belted applications per NEMA MG-1 Table 14-1A. L-10 life calculations for vertical motors and horizontal motors mounted in the vertical position shall consider the application's thrust loading.
- G. TEFC motors shall also include an external shaft slinger on drive end.
- H. Multispeed Motors: Variable torque.
  - 1. Separate windings shall be provided for each speed
- I. Stator: Copper windings.
- J. Rotor: Random-wound, squirrel cage.
- K. Temperature Rise: Match insulation rating.
- L. Insulation: Class F.
- M. Code Letter Designation:
  - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
  - 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- N. Motors shall not exceed dBA levels listed in NEMA MG-1 54 PART 9 Tables 9-1 and 9-3, at all speeds.
- O. Motors shall be suitable for continuous duty at rated horsepower, with a maximum hot spot temperature that does not exceed the temperature limit of the insulation, when operated in an ambient temperature of 40 degrees C, except as otherwise indicated.
- P. Direct connected motors shall be furnished with adjustable base. Motors connected to driven equipment by belt or shaft shall be furnished with adjustable NEMA foundation sliding bases.
- Q. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

- R. For motors used with variable frequency drives, provide General Purpose NEMA Premium Efficiency Class motors complying with NEMA MG-1 Part 30 with windings that meet the requirements of NEMA MG-1 Part 31.4.4.2 and with minimum insulation of Class F.
1. For all PWM VFD driven motors up to 100 HP: Provide a maintenance free, circumferential conductive micro fiber grounding ring installed on the AC motor to discharge shaft currents to ground. Grounding ring shall be AEGIS SGR (Shaft Grounding Ring).
  2. For all PWM VFD driven motors 100 HP and larger: Provide a maintenance free, circumferential conductive micro fiber grounding ring installed on the drive end of the AC motor to discharge shaft currents to ground. Grounding ring shall be AEGIS SGR (Shaft Grounding Ring). In addition, all VFD driven motors 100 HP and larger shall utilize an insulated ceramic bearing assembly on the non-drive end of the motor, in conformance with the AEGIS installation requirements.
  3. Motors protected by the AEGIS SGR shall be warranted for the term of the manufacturer's motor warranty from induced bearing current damage.
- S. Explosion Proof motors:
1. UL listed for application or duty.
  2. Motors shall conform to requirements defined in Article 500, 501, 502, and 503 of the National Electric Code.
  3. Motor nameplate shall be specifically marked "explosion proof."
  4. Sound power levels shall not exceed recommendations of NEMA MG-1 PART 9 Tables 9-1 and 9-3, at all speeds.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine areas to receive field-installed motors for compliance with requirements, installation tolerances, and other conditions affecting performance.
- B. Examine roughing-in of conduit systems to verify actual locations of conduit connections before motor installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 MOTOR INSTALLATION**

- A. Anchor each motor assembly to base, adjustable rails, or other support, arranged and sized according to manufacturer's written instructions. Attach by bolting. Level and align with load transfer link.
- B. Install motors on concrete bases
- C. Comply with mounting and anchoring requirements specified in Section 20 0548 "Vibration Controls for Mechanical."

#### **3.3 FIELD QUALITY CONTROL**

- A. Prepare for acceptance tests as follows:
1. Run each motor with its controller. Demonstrate correct rotation, alignment, and speed at motor design load.
  2. Test interlocks and control features for proper operation.
  3. Verify that current in each phase is within nameplate rating.

- B. Testing: Owner shall engage a qualified testing agency to perform the following field quality-control testing should the proper performance of the motor be in question. If motor performance is found to be deficient, Contractor shall replace motor at no cost to Owner.
  - 1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.15.1. Certify compliance with test parameters.
  - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

### **3.4 ADJUSTING**

- A. Align motors, bases, shafts, pulleys and belts. Tension belts according to manufacturer's written instructions.
- B. Verify that bearings are factory lubricated before starting motors. Lubricate per manufacturer's instructions. Do not over-lubricate bearings.
- C. Check motors for unusual heating, noise, or excess vibration during operation. Correct any such deficiencies.
  - 1. Any motors with vibration exceeding specified limits, as noted in the Testing, Adjusting and Balancing Section, or manufacturer's recommendations, whichever is more stringent, shall be corrected, at no cost to Owner, until reduced below those limits.

### **3.5 MOTOR CLEANING**

- A. After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
- B. Clean motors, on completion of installation, according to manufacturer's written instructions.

### **3.6 MOTORS USED WITH VARIABLE FREQUENCY DRIVES**

- A. Install shaft grounding rings on all equipment motors using variable speed drives.
- B. Install per manufacturer's instructions.
- C. Assure grounding of SGR to motor frame.

**END OF SECTION 20 0513**

## **SECTION 20 0514 – VARIABLE SPEED DRIVES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section includes separately enclosed, preassembled, electronic variable frequency drives (VFDs), rated 600 V and less, for speed control of three-phase, squirrel-cage induction motors.
- B. Provide VFDs meeting the requirements contained herein and as indicated in the equipment schedule.

#### **1.3 QUALITY ASSURANCE**

- A. VFD and options shall comply with NFPA 70 (National Electrical Code), IEEE 519, UL 508 and FCC compliance for Radio Frequency Interference (RFI) and Electro- Mechanical Interference (EMI).

#### **1.4 QUALIFICATIONS OF MANUFACTURERS**

- A. Furnish essentially standard products of manufacturers regularly engaged in the production of such equipment for a minimum of ten (10) years.

#### **1.5 SOURCE QUALITY CONTROL**

- A. The integrated circuits shall undergo a 24-hour "burn-in" to test reliability. During the "burn-in", the temperature shall be cycled between 0 and 70 deg C with the speed varied from 10% to 100% of rated speed.
- B. Perform and record all normal factory tests on subassemblies and total assembly. Notify the Owner of the time of tests and extend reasonable cooperation to them or their representatives to permit them to witness tests should they so request before approval for shipment.

#### **1.6 HARMONIC DISTORTION**

- A. The VFD manufacturer shall provide all necessary filters as required to ensure compliance with IEEE Standard 519 "Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems."

#### **1.7 SUBMITTAL DATA**

- A. Submit for approval, the following product data:
  - 1. Dimensions and elevations.
  - 2. Front and side working spaces shall meet NEC requirements.
  - 3. Complete product data listing all included features.
  - 4. Factory test reports.
  - 5. The electrical rating for each VFD, matched to each piece of driven equipment.
  - 6. Short circuit current (withstand) rating.
  - 7. Project specific wiring diagrams indicating:
    - a. Line/load connection points
    - b. Main input and inverter input disconnect switches



- c. Integral motor overloads and manual motor protection for motors.
  - d. Fusing/circuit breakers
  - e. Auxiliary control transformer
  - f. Local/remote circuit
  - g. Hand-off-auto circuit
  - h. Safety interlock, run permissive, and drive initiated external circuits
  - i. Analog inputs and outputs
  - j. Pilot lights
  - k. Each wire on the wiring diagram shall be labeled with a distinct wire identifier.
8. VFD panel face diagram indicating the location of the main and inverter disconnect switches, local/remote and H-O-A switches, VFD/bypass switch, pilot lights, digital display, keypad, and any other face mounted device, along with the panel face labeling.

## **1.8 MAINTENANCE DATA AND OPERATING INSTRUCTIONS**

- A. Furnish to the Owner five (5) sets of instruction manuals covering installation, operation and servicing procedures for the equipment furnished, and complete illustrated parts breakdown with manufacturer's name, nomenclature, and part number for each component part and assembly. Include a list of recommended spare parts with current unit prices.

## **1.9 ENGINEERING FIELD SERVICE**

- A. The manufacturer of the equipment shall provide a qualified engineer to check the complete system after all equipment is installed and wired. Furnish to the Owner, the manufacturer's written certification assuring that each item of equipment is complete, in good condition, free from damage, and properly installed, connected and adjusted. The manufacturer's engineer shall make any adjustments or replacements which may be necessary to ensure the proper functioning of the equipment.

## **1.10 WARRANTY**

- A. The VFD shall be warranted by the manufacturer for a period of 36 months from date of start-up. The warranty shall include parts, labor, travel costs, and living expenses incurred by the manufacturer to provide factory authorized service.

## **PART 2 - PRODUCTS**

### **2.1 VARIABLE FREQUENCY DRIVES**

- A. Manufacturers: Subject to compliance with the Contract Documents, manufacturers for products specified in this Section shall be one of the following:
- 1. ABB
  - 2. Danfoss
  - 3. Siemens
  - 4. Toshiba
  - 5. Yaskawa
- B. VFDs manufactured by parent companies or their subsidiaries are not acceptable.
- C. All VFDs for the project shall be provided from one supplier and from one manufacturer.

### **2.2 GENERAL**

- A. VFDs designated for installation indoors shall have enclosures rated NEMA 1. VFDs designated for installation outdoors shall have enclosures rated NEMA 3R minimum. The same NEMA requirements shall be provided for enclosures housing a bypass or any other accessory.

- B. Unit shall be dead front construction.
- C. All relays shall be plug-in style base.
- D. All fuses shall be mounted in fuse blocks with insulated covers. Covers shall shield fuse ends and wire terminations.
- E. The VFD (including bypass and other accessories) shall have an overall short circuit current (withstand) rating of 42,000 amps symmetrical minimum and shall be marked with its short circuit current rating in compliance with UL.
- F. The unit, including all specified accessories, shall have a minimum efficiency of 85 percent at any speed from 50 to 100 %. The unit shall have a power factor of 0.9 or higher when operating at any speed from 50 to 100%.
- G. The VFD shall be variable torque type and shall provide full motor torque at any operating speed from 40% to 100%.
- H. The VFD shall provide variable torque V/Hz control when operating at speeds less than 100%.
- I. Provide the VFD with a main input disconnect switch, accessible without opening the drive cabinet, equipped with current limiting fuses and fuse rejection clips, or with circuit breakers. All other fuse blocks with current limiting fuses installed shall be equipped with fuse rejection clips. It shall be possible to padlock the disconnect switch in the off position.
- J. Provide minimum 6 pulse PWM type VFDs.
- K. Provide the necessary electronics to avoid audible noise generated from motor due to frequency change. The unit shall not increase the motor audible noise by more than 3 dB above the motor's across the line noise at any motor speed from 50 to 100 %.
- L. The VFD shall include self diagnostics with a digital display that identifies fault conditions and simplifies trouble shooting. Fault indication shall be retained even after a power outage or an input over-current protective device trip.
- M. VFD shall be provided with RFI/EMI filters.
- N. Unit shall be UL, CSA or ETL labeled.
- O. VFD shall include current sensors on all three output phases to accurately measure motor current.
- P. Provide minimum 3 percent AC input line reactors and/or minimum 5 percent DC link reactors to limit the maximum current total harmonic distortion (THD) to not more than 100% of the VS input current waveform at any VFD operating speed from 20% to 100%. Reactors shall be integral to the VFD. If testing reveals the maximum THD is exceeded, the manufacturer shall provide and install additional reactors at no cost to reduce the THD to within these specified limits.
- Q. The VFD shall have a dedicated terminal block for all external inputs and outputs.
- R. For drives supplied with bypass, provide factory mounted and wired 115V, 1 phase, 60 Hz control power transformer sized for handling an additional 30 VA inductive load. Limit fuse size for the control transformer to 3 amps maximum.
- S. The VFD input and output shall be rated at 480V, 3 phase.

- T. Provide a factory mounted and wired manual bypass device as scheduled. The bypass device shall allow the load to run across-the-line while electrically isolating the VFD so that maintenance can be performed on the drive components.

## 2.3 CONTROL FEATURES

- A. The VFD shall be provided with the following control features:
1. Factory mounted and wired Hand-Off-Auto selector switch that allows local or remote starting or stopping of the drive. Separate start and stop buttons, electronic circuits that "virtually" provide this capability, or other alternative devices are not acceptable.
  2. Factory mounted and wired VFD-Bypass switch, if bypass device is provided.
  3. Factory mounted and wired Local-Remote speed control switch that allows either local or remote control of the drive speed. Key pad buttons are also acceptable provided that permanently labeled, dedicated buttons are provided for the local and the remote speed control functions.
  4. Main input disconnect switch.
  5. Inverter input disconnect switch, accessible without opening the drive cabinet, if bypass device is provided.
  6. Manual speed potentiometer or keypad control, for local speed control with the Local-Remote speed control switch in the Local position.
  7. Provide one VFD for each scheduled motor and branch circuit power/motor protection for each motor.
  8. VFD shall accept an input reference (feedback) signal, 0-10 Vdc analog input, or 4-20 mA analog input, as indicated in VFD schedule, for remote speed control with the Local-Remote speed control switch in the Remote position. Provide input signal isolation to isolate input signal ground from VFD internal control ground.
  9. A remote start/stop contact input that functions in the automatic mode only.
  10. A safety interlock circuit that functions in all drive modes.
  11. A run permissive circuit, separate from the safety interlock circuit, which prevents motor operation when in drive. This circuit, via the customer's external contact device, signals the motor may run, provided the safety interlock contact(s) is made. A typical application would be for a time delay before motor start to allow some external event to occur. The run permissive circuit shall be jumpered from the factory.
  12. Provide the following drive initiated external circuits:
    - a. Powered run mode: A circuit that is powered after the motor is started in drive or by-pass modes.
    - b. Powered run request: A circuit that is powered whenever the drive safety interlock contact(s) are closed, and the drive H-O-A is in hand, or the drive H-O-A is in auto and the remote start/stop contact is closed.
  13. A standard USB port for direct connection of a Personal Computer (PC) to the VFD. The manufacturer shall provide PC software to allow complete setup and access to the VFD through the USB port. It shall be possible to communicate to the VFD through this USB port without interrupting VFD communications to the building management system
  14. An integral PID controller that, when activated, controls drive speed to maintain a programmed setpoint based on a remote analog input feed-back signal.
    - a. The VFD shall be able to apply a scaling factor to the feedback signal
    - b. The VFD shall be able to calculate the square root of the feedback signal so that a pressure sensor can be used to measure flow.
  15. A real-time clock shall be an integral part of the VFD.
    - a. It shall be possible to use this to display the current date and time on the VFD's display.

- b. The clock shall include a time clock function with 7 day programmability and a minimum of four programmable time periods per day, with individually selectable ON and OFF functions. The time clock function shall be programmable to control start/stop functions, constant speeds, PID parameter setpoints and output relays. The time clock function shall be programmable through the controller display and keypad, or by included software that allows programming via a PC and a USB connection.
- 16. VFD shall be capable of starting a coasting load.
- 17. VFD shall automatically attempt to restart a minimum of three (3) times during an adjustable time period of no less than 30 seconds after shutting off for any reason, except for short circuit or motor overload.
- 18. The VFD shall have adjustable motor acceleration and deceleration rates.
- 19. The VFD shall have the ability to lock-out a minimum of four critical frequency ranges to prevent the VFD from operating the load at a speed that causes vibration in the driven equipment.
- 20. The VFD shall be configured as required to meet system operational requirements including:
  - a. Provide an additional set of N.O. contacts on the VFD-Bypass switch that close when the switch is set to Bypass.
  - b. Provide one normally open and one normally closed auxiliary contacts to actuate when the motor is started in any mode.
  - c. Provide a minimum of one 4-20 ma analog output signal selectable to proportionally indicate drive output frequency, current, or power, or to indicate the VFD input reference/feedback signal, for monitoring by DDC

## **2.4 INDICATORS**

- A. Indicating lamp for "POWER AVAILABLE" and for "MOTOR ON BYPASS". Lights shall be LED type.
- B. Motor RPM and AMP display factory mounted on the face of the unit, either as a separate indicator or via the controller display..

## **2.5 SAFETIES**

- A. Provide status lights or digital display indication of the cause of any shutdown.
- B. The VFD shall be provided with the following safety features:
  - 1. VFD over voltage and under voltage protection and protection against temporary power outages.
  - 2. VFD over temperature protection.
  - 3. Motor over temperature protection per NEC 430.126(A)(2).
  - 4. Short circuit and ground fault protection.
  - 5. Separate motor overload protection functional in by-pass and normal operation. For VFDs controlling multiple motors, provide overload protection for each motor.
  - 6. Adjustable current limiter.

## **2.6 LABELING**

- A. Provide engraved plastic labels permanently attached to the VFD panel face indicating the function of all switches and indicators, and the equipment served.
- B. Tag all wiring in the drive. Tag nomenclature shall match the corresponding wire identification nomenclature indicated on the approved drive submittal.
- C. For VFDs serving smoke purge, stair pressurization, or other smoke control systems, include an engraved permanently attached red faced label, minimum 6" x 6", with the following nomenclature: CAUTION: THIS VFD IS PART OF A LIFE SAFETY SMOKE CONTROL SYSTEM. NOTIFY OWNER OR DEPARTMENT OF PUBLIC SAFETY PRIOR TO ANY CHANGE OR MAINTENANCE ACTIVITY TO THIS DRIVE.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Unit installation, including mounting and supports, and wiring to motor shall be by the Electrical Contractor, in compliance with Division 26. Coordinate with the Electrical Trades and Control Trades.
- B. Install the VFD on the motor or as close as possible to the motor. The load side power cables to the motor shall be kept as short as possible and shall not be run in the same conduit as the line side power cables. Control wiring shall be in separate conduit from power wiring. Where applicable, control wires from the motor disconnect early break contacts may be installed with the motor power wiring.
- C. Do not locate the operating means for individually mounted equipment at a height greater than 66 inches above the floor unless prior approval is obtained from the Architect/Engineer.
- D. Assemble the VFD and any accessories and provide all power and grounding connections.
- E. Provide all required fuses as recommended by the equipment manufacturer.
- F. Protect the unit from dirt, dust, water and physical damage prior to and during construction. If the inside of the unit becomes dirty or dusty before acceptance by Owner, it shall be thoroughly cleaned by the unit manufacturer at the contractor's expense.
- G. Where a disconnect is mounted at the driven motor an auxiliary switch in the disconnect shall be wired to the VFD to signal when the disconnect is open

#### **3.2 CONNECTIONS**

- A. Conduit installation requirements per Division 26. Drawings indicate general arrangement of conduit, fittings, and specialties.
- B. Ground equipment.
- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not included, use those specified in UL 486A and UL 486B.

#### **3.3 FIELD QUALITY CONTROL**

- A. Provide the services of a factory trained and certified technician to supervise, check, test and start. The contractor shall notify Owner's representative 5 days in advance of the start-up.
- B. Prepare for acceptance tests as follows:
  - 1. Test insulation resistance for each VFD element, bus, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- C. Testing: Perform the following field quality-control testing:
  - 1. After completion of system wiring, the manufacturer's engineer shall inspect, test, adjust, and re-adjust as necessary, all equipment in terms of design function and performance and provide a written report.
  - 2. Provide equipment to check the calibration of instruments. Instruments not in calibration shall be recalibrated to function as required or shall be replaced.

3. Calibrate and adjust devices, linkages, accessories, and components for stable and accurate operation to meet the design intent and to obtain optimum performance from the equipment. Final adjustment, calibration and checking shall be performed while the system is in full operation. Cause every device to automatically function as intended to insure its proper operation.
4. After calibration, adjustment and checking have been completed and system is operational, demonstrate to the Owner's Representative the complete and correct functioning of all system components and equipment. These demonstrations shall consist of operating the controls through their normal full ranges and sequences. Simulate abnormal conditions to demonstrate proper functioning of the devices. Readjust settings to their correct design values and after sufficient time, observe ability of controls to establish the desired conditions, noting abnormal deviations. Make necessary repairs, replacements, or adjustments on items which fail to perform satisfactorily and repeat tests to demonstrate compliance with the design intent.
5. When system is in specified operational condition, and when pertinent operational functions have been demonstrated, system will be accepted.
6. Before and after installation, provide a one minute record tape four times a day for 7 days and a onetime video demonstration by the manufacturer of the voltage and current distortion and harmonic distortion of the first six (6) harmonics at the variable frequency drive feeder input circuit breaker and output of variable frequency drive to motor. Submit results in a report to the Architect/Engineer identifying compliance with performance criteria specified herein.
7. The VFD supplier shall provide, at no additional cost, any additional devices required to meet the THD limits indicated in Part 1 of this specification.

D. Test Reports: Prepare a written report to record the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

**3.4 ADJUSTING**

- A. Set field-adjustable switches and circuit-breaker trip ranges.

**3.5 VFD CLEANING**

- A. Clean internally, on completion of installation, according to manufacturer's written instructions. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

**3.6 TRAINING**

- A. Training shall not be performed until system is operational and functional and two (2) weeks after receiving approved job specific technical manuals. Scheduling of separate training sessions shall be coordinated with the CM and Owner's agent.
- B. The manufacturer shall provide a minimum of two 4 hour sessions of training to the Owner's maintenance staff describing the proper operation, programming, service and maintenance of the VFDs and other components conducted by a factory-trained service technician.

**END OF SECTION 20 0514**

## **SECTION 20 0519 – THERMOMETERS, PRESSURE GAUGES, METERS AND ACCESSORIES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SCOPE OF WORK**

- A. Thermometers, pressure gauges, meters and accessories.

#### **1.3 QUALITY ASSURANCE**

- A. Manufacturers and Products: The products and manufacturers specified in this Section establish the standard of quality for the Work. Subject to compliance with all requirements, provide specified products from the manufacturers named in Part 2.
- B. Reference Standards: Products in this section shall be built, tested, and installed in compliance with the specified quality assurance standards; latest editions, unless noted otherwise.
1. UL Compliance: Comply with applicable UL standards pertaining to meters and gauges.
  2. ASME and ISA Compliance: Comply with applicable portions of ASME and Instrument Society of America (ISA) standards pertaining to construction and installation of meters and gauges.
  3. ASME/ANSI B40.1, Pressure Gauge Standard.
  4. National Sanitation Foundation NSF/ANSI-61 (potable drinking water) and NSF-61 Annex G (listed as  $\leq 0.25\%$  weighted average lead content) Applies to any item in contact with domestic water.
  5. US Safe Drinking Water Act.

#### **1.4 SUBMITTALS**

- A. Product Data: Include scale range, ratings, and calibrated performance curves for each meter, gage, fitting, specialty, and accessory specified.
- B. Shop Drawings: Include schedule indicating manufacturer's number, scale range, fittings, and location for each meter and gage.
- C. Product Certificates: Signed by manufacturers of meters and gages certifying accuracies under specified operating conditions and compliance with specified requirements.

### **PART 2 - PRODUCTS**

#### **2.1 THERMOMETERS, GENERAL**

- A. Scale Range: Temperature ranges for services listed are as follows:

<b>Service</b>	<b>Range (Degrees F)</b>
Domestic Cold Water	0-120
Domestic Hot Water	0-180
Chilled Water/Condenser Water	0-120
Heat Pump Water	0-120
Heating Hot Water	0-200

- B. Range and Accuracy: Plus or minus 1 percent of range span or plus or minus one scale division to maximum of 1.5 percent of range span.

- C. Thermometer Wells: Brass or stainless steel, with neck extension for insulated piping, with cap and chain fastened to well. 3/4"NPT, 2 1/2" insertion length, and extension length as required to extend well to outside of insulation. Lead free when used for domestic water applications.
- D. Outdoor thermometers shall be ultraviolet proof and specifically manufactured for outdoor use.

## **2.2 DIGITAL THERMOMETERS**

- A. Manufacturers:
  - 1. Weiss Model DVBM25 (vari-angle)
  - 2. Miljoco Electronic Digital (light powered)
  - 3. Techcontrols
- B. Digital Thermometer: electronic, with LCD display and solar cell, clear plastic window, adjustable angle, separable socket.
  - 1. Range and accuracy: -40 to 300 deg.F, accuracy greater of (+/-) 1 deg.F or 1% of reading.

## **2.3 GLASS THERMOMETERS**

- A. Manufacturers:
  - 1. Industrial Glass
  - 2. H.O. Terice
  - 3. Weksler
  - 4. Marsh
  - 5. Ashcroft
  - 6. Weiss
  - 7. Miljoco Corporation
- B. Industrial Glass Thermometer: adjustable angle, scale to be 9" long with white aluminum back and black graduation, aluminum casing, blue appearing liquid tube, glass window. Stem for air duct shall be 6" long with protective aluminum slotted bulb guard and mounting flange. Stem for piping shall be 3-1/2" long aluminum, brass or stainless steel, stem to match specified thermometer well. Adjust stem length for insulation extension.

## **2.4 PRESSURE GAUGES**

- A. Manufacturers:
  - 1. Dwyer
  - 2. H. O. Terice
  - 3. Weksler
  - 4. Marsh
  - 5. Ashcroft
  - 6. Weiss
  - 7. Miljoco Corporation
- B. Unless otherwise noted, provide all pressure gauges with clear glass window, cast aluminum, stainless steel or polypropylene case, black on white face, stainless steel wetted parts, brass 1/2" MPT socket, 1% full scale accuracy complying with ASME/ANSI B40-1 Grade 1A. Lead free when used for domestic water applications.
- C. Water and Compressed Air Services through 2" piping: 2 1/2" diameter face, stainless steel case, brass or stainless steel 1/4" MPT socket, 2% full scale accuracy.



- D. Water and Compressed Air Services over 2" piping: 4 1/2" diameter face, 6" diameter face for location more than 8 feet above floor, sealed glass window, glycerin filled for connections within 10 feet of pumps. For applications exceeding 145 deg. F, provide 316 stainless steel needle valves rated minimum 500 psi, in lieu of glycerin filled.
- E. Steam Service: 4 1/2" diameter face, 6" diameter face for location more than 8 feet above floor, sealed glass window, brass or stainless steel coil siphon tube with a minimum pressure rating of 1000 psi.
- F. Critical System Pressure Gauges: Stainless steel socket, 1/2% of full range accuracy, 6" diameter face, in accordance with AMSE/ANSI B40-1 Grade 2A. Provide where indicated on the Drawings.
- G. Differential Pressure Gauges: 4 1/2" diameter face, 6" diameter face for location more than 8 feet above floor, sealed glass window, glycerin filled for connections within 10 feet of pumps. For applications exceeding 145 deg. F, provide 316 stainless steel needle valves rated minimum 500 psi, in lieu of glycerin filled. Provide where indicated on the Drawings.
- H. Except where noted otherwise, select range for twice normal operating pressure:
  - 1. Water (CW and HW): 0-100 psig
  - 2. Steam (15#): 30" Hg vac. – 30 psig
  - 3. Steam (60#): 30" Hg vac. – 100 psig
  - 4. Compressed Air: 0-125 psig
- I. Outdoor gauges shall be ultraviolet proof and specifically manufactured for outdoor use.

## **2.5 PRESSURE-GAUGE FITTINGS**

- A. Syphons: NPS 1/4 coil of brass tubing with threaded ends.
- B. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant porous-metal disc of material suitable for system fluid and working pressure.

## **2.6 PRESSURE/TEMPERATURE TEST PLUGS AND KITS**

- A. Manufacturers:
  - 1. Plugs:
    - a. Peterson Products Company (Pete's Plug)
    - b. Schrader
    - c. Sisco
    - d. Miljoco Corporation
  - 2. Meter:
    - a. Auto Flow
    - b. Griswold
- B. Provide 1/4" brass pressure and temperature test plugs where shown on drawings, with two core Nordel rated for 275 degrees and 300 psig.
- C. Provide one readout meter kit including required hoses with a minimum 3-1/2" dial differential pressure gauge. Gauge shall read 0 to 60 psig and have end connections to match both the flow valves and plugs. Included in the case shall be two pocket thermometers (25 to 125 and 0 to 220 degrees), gauge adapter, and one pocket pressure gauge (0 to 160 psig). Meter shall become property of Owner (hand over to Owner's Project Manager) after completion of work.

## **2.7 WATER METERS**

- A. Main building service entrance water meter shall be purchased from the local municipality and installed by Contractor.

## **PART 3 - EXECUTION**

### **3.1 METER AND GAGE INSTALLATION – GENERAL**

- A. Install meters, gages, and accessories according to manufacturer's written instructions for applications where used.

### **3.2 INSTALLATION OF THERMOMETERS**

- A. Install and orient wells and thermometers so thermometer can be read from the floor.
- B. Thermometer Wells: For piping 2" and below, install in piping tee where thermometers are indicated, in vertical position. For piping 2 1/2" and above, "weldolets" may be used. Fill well with oil or graphite and secure cap.
- C. Install as indicated on the drawings

### **3.3 INSTALLATION OF PRESSURE GAUGES**

- A. Install pressure gauges with 1/2" isolation ball valve. Where needle valves are specified as a substitute for glycerin filled in Part 2, install the needle valve between the ball valve and the gauge. Locate gauges to be readable from the floor preferably at eye level. Mount gauges securely to prevent excessive vibration, adjust needle valve to dampen pulsations. Install syphon tubes for steam pressure gauges, connected after the isolation ball valve. Do not install pressure gauges on bottom of piping.
- B. Install as indicated on the drawings

### **3.4 WATER METER INSTALLATION**

- A. Water meter piping and specialties shall be installed according to AWWA M6. Coordinate installation of water meter with the local municipality.

### **3.5 INSTALLATION OF TEST PLUGS**

- A. Test Plugs: Install in piping tee where indicated, located on pipe at most readable position. Secure cap.

### **3.6 ADJUSTING AND CLEANING**

- A. Calibrate meters according to manufacturer's written instructions, after installation.
- B. Adjust faces of meters and gages to proper angle for best visibility.
- C. Clean windows of meters and gages and clean factory-finished surfaces. Replace cracked and broken windows, and repair scratched and marred surfaces with manufacturer's touchup paint.

**END OF SECTION 20 0519**

## **SECTION 20 0523 – VALVES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Provide valves as scheduled and specified in this Section for the following systems:
  - 1. Domestic Cold Water, Hot Water, Hot Water Return
  - 2. Other similar piping systems except where specialty valves are specified under other sections

#### **1.3 QUALITY ASSURANCE**

- A. Manufacturers and Products: The products and manufacturers specified in this Section establish the standard of quality for the Work. Subject to compliance with all requirements, provide specified products from the manufacturers named in Part 2.
- B. ASME Compliance:
  - 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
  - 2. ASME B31.1 for power piping valves.
  - 3. ASME B31.9 for building services piping valves.
- C. Reference Standards: Products in this section shall be built, tested, and installed in compliance with the specified quality assurance standards; latest editions, unless noted otherwise.
  - 1. National Sanitation Foundation NSF/ANSI-61, including Annex G (listed as  $\leq 0.25\%$  weighted average lead content) (and/or NSF/ANSI-372) and Annex F. Applies to any item in contact with domestic (potable) water.
  - 2. US Safe Drinking Water Act (any item in contact with domestic (potable) water).

#### **1.4 DEFINITIONS**

- A. The following are standard abbreviations for valves:
  - 1. CWP: Cold working pressure.
  - 2. EPDM: Ethylene-propylene-diene terpolymer rubber.
  - 3. NBR: Acrylonitrile-butadiene rubber.
  - 4. PTFE: Polytetrafluoroethylene plastic.
  - 5. SWP: Steam working pressure.
  - 6. TFE: Tetrafluoroethylene plastic.

#### **1.5 SUBMITTALS**

- A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

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

- A. Prepare valves for shipping as follows:
  - 1. Protect internal parts against rust and corrosion.
  - 2. Protect threads, flange faces, grooves, and weld ends.
  - 3. Set angle, gate, and globe valves closed to prevent rattling.
  - 4. Set ball and plug valves open to minimize exposure of functional surfaces.
  - 5. Set butterfly valves closed or slightly open.
  - 6. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
  - 1. Maintain valve end protection.
  - 2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL VALVE REQUIREMENTS**

- A. All valves shall have bodies, seats, stem seals and disc materials compatible with intended fluid, temperature, pressure and service.
- B. Valve Pressure and Temperature Ratings: Unless noted otherwise, valves shall be rated for a minimum of 125# WSP (working steam pressure)/ 250# WOG (cold water, oil, gas).
- C. Unless noted otherwise, valves through 2" shall have screwed connections for steel piping and sweat connections for copper piping. Domestic cold water, hot water and hot water return shall have sweat connections (lead free); valves 2-1/2" and larger shall be flanged.
- D. Valves in contact with domestic (potable) water shall be "lead free" NSF/ANSI-61 Annex G (and/or NSF/ANSI-372) labeled.
- E. All EPDM shall be peroxide cured. All wetted seals shall be made from materials that are immune from chloramine degradation.
- F. Manually operated valves 4" and larger installed 10 feet above finished floor or higher, shall have chain wheel operators. Chain shall reach to within 7'-0" of floor or operating platform, or within two feet of accessible ceiling.
- G. Valve Sizes: Same as upstream pipe, unless otherwise indicated.
- H. Provide extended valve stems for insulated piping.
- I. Where the valves are installed outdoors, all components including the gear operated wheel operators shall be weatherproofed.
- J. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.
- K. Valve Bypass and Drain Connections: MSS SP-45.

- L. Solder Joint: With sockets according to ASME B16.18.
  - 1. Caution: Use solder with melting point below 840 deg F for angle, check, and globe valves; below 421 deg F for ball valves.
- M. Threaded: With threads according to ASME B1.20.1.
- N. Valve Actuators:
  - 1. Chainwheel: For attachment to valves, of size and mounting height, as indicated in the "Valve Installation" Article in Part 3. I didn't see any additional information about chainwheel requirements in Part 3
  - 2. Gear Drive: For quarter-turn valves, provide gear operators for all butterfly valve sizes.
  - 3. Handwheel: For valves other than quarter-turn NPS 5 and smaller.
  - 4. Lever Handle: For quarter-turn valves NPS 6 and smaller, except plug valves.
  - 5. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug head.

## **2.2 BALL VALVE**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Apollo
  - 2. Milwaukee
  - 3. NIBCO
  - 4. Watts
  - 5. Bonomi
  - 6. Jomar
- B. Two-piece, full port, bronze body, stainless steel ball and stem:
  - 1. Description:
    - a. Standard: MSS SP-110
    - b. SWP Rating: 150 psig
    - c. CWP Rating: 600 psig
    - d. Body Design: Two Piece
    - e. Body Material: Bronze
    - f. Ends: Threaded
    - g. Seats: PTFE or TFE
    - h. Stem: Stainless Steel
    - i. Ball: Stainless Steel, vented
    - j. Port: Full
    - k. Handle: Plastic Coated Lever
    - l. Locking Device: When Noted on Drawings
    - m. Approvals: UL or CSA for Natural Gas Service

## **2.3 BUTTERFLY VALVE**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Bray
  - 2. Dezurik
  - 3. Jamesbury
  - 4. Milwaukee
  - 5. Tri-Seal Valve
  - 6. Xomox

7. ABZ 397 Series
  8. Jomar
- B. Unless noted otherwise, all butterfly valves shall be full lug construction, suitable for bi-directional dead end service, and have open position memory stop. Manually operated butterfly valves 4" and larger shall have enclosed worm gear operators with position indicators.
- C. Class 150 Butterfly Valves:
1. Description:
    - a. Resilient Seat
    - b. Standard: MSS SP-68
    - c. CWP Rating: 200 psig at 150 Deg F
    - d. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
    - e. Body Material: Ductile Iron
    - f. Seat: EPDM
    - g. Shaft: Positive Drive Blow-Out Proof 416SS Shaft, graphite Teflon impregnated stem bushings, O-ring stem seal
    - h. Disc: 316 Stainless Steel
    - i. Service: Bidirectional

## **2.4 HIGH PERFORMANCE BUTTERFLY VALVE**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Bray – Braylok Series 41
  2. Dezurik – BHP
  3. Jamesbury - 815L
  4. Milwaukee - HP Series
  5. Tri-Seal Valve-Contromatics
  6. Xomox Pliaseal
  7. ABZ Absolute Series 402
- B. Unless noted otherwise, all butterfly valves shall be full lug construction, suitable for bi-directional dead end service, and have open position memory stop. Manually operated butterfly valves 4" and larger shall have enclosed worm gear operators with position indicators.
- C. Class 150 High-Performance Butterfly Valves:
1. Description:
    - a. Standard: MSS SP-68
    - b. CWP Rating: 150 psig at 250 Deg F
    - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
    - d. Body Material: Carbon steel (316 SS if required for NSF 61 compliance for domestic water)
    - e. Seat: Reinforced PTFE
    - f. Shaft: 17-4 PH Stainless Steel; offset from seat plane with Teflon stem packing
    - g. Disc: 316 Stainless Steel
    - h. Bearings: 316SS/PTFE Upper and Lower Stem
    - i. Seat Leakage: ANSI Class VI
    - j. Service: Bidirectional

## **2.5 HIGH PERFORMANCE METAL-TO-METAL SEATED BUTTERFLY VALVE**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Bray Trilok
  2. Crane Flowseal MS
  3. Metso/Neles Neldisc
  4. Adams MAK
  5. ABZ Extreme 6000 Series
  6. Weir Tricentric
  7. Zwick Tri-Con
- B. Class 150 High-Performance Butterfly Valves:
1. Description:
    - a. Metal Seated triple offset type valve
    - b. CWP Rating: 150 psig at 550 Deg F
    - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
    - d. Body Material: Carbon steel
    - e. Seat: Laminated 316SS/Graphite
    - f. Shaft: A564-630 H1100
    - g. Disc: 316 Stainless Steel
    - h. Bearings: 304SS/Graphite Upper and Lower Stem with SS Collar
    - i. Seat Leakage: Zero leakage closure classification per CFI 70-2 Class 4
- C. Valve Flow Capacity: The Cv value for various valve sizes in the full open position shall be as follows:
- |     |          |       |
|-----|----------|-------|
| 1.  | 4 inch:  | 230   |
| 2.  | 6 inch:  | 660   |
| 3.  | 8 inch:  | 1500  |
| 4.  | 10 inch: | 2400  |
| 5.  | 12 inch: | 3600  |
| 6.  | 14 inch: | 5500  |
| 7.  | 16 inch: | 7600  |
| 8.  | 18 inch: | 10300 |
| 9.  | 20 inch: | 13000 |
| 10. | 24 inch: | 20200 |

## **2.6 BUTTERFLY VALVE – GROOVED**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Victaulic Vic-300
- B. Grooved ductile iron body, suitable for installation with grooved piping, EPDM coated steel disc and shaft, stainless steel hub bearing, EPDM seat, Teflon stem packing. Rated for 300 psi, 230 degrees F.
- C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Grinnel Gruvlock Series 7700
- D. Grooved nylon coated ductile iron body, EPDM coated ductile iron disc, stainless steel shaft, bronze shaft bearing.

- E. Grooved butterfly valves may be used only within grooved piping systems and only when specifically noted as permitted in other related Section. Otherwise, standard butterfly valves shall be provided.

## **2.7 SWING CHECK VALVE**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Milwaukee 509
  2. Crane 37
  3. Grinnell 3300
  4. NIBCO
  5. Apollo
  6. Kitz
- B. Bronze body and trim swing check valve

## **2.8 SILENT CHECK VALVE**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Wafer Style:
    - a. Milwaukee - Series 1400
    - b. APCO - Series 300
    - c. Mueller
    - d. Metraflex
    - e. Titan Flow Control, Inc.
  2. Globe Style:
    - a. Milwaukee
    - b. APCO
    - c. Mueller
    - d. Metraflex
    - e. Apollo
    - f. Titan Flow Control, Inc.
- B. Spring loaded type check valve, stainless steel spring, iron body and bronze trim

## **2.9 LUBRICATED PLUG VALVE**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Homestead
  2. Miliken
  3. Resun
- B. Class 125, Lubricated Plug Valves:
1. Description:
    - a. Standard: MSS SP-78
    - b. NPS 2" and Smaller: CWP Rating: 150 psig, bronze body, square head, threaded ends
    - c. NPS 2-1/2" and Larger: CWP Rating: 175 psig, semi-steel body, wrench operated, single gland, flanged ends



- d. Pattern: Straight away
- e. Plug: Cast iron or bronze with sealant groove

## **2.10 DRAIN VALVE**

- A. General Service: Ball valve with 3/4-inch hose threaded end fitting and cap.

## **2.11 MANUAL BALANCING VALVE**

- A. General Manual Balancing Valve Requirements:
  - 1. Provide ports for measuring flow, memory stop, bubble tight shut-off, valve Cv characteristics suitable for throttling.
  - 2. Size valve to produce readable design flow and maximum full open pressure drop of 3 feet.
  - 3. Ensure NSF 61 compliance for balance valves used in domestic (potable) water systems
- B. Through 2": brass body, brass or stainless steel ball or brass disc or plug, calibrated.
  - 1. Manufacturers:
    - a. Bell & Gossett Circuit Setter Plus
    - b. Armstrong
    - c. IMI Flow Design Accusetter
    - d. Taco
    - e. Victaulic
- C. Valves 2-1/2" and larger: cast iron or ductile iron body, brass ball or brass or bronze disc, EPDM seat, and brass or stainless steel stem.
  - 1. Manufacturers:
    - a. Bell & Gossett Circuit Setter Plus
    - b. Armstrong
    - c. IMI Flow Design Accusetter
    - d. Taco
    - e. Victaulic
- D. Venturi Style: bronze body, brass ball, and venturi flow measuring station.
  - 1. Manufacturers:
    - a. Preso B Plus
    - b. IMI Flow Design Accusetter
- E. Provide gauge kit for projects requiring over 20 balancing valves. Gauge kits shall be capable of directly reading GPM or shall include conversion chart from Cv and pressure. Provide to Owner's Project Manager

## **2.12 HIGH PURITY WATER VALVE**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following
  - 1. GF Harvel
  - 2. Hayward
  - 3. Watts
  - 4. Simtech

- B. Union body ball valve with Teflon seat and Viton stem packing. Construction, material, pipe connections and size to match piping.

### **2.13 SOLENOID VALVE**

- A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
  - 1. Magnetrol Figure No. 200-A
  - 2. ASCO
  - 3. Skinner
- B. Full port, bronze body, malleable iron coil enclosure, stainless steel plunger, valve stem, bonnet tube, and spring, Buna-N seal, rated for 500 psi. See drawings for voltage, size and position (NC or NO).

## **PART 3 - EXECUTION**

### **3.1 VALVE APPLICATION SCHEDULE**

- A. Domestic Cold Water/Hot Water/Hot Water Return Systems:
  - 1. Isolation through 2": Ball Valve
  - 2. Isolation 2-1/2" and Larger: Butterfly Valve NSF 61 Compliant
  - 3. Main Service Water Valve at Building Entrance: High Performance Butterfly Valve NSF 61 Compliant
  - 4. Check 2-1/2" and Larger: Silent Check Valve
  - 5. Balancing: Manual Balancing Valve

### **3.2 EXAMINATION**

- A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- D. Examine threads on valve and mating pipe for form and cleanliness.
- E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- F. Do not attempt to repair defective valves; replace with new valves.

### **3.3 VALVE INSTALLATION**

- A. Piping installation requirements are specified in other Division 20, 21, 22 and 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install valves such that operator is completely operable, and the valve position indicator is discernible from the floor.
- C. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

- D. Locate valves for easy access and provide separate support where necessary.
- E. Provide branch isolation valves at all branch piping take-offs from main headers whether specifically indicated on the drawings or not. This pertains to all piping systems.
- F. Install valves in horizontal piping with stem at or above center of pipe.
- G. Install valves in position to allow full stem movement.
- H. Solenoid Valve Installation Requirements:
  - 1. Provide a strainer before each solenoid valve. Provide a water hammer arrestor upstream of solenoid valves used for water service.

**END OF SECTION 20 0523**

## **SECTION 20 0529 – HANGERS AND SUPPORTS FOR MECHANICAL**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. This Section includes hangers and supports for mechanical system piping ductwork and equipment.

#### **1.3 DEFINITIONS**

- A. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

#### **1.4 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
  - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
  - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Engineering Responsibility: Design and preparation of Shop Drawings and calculations for each multiple pipe support, trapeze, and equipment support by a qualified professional engineer.
  - 1. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of hangers and supports that are similar to those indicated for this Project in material, design and extent.

#### **1.5 QUALITY ASSURANCE**

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

#### **1.6 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer for multiple piping supports and trapeze hangers. Include design calculations and indicate size and characteristics of components and fabrication details.

C. Shop Drawings – Non-Penetrating Rooftop Hangers and Supports:

1. Provide project specific, engineered stamped shop drawings and calculations including extents of installation, load bearing capacity and structural requirements.
2. Show installation layout, indicating product type and spacing. Coordinate with manufacturer's take off evaluations, measurements, control dimensions, and rooftop requirements analysis.
3. Show details of each roofing system including material layers and thicknesses, flashing, terminations, and penetrations with each rooftop support system to be installed.
4. All supports shall be pre-assembled and shipped for turnkey installation. Indicate all steps and preparation required by others.

**1.7 DELIVERY, STORAGE AND HANDLING**

- A. Package for delivery to best protect finish surfaces while using the least amount of single-use packaging as possible. If possible, package and ship product using reusable blankets and fabrics or reusable cardboard and crate systems.
- B. Protect materials against weather and contact with damp or wet surfaces from time of delivery through time of installation. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes.
- C. When storing prior to installation, raise off floor on pallets, stack flat with protective material between to eliminate chance of creating nicks, scratches, and other imperfections and damage to finish surfaces, wrap weather-tight, and provide for air circulation within and around stacks and under temporary coverings.
- D. Do not allow materials to become damp. Maintain temperatures at 60°F or higher, and humidity between 20% and 60% prior to, during and after installation.

**1.8 WARRANTY**

- A. Non-Penetrating Rooftop Hangers and Supports:
  1. Provide manufacturers standard product warranty against defects in manufacturing, proper operation, and against damaging roofing membrane when products are installed in accordance with engineered shop drawings and manufacturer's instructions. Warranty is not a maintenance agreement, insurance policy or obligation to repair leaks determined to be a result of the building design, installation, construction error, misuse of system, failure to inspect or maintain system or other limitations in manufacturer's standard warranty.
    - a. Warranty Period: 20 years.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Pipe Hangers:
    - a. Anvil
    - b. Cooper B-Line
    - c. Carpenter & Patterson, Inc.
    - d. PHD Manufacturing
    - e. Unistrut Corporation
    - f. Powerstrut

2. Channel Support Systems:
  - a. Anvil
  - b. Cooper B-Line
  - c. Carpenter & Patterson, Inc.
  - d. PHD Manufacturing
  - e. Unistrut Corporation
  - f. Powerstrut
3. Thermal-Hanger Shield Inserts:
  - a. Cooper B-Line
  - b. ERICO International Corporation
  - c. Pipe Shields, Inc.
  - d. Rilco Manufacturing Company
  - e. Value Engineered Products
  - f. American Mechanical Insulation Sales
4. Drilled Insert Anchors:
  - a. Hilti
  - b. Powers Fasteners
5. Cast in Place Concrete Inserts:
  - a. Unistrut
  - b. Grinnell
  - c. Anvil Fig 285 for loads up to 400 lb
  - d. Anvil Fig 281 for loads up to 1200 lb
6. Powder-Actuated Fastener Systems: **NOT ALLOWED**

## 2.2 METAL PIPE HANGERS AND SUPPORTS

- A. Provide adjustable type pipe hangers, supports and accessories for the proper support of all piping.
- B. Pipe Hangers, Supports, and Components: MSS SP-58, factory-fabricated components. Refer to "Hanger and Support Application" Article in Part 3 for where to use specific hanger and support types.
- C. Carbon-Steel Pipe Hangers and Supports:
  1. Description: MSS SP-58, factory-fabricated components.
  2. Galvanized Metallic Coatings: Pre-galvanized or hot dipped.
  3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
  4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
  5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
- D. Copper Pipe Hangers:
  1. Description: MSS SP-58, copper-coated-steel, factory-fabricated components.
  2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper coated steel.
- E. Dielectric protection for hangers and supports: Where copper piping is supported with steel hangers and supports, dielectric protection must be provided. Use one of the following means as applicable:
  1. Coated hangers (copper or plastic coating)

2. Insulation inserts
3. Cushion clamps

## **2.3 METAL FRAMING/CHANNEL SUPPORT SYSTEMS**

### **A. Metal Framing Manufacturer's Association (MFMA) Manufacturer Metal Framing Systems:**

1. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
2. Standard: MFMA-4.
3. Channels: Continuous slotted steel channel with in-turned lips.
4. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel for general applications.
6. Metallic Coating: Manufacturer's standard finish, unless bare metal surfaces are indicated.
7. Paint Coating: None
8. Plastic Coating: Provide on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
9. Combination Coating: None

## **2.4 TRAPEZE PIPE HANGERS**

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

## **2.5 THERMAL-HANGER SHIELD INSERT ASSEMBLIES**

- A. Except as noted, thermal hanger shield "insert" assemblies shall be used on all insulated pipe systems at each horizontal support, and at each clamped or guided vertical support. Manufactured units shall comply with MSS SP-58 standards and be tested per MSS SP-89 guidelines. Each assembly shall closely fit the various pipe diameters and match the outside diameter of the adjoining pipe insulation. Provide pre-grooved inserts when piping is heat traced. Compressive strength shall be adequate to prevent deformation at the project's hanger spacing requirements, with a minimum 3:1 safety factor.
- B. Thermal hanger shield insert assembly: Water-repellent treated, ASTM C 533, Type I calcium silicate, asbestos free insert. With G-90 galvanized sheet metal shield. With attached vapor barrier, where indicated. Each component shall have an ASTM E84 flame/smoke rating maximum of 25/50.
- C. Inserts for Cold Piping (piping conveying materials less than or equal to 60°F), including all chilled water and domestic cold water piping: Insert with an attached vapor barrier.
1. Provide insert and sheet metal shield covering entire circumference of pipe.
- D. Inserts for Hot Piping (piping conveying materials at more than 60°F and that is required to be insulated): Insert only with no vapor barrier.
1. For clevis or band hangers that support pipe from bottom: Insert and sheet metal shield shall cover lower 180 degrees of pipe, or entire circumference of pipe.
  2. For trapeze hangers or clamped pipe: Insert and sheet metal shield shall cover entire circumference of pipe.
- E. Inserts for piping less than 3/4 inch diameter: Not required except for piping conveying materials less than 45°F.

- F. Minimum Compressive Strength of Insert Material:
  - 1. 100 psig for sizes smaller than NPS 6.
  - 2. 600 psig for sizes NPS 6 and larger.
- G. Insert Length: Extend 2 inches beyond sheet metal shield.
- H. Vapor barrier: meeting ASTM C1136, with 0.02 perms maximum water vapor permeance.
- I. Adhesives shall comply with NFPA 90-A.
- J. Sheet Metal Shield Dimensions for Pipe: Not less than the following:
  - 1. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
  - 2. NPS 4: 12 inches long and 0.06 inch thick.
  - 3. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick
  - 4. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick

## **2.6 BUILDING ATTACHMENTS FOR MECHANICAL WORK SUPPORTS**

- A. General Requirements:
  - 1. Provide building attachments required for supporting mechanical work, suitably selected and installed for the loads applied with a minimum additional safety factor of 3.
  - 2. Where specified attachments are not suitable for conditions, submit to Engineer for approval, proposal for alternate building attachments.
  - 3. Provide supplemental trapeze supports where necessary. Design trapeze to support all trades. Coordinate loads and supports with all trades. Size trapeze for maximum deflection of 1/64 of the span.
- B. Attachments to Structural Steel:
  - 1. Support mechanical work from building structural steel where possible and approved. No welding or bolting to structural steel is permitted unless authorized by Architect. C-clamps are only allowed when restraining straps are used. C-clamps can be used without restraining straps for Division 21 work only.
- C. Cast in Place Concrete Inserts:
  - 1. Provide inserts selected for applied load of present load plus 100% for future, and coordinated with concrete work. Plan, lay-out and coordinate setting of inserts prior to concrete pour.
- D. Drilled Insert Anchors:
  - 1. Where mechanical work cannot be supported from structural steel, or cast in place concrete inserts, provide drilled concrete insert anchors. Submit for approval, project specific installation drawings for all loads over 100 lbs. Install inserts in web of beam if possible and approved. Insert depth shall not exceed two thirds the thickness of the concrete. Where existing concrete appears to be deteriorating, or where applied load at insert exceeds 1000 lbs., conduct test of concrete to determine de-rated capacity of insert. Anchors may be adhesive or expansion type up to 1000 lbs., and shall be adhesive type for loads over 1000 lbs.
- E. Attachments to metal decking: **NOT ALLOWED.**



## **2.7 EQUIPMENT SUPPORTS**

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

## **2.8 MISCELLANEOUS MATERIALS**

- A. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- B. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, black and galvanized.
- C. Grout: ASTM C 1107, Grade B, factory-mixed and -packaged, non-shrink and nonmetallic, dry, hydraulic-cement grout.
  - 1. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
  - 2. Properties: Non-staining, noncorrosive, and nongaseous.
  - 3. Design Mix: 5000-psi, 28-day compressive strength.
- D. Support Pads: Designed specifically to fit non-penetrating rooftop supports while protecting the rooftop envelope. Slip resistant and heat molded with a small lip to hold the support pad and reduce movement on the rooftop.
  - 1. Support Pad Material: 100 percent recycled rubber.
  - 2. Dimensions: Minimum 2 inches larger than support base width and length.

## **PART 3 - EXECUTION**

### **3.1 HANGER AND SUPPORT APPLICATIONS**

- A. Comply with MSS SP-69 for pipe hanger selections and applications
- B. Comply with all guidelines and limitations for loading and fastening where indicated on structural or architectural project documents.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel for pipe hangers, supports and attachments for general service applications.
- F. Use corrosion resistant steel for pipe hangers, supports and attachments for outdoor use and for hostile environment applications.
- G. Use copper-plated pipe hangers and copper or stainless steel attachments for copper piping and tubing.
- H. Use padded hangers for piping that is subject to scratching.
- I. Use thermal-hanger shield inserts for insulated piping and tubing.
- J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated, install the following types:
  - 1. Adjustable Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.

2. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 20 with steel pipe base stanchion support and cast-iron floor flange or carbon steel plate.
  3. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
  4. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
  5. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.
- K. Vertical Piping Clamps: Unless otherwise indicated, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 24.
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 24, if longer ends are required for riser clamps.
- L. Hanger Rod Attachments: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
  2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
- M. Building Attachments: Unless otherwise indicated, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  2. Support mechanical work from building structural steel where possible and approved. No welding or bolting to structural steel is permitted unless authorized by Architect.
  3. C-clamps are allowed with restraining straps only.
  4. Center-Beam Clamps (MSS Type 21 or 28) for loads over 120 lb: For attaching to center of bottom flange of beams. Malleable center hung Anvil Fig. 228.
  5. Side-Beam Clamps (MSS Type 20 or 27) - for loads up to 120 lb
- N. Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Protection Shields (MSS Type 40): Of length and thickness per Section 2.5 above.
- O. Thermal-Hanger Shield Inserts: Used on all insulated pipe systems at each horizontal support, and at each clamped or guided vertical support per Section 2.5 above.
- P. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
  2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
- Q. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- R. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

### 3.2 HANGER AND SUPPORT INSTALLATION

- A. Pipe Hanger and Support Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

- B. Metal Framing/Channel Support System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems.
  - 1. Field assemble and install according to manufacturer's written instructions.
- C. Metal Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated, trapeze pipe hangers
  - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
  - 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D-1.1.
- D. Fastener System Installation:
  - 1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- E. Non-Penetrating Rooftop Hangers and Supports: Install in accordance with manufacturer's instructions.
  - 1. Clean roofing surfaces in accordance with the roofing manufacturer's instructions prior to installation.
  - 2. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for each substrate under the project conditions
  - 3. Install supports and hangers in accordance with manufacturer's recommendations.
  - 4. Install supports at maximum spacing of 10 feet unless closer spacing is required due to weight of pipe or conduit requirements, or greater spacing is specifically allowed by support manufacturer.
    - a. Space and adjust supports to evenly distribute weight.
    - b. Do not exceed support manufacturer's recommended load limits or specified mechanical piping limits.
  - 5. Remove roofing aggregate from area 2 inches larger than support base; comply with roofing manufacturer's requirements to maintain roofing warranty.
  - 6. Install support pad beneath each support base.
  - 7. Support Pads:
    - a. Remove rock, aggregate, dirt and excess dust from area to be covered by pad.
    - b. Apply support pad on cleaned area.
    - c. Center bases on top of support pads.
- F. Install building attachments within concrete slabs or attach to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, and expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- G. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- H. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- I. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

- J. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9, "Building Services Piping," is not exceeded.
- L. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
1. NPS 3/4 or Smaller: Maximum span, 5 feet; minimum rod size, 3/8 inch.
  2. NPS 1: Maximum span, 6 feet; minimum rod size, 3/8 inch.
  3. NPS 1-1/4: Maximum span, 8 feet; minimum rod size, 3/8 inch.
  4. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
  5. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
  6. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 1/2 inch.
  7. NPS 3: Maximum span, 10 feet; minimum rod size, 1/2 inch.
  8. NPS 4: Maximum span, 12 feet; minimum rod size, 1/2 inch.
  9. NPS 6: Maximum span, 14 feet; minimum rod size, 5/8 inch.
- M. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
1. NPS 3/4 or Smaller: Maximum span, 7 feet; minimum rod size, 3/8 inch.
  2. NPS 1: Maximum span, 7 feet; minimum rod size, 3/8 inch.
  3. NPS 1-1/4: Maximum span, 8 feet; minimum rod size, 3/8 inch.
  4. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
  5. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
  6. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 1/2 inch.
  7. NPS 3: Maximum span, 12 feet; minimum rod size, 1/2 inch.
  8. NPS 4: Maximum span, 14 feet; minimum rod size, 5/8 inch.
  9. NPS 6: Maximum span, 17 feet; minimum rod size, 3/4 inch.
  10. NPS 8: Maximum span, 19 feet; minimum rod size, 3/4 inch.
  11. NPS 10: Maximum span, 22 feet; minimum rod size, 7/8 inch.
  12. NPS 12: Maximum span, 23 feet; minimum rod size, 7/8 inch.
  13. NPS 14: Maximum span, 25 feet; minimum rod size, 1 inch.
- N. Install hangers for cast iron drainage piping minimum of one (1) hanger per pipe section close to joint on the barrel, at change of direction and at branch connections. Hanger and rod diameters for each pipe size shall be as indicated below.
1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
  2. NPS 3: 60 inches with 1/2-inch rod.
  3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
  4. NPS 6: 60 inches with 3/4-inch rod.
- O. Support cast-iron piping vertical runs at roof, at each floor, and at 10-foot intervals between floors.
- P. Support vertical runs at roof, at each floor, and at 48 inches intervals between floors.
- Q. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9, "Building Services Piping," are not exceeded.
- R. Insulated Piping: Comply with the following:
1. Attach clamps and spacers to piping.
    - a. Piping not required with vapor retarder insulation: Clamp may project through insulation.

- b. Piping required with vapor retarder insulation: Use thermal-hanger shield insert with clamp sized to match OD of insert.
- c. Do not exceed pipe stress limits according to ASME B31.9.

### **3.3 EQUIPMENT SUPPORTS**

- A. Fabricate structural-steel stands to suspend equipment from structure above or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.
- D. Roof mounted equipment supports.

### **3.4 METAL FABRICATION**

- A. Cut, drill, and fit miscellaneous metal fabrications for heavy-duty steel trapezes and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

### **3.5 ADJUSTING**

- A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

### **3.6 PAINTING**

- A. Touching Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Touching Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 Section "Painting."
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

**END OF SECTION 20 0529**

## **SECTION 20 0548 - VIBRATION CONTROL**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Provide vibration control items for isolating vibration of mechanical equipment, piping and ductwork.
- B. Provide isolators, bases, pads, sleeves, hangers and other devices specified, required, or detailed for the project. Include all vibration isolation system elements as recommended by the equipment manufacturer's representative to ensure a complete, high performing and safe installation. Furnish and install all incidental materials required.
- C. Items included in this section:
  - 1. Flexible pipe connectors
  - 2. Flexible metal hose
  - 3. Inertia bases
  - 4. Vibration isolators

#### **1.3 QUALITY ASSURANCE**

- A. Work of this section shall be performed by suppliers and skilled tradesmen who are experienced in vibration control and mitigation to meet the requirements of this Section.
- B. Provide field supervision and inspection to ensure proper installation, adjustment and performance. Replace any isolators that are found to resonate with the supported equipment.
- C. Isolators shall be selected, installed and adjusted to prevent the transmission of objectionable vibration and noise to the building structure.
- D. The size and number of mounts and hangers shall be chosen to meet these specifications, even if not specifically shown on the plans. Brackets, rails, bases, braces, etc., shall be provided as needed for a complete, high performing and safe installation.

#### **1.4 SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
  - 2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device required.
- B. Shop Drawings:
  - 1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
  - 2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

C. Delegated-Design Submittal: For each vibration isolation device.

1. Include design calculations for selecting vibration isolators and for designing vibration isolation bases.

## **PART 2 - PRODUCTS**

### **2.1 ACCEPTABLE MANUFACTURERS**

A. Subject to compliance with the Contract Documents, manufacturers for products specified in this Section shall be one of the following:

1. Vibration Eliminator Co.
2. Mason Industries, Inc.
3. Kinetics Noise Control
4. Vibration Mounting and Controls (VMC)
5. Korfund
6. Vibration Isolation Co.
7. Amber Booth

### **2.2 FLEXIBLE METAL HOSE CONNECTORS**

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

1. Metraflex
2. Flex Hose Co.
3. Flexonics
4. Mason Industries Inc.
5. Anaconda

B. Provide metal hoses with length and end fittings as shown on drawings, with an inner corrugated hose made of type 304, 321, or 316 stainless steel and outer braid made of 304 stainless steel.

C. For copper piping systems, use copper construction braided hoses.

### **2.3 FLEXIBLE PIPE CONNECTORS (RUBBER)**

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

1. Mason Industries Inc. Type SFDEJ
2. Metraflex Type DS

B. Flexible connectors with neoprene and nylon type elements, with carbon steel or ductile iron floating flanges. Rated for 150 psig working pressure at 200°F, with peroxide cured EPDM liner and cover, ultraviolet resistant, hand wrapped, non-molded, multiple arch body, with control rods or cables.

### **2.4 INERTIA BASES**

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

1. Mason Industries, Inc.: Basis of design models noted below. Refer to Article 2.1 for approved equal manufacturers.
  - a. Type A: Model WFSL with unhouseed spring isolators.
  - b. Type B: Model BMK/KSL with unhouseed spring isolators.

- B. All mounts shall have leveling bolts rigidly secured to the equipment being isolated.
- C. Base Type A – Steel Inertia Base:
  - 1. Shall be a structural steel base frame with clearance holes located to correspond to the mounting bolt holes of the equipment mounted on the base.
  - 2. Bases shall have built-in motor slide rails and shall be reinforced as necessary to withstand belt pull without drive misalignment or base distortion. The bases shall be constructed with deep angle steel sections with a minimum vertical angle leg of 4 inches for motors of 7.5 hp or less, 5 inches for motors between 7.5 hp and 20 hp and 6 inches for motors over 20 hp.
- D. Base Type B – Concrete Inertia Base:
  - 1. Shall have an integral rectangular structural steel form into which concrete is poured. Perimeter members shall be beams of depth equal to 10% of the longest span of the base, but not more than 12 inches nor less than 6 inches deep. Forms shall include motor slide base and all reinforcing steel. Where anchor bolt locations fall in concrete, the reinforcing steel shall include drilled members with sleeves welded below the steel to accept the anchor bolts. Height saving steel brackets shall be used in all mounting locations.
  - 2. When the concrete base in “T” shaped, isolators shall be located under the projections as well as under the main body in order to prevent cantilever distortion.

## 2.5 VIBRATION ISOLATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Mason Industries, Inc.: Basis of design models noted below. Refer to Article 2.1 for approved equal manufacturers.
    - a. Mounts:
      - 1) Type 1: Model MSW
      - 2) Type 2: Model ND
      - 3) Type 3: Model SLF
    - b. Hangers:
      - 1) Type 1: Model HD
      - 2) Type 2: Model 30N
- B. Isolator Mounts:
  - 1. Type 1:
    - a. Waffle Pads shall be 3/8-inch-thick neoprene pads ribbed or waffled on both sides. The pads shall be manufactured with quality neoprene and selected for a maximum durometer of 50 and designed for 15% strain. Where required, steel load-spreading plates shall be incorporated between the equipment and the neoprene pad.
    - b. If the isolator is bolted to the structure, a neoprene mounting sleeve shall be installed under the bolt head between the steel washer and the base plate.
  - 2. Type 2:
    - a. Shall be laterally stable, double deflecting, molded neoprene isolators. All metal surfaces shall be covered with neoprene. The top and bottom surfaces shall be ribbed and bolt holes shall be provided in the base. The mounts shall have leveling bolts rigidly secured to the equipment.



- b. The isolator shall be manufactured with bridge bearing quality neoprene and selected for a maximum durometer of 50 and designed for 15% strain. DDNM mounts shall be selected for a static deflection of 3/8 inch unless otherwise specified.

3. Type 3:

- a. Shall have a free-standing and laterally stable steel spring without any housing. Springs shall be designed so that the ratio of the horizontal to vertical spring constant is between one and two. The spring diameter shall be not less than 80% of the compressed height of the spring at rated load. Loaded springs shall have a minimum additional travel to solid equal to 50% of the specified static deflection.
- b. Unless otherwise specified, the minimum static deflection of Type 3 isolators for equipment mounted on grade slabs shall be 1 inch and for the minimum static deflection for equipment mounted above grade level shall be 2 inches.
- c. Two Type 3 isolation pads sandwiching a 16 gauge stainless or galvanized steel separator plate shall be bounded to the isolator baseplate.
- d. Unless otherwise specified, isolators need not be bolted to the floor for indoor installations. If the base plates are bolted to the structure, a neoprene mounting sleeve shall be installed under the bolt head between the steel washer and the base plate.

4. Type 4:

- a. Laterally stable, restrained spring type with housings and heavy top plates for supporting the equipment and resisting seismic and wind loading. Spring isolators shall be comprised of two interfacing but independent elements; a coil spring element and a seismically rated housing. Housings and springs shall be powder coated and hardware galvanized. The spring coil element shall be comprised of one or more coil assemblies having all of the characteristics of freestanding coil spring isolators.
- b. The seismically rated housing shall be sized to meet or exceed the force requirements applicable to the project and have the capability of accepting coils of various sizes, capacities, and deflections as required to meet the desired isolation criteria. All spring forces will be contained within the coil/housing assembly and under no seismic load condition shall the restraint anchoring hardware be exposed to spring generated forces. Top plate and restraining bolts shall be out of contact with the housing during normal operation.
- c. The restraint element shall incorporate a steel housing with elastomeric elements at all dynamic contact points. The restraint will allow a maximum of 1/4 in. (25 mm) motion in any direction from the neutral position. All elastomeric elements shall be replaceable.
- d. The leveling nut or screw shall be accessible for adjustment with the use of a pneumatic or electric impact wrench. The spring element shall be replaceable without having to lift or otherwise remove the supported equipment.

C. Isolator Hangers:

1. Type 1:

- a. Double Deflection Low Dynamic Stiffness Hangers shall consist of a molded low dynamic stiffness (LDS) isolating element in a steel hanger box. A LDS sleeve shall be provided where the lower hanger rod passes through the steel hanger box, such that the hanger rod cannot contact the steel hanger. The diameter of the clear hole in the hanger box shall be at least 3/4 inch larger than the diameter of the hanger rod and permit the hanger rod to swing through a 30° arc. When installed, the hanger box shall be allowed to rotate through a full 360° without encountering any obstructions.
- b. The isolator shall be manufactured with quality LDS and selected for a maximum durometer of 50 and designed for 15% strain. Unless otherwise specified, the static deflection of Type 2 hangers shall be minimum of 0.3 inches.

2. Type 2:

- a. Spring and Low Dynamic Stiffness Hangers shall consist of a steel spring in a series with a low dynamic stiffness (LDS) isolating element. The spring shall have a minimum additional travel to solid equal to 50% of the specified deflection. The neoprene element shall have a static deflection of not less than 0.3 inches with a strain not exceeding 15%.
- b. Unless otherwise specified, the static deflection of SPH hangers shall be 2 inches.
- c. Spring diameter and hanger box hole size shall be large enough to permit the hanger rod to swing through a 30° arc. A neoprene sleeve shall be provided where the lower hanger rod passes through the steel hanger box, such that the hanger rod cannot contact the steel hanger. The diameter of the clear hole in the hanger box shall be at least 3/4 inch larger than the diameter of the hanger rod. When installed the spring element shall not be cocked and the hanger box shall be allowed to rotate through a full 360° arc without encountering any obstructions.

### PART 3 - EXECUTION

#### 3.1 GENERAL

- A. All equipment mounted on vibration isolators shall have a minimum operating clearance of 1 inch between the bottom of the equipment or inertia base and the concrete housekeeping pad (or bolt heads) beneath the equipment.
- B. Provide a minimum of 4 inches between isolated equipment and the walls, ceiling, floors, columns and any other equipment not installed on vibration isolators.
- C. Piping, ductwork, conduit or mechanical equipment shall not be hung from or supported on other equipment, pipes, or ductwork installed on vibration isolators.
- D. Vibration isolator sizes and layout shall be determined by the vibration isolator supplier
- E. Equipment connected to water or other fluid piping shall be erected on isolators or isolated foundations at correct operating heights prior to connection of piping. Equipment should be blocked-up with temporary shims to final operating height. When the system is assembled and fluid is added, the isolators shall be adjusted to allow removal of the shims.
- F. All mechanical equipment not specifically identified in this specification that contains rotating or vibrating elements shall be installed on Mount Type 2 neoprene isolators as appropriate. Provide supporting steel structure between isolators and equipment if isolator does not readily connect to equipment.
- G. All equipment and their respective isolators shall be directly mounted on primary steel. Units and isolators shall not be mounted on resiliently supported steel cabinets or plenum floors or other flexible construction.
- H. Roof mounted fans or roof top units shall be installed on a curb mounted base.
- I. All wiring connections to mechanical equipment on vibration isolators (either spring or neoprene type) shall be made with a minimum 36-inch-long flexible conduit. Coordinate wiring connections with the Electrical Installer.

#### 3.2 APPLICATION TABLES

Floor Mounted Equipment Type	Slab on Grade		Floor Span Up to 30 Feet		Floor Span 30 to 40 Feet	
	Base Type	Isolator Type	Base Type	Isolator Type	Base Type	Isolator Type
Chillers:						
Water Cooled Reciprocating	None	Mount 1	None	Mount 1	None	Mount 1

Floor Mounted Equipment Type	Slab on Grade		Floor Span Up to 30 Feet		Floor Span 30 to 40 Feet	
	Base Type	Isolator Type	Base Type	Isolator Type	Base Type	Isolator Type
Water Cooled Centrifugal	None	Mount 1	None	Mount 4	None	Mount 4
Absorption	None	Mount 1	None	Mount 1	None	Mount 1
Cooling Towers:						
All	None	Mount 1	None	Mount 4	None	Mount 4
Air Compressors:						
Tank Mounted - Horizontal <20 HP	None	Mount 3	None	Mount 3	None	Mount 3
All Others	B	Mount 3	B	Mount 3	B	Mount 3
Pumps:						
Base Mounted < 7.5 HP	None	Mount 3	B	Mount 3	B	Mount 3
All Others	None	Mount 3	B	Mount 3	B	Mount 3
Fans:						
< 22" diameter	None	Mount 2	None	Mount 3	B	Mount 3
> 22" diameter and < 2" SP	A	Mount 3	B	Mount 3	B	Mount 3
> 22" diameter and > 2" SP	B	Mount 2	B	Mount 3	B	Mount 3
Rooftop Unit:						
All	Curb	Mount 1	Curb	Mount 1	Curb	Mount 1
Computer Room Units:						
All	None	Mount 3	None	Mount 3	None	Mount 3
Generators:						
All	None	Mount 3	B	Mount 3	B	Mount 3

"Floor Span": Defined as the distance between centers of floor joists.

B. Suspended Equipment:

Equipment Type	Isolator Type
Pumps:	
Inline Pumps < 5 HP	Hanger 2
Fans (including Fan Coil Unit and Heat Pumps:	
< 22" diameter	Hanger 1
> 22" diameter and < 2" SP	Hanger 2
> 22" diameter and > 2" SP	Hanger 2

"Floor Span": Defined as the distance between centers of floor joists.

### 3.3 BASE MOUNTED PUMPS

- A. Any rigid pipe elbows at the pump suction and discharge connections shall be supported from the inertia base. All pipe connections shall be with a flexible pipe connector.

### 3.4 FAN ISOLATION - GENERAL

- A. All fan bases and isolators shall be sized so that thrust restraints (which would act against turning moment caused by static pressure) are not required.

**3.5 PIPES WITH MULTIPLE CONNECTIONS**

- A. Where a pipe run connects multiple items of equipment in the Mechanical Room the pipe hanger isolators for the entire run shall be chosen to suit the connected equipment of greatest static deflection.

**END OF SECTION 20 0548**

## **SECTION 20 0553 – MECHANICAL IDENTIFICATION**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Provide Mechanical system identification for piping, valves, ductwork, architectural access panels and equipment.

#### **1.3 QUALITY ASSURANCE**

- A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

#### **1.4 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label
- C. Valve numbering scheme.
- D. Valve Schedules: For each piping system to include in maintenance manuals.

### **PART 2 - PRODUCTS**

#### **2.1 ACCEPTABLE MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Brady Company
  - 2. Brimer
  - 3. Craftmark
  - 4. MSI (Marking Services Incorporated)
  - 5. Seton Name Plate Corporation

#### **2.2 PIPE MARKERS**

- A. Manufacturer's standard, pre-printed, color-coded, plastic pipe markers, complying with ANSI A13.1, and requirements below. Self-adhesive markers are not acceptable.
- B. For pipe diameter (with insulation) less than 6": full-band, semi-rigid, snap-on pipe markers, extending 360 degrees around pipe.
- C. For pipe diameter (with insulation) of 6" and larger: full-band or strip-type pipe markers, but not narrower than 3 times letter height. Fasten with nylon or stainless steel bands for pipe 6" through 12". Fastened with stainless steel bands for piping over 12".
- D. Lettering: Standard nomenclature which best describes piping system, as selected by Engineer (in cases of variance from table below).

- E. Arrows: Pipe marker arrows indicating direction of flow, either integrally with piping system lettering, or as a separate marker.
- F. Identify contents of piping by both fluid contained and unique temperature and /or pressure (if necessary, to distinguish between other systems with same fluid at different conditions); e.g. Potable Hot Water - 110F vs Potable Hot Water – 140F
- G. Use the following color coding and nomenclature for pipe markers:

	<u>Piping System</u>	<u>Label I.D.</u>	<u>Letter and Label Color</u>
1.	Brine	BR	White on Green
2.	Cold Water, Domestic	CW	White on Green
3.	Compressed Air	CA	White on Blue
4.	Deionized Water	DIW	White on Green
5.	Deionized Water Return	DIWR	White on Green
6.	Fire Protection	FP	White on Red
7.	Hazardous Waste	HAZ	Black on Orange
8.	Hot Water, Domestic	HW	White on Green
9.	Hot Water Return, Domestic	HWR	White on Green
10.	Natural Gas	G	Black on Yellow
11.	Non-Potable Water	NPW	White on Green
12.	Reverse Osmosis Water	RO	White on Green
13.	Sanitary Vent	V	White on Green
14.	Sanitary Waste	SAN	White on Green
15.	Sanitary Waste Pumped	SAN-P	White on Green
16.	Softened Cold Water	SCW	White on Green
17.	Storm Sewer Water	ST	White on Green
18.	Storm Sewer Water, Pumped	ST-P	White on Green
19.	Acid Waste	AW	Black on Orange
20.	Acid Waste Vent	AV	Black on Orange
21.	Vacuum	VAC	White on Blue
22.	Chilled Water Supply	CHWS	White on Green
23.	Chilled Water Return	CHWR	White on Green
24.	Condenser Water Supply	CWS	White on Green
25.	Condenser Water Return	CWR	White on Green
26.	Condensate Drain	COND	White on Green
27.	Condensate Pumped	COND-P	White on Green
28.	Fuel Oil Supply	FOS	Black on Yellow
29.	Fuel Oil Return	FOR	Black on Yellow
30.	High Pressure Condensate	HPC	White on Blue
31.	High Pressure Steam	HPS	White on Blue
32.	Hot Water Heating Supply	HWHS	White on Green
33.	Hot Water Heating Return	HWHR	White on Green
34.	Low Pressure Condensate	LPC	White on Blue
35.	Low Pressure Steam (15 #)	LPS	White on Blue
36.	Medium Pressure Condensate	MPC	White on Blue
37.	Medium Pressure Steam (60 #)	MPS	White on Blue
38.	Heat Pump Water Supply	HPWS	White on Green
39.	Heat Pump Water Return	HPWR	White on Green
40.	Medical Compressed Air	MCA	Black on Yellow
41.	Medical Vacuum	MVAC	Black on White
42.	Laboratory Compressed Air	LCA	Black on Yellow/White Checkerboard
43.	Laboratory Vacuum	LVAC	Black Boxed on White/Black Checkerboard
44.	Oxygen	O2	White on Green
45.	Carbon Dioxide	CO2	White on Gray
46.	Nitrogen	N2	Black on Yellow
47.	Nitrous Oxide	N2O	White on Blue

- H. Underground Pipe Markers: Manufacturer's standard, permanent, bright-colored plastic tape, intended for direct-burial service, 6" wide x 4 mils thick, continuously printed to indicate service of buried pipe. For plastic pipe, provide label with detectable nonferrous locator.

## 2.3 DUCT MARKERS

- A. Plastic, adhesive type color-coded duct markers, with arrow indicating direction of flow, and with fan system identified. Conform to the following color code and nomenclature:

<u>Service/Duct</u>	<u>Label I.D.</u>	<u>Letter and Label Color</u>
1. Supply Air (Eqpt #)	SA (Eqpt. #)	White on Green
2. Return Air (Eqpt #)	RA (Eqpt #)	White on Blue
3. Exhaust Air (Eqpt #)	EA (Eqpt #)	Black on Yellow
4. Outdoor Air (Eqpt #)	OA (Eqpt #)	White on Blue
5. Relief Air (Eqpt #)	RLF (Eqpt #)	White on Blue
6. Hazardous Exhaust (Eqpt #)	HEA (Eqpt #)	White on Purple

- B. Provide plastic adhesive duct access door markers indicating item and associated equipment accessed, and appropriate safety and procedural information. (eg. Fire Damper AHU-1)

## 2.4 EQUIPMENT MARKERS

- A. Engraved plastic equipment markers for all scheduled equipment, (eg., chillers, pumps, air handling units, heat exchangers, fans, etc.). Indicate equipment mark and service, (eg. EF-1 Serving Toilet Rms 2035 & 2036; CHWP-1 Serving CH-1; AHU-1 Serving Flr 1 Offices) nominal capacity (tons, cfm or gpm). Scale marker and lettering to equipment labeled. White lettering on black background.

## 2.5 VALVE TAGS

- A. 1-1/2" diameter brass valve tags with 1/4" stamp-engraved designations with piping system abbreviation and sequenced valve numbers. Provide solid brass chain, or solid brass S-hooks of the size and type required for proper attachment of tags to valves.

## PART 3 - EXECUTION

### 3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Coordination: Install identification after insulation is applied. Protect identification from paint or apply after painting is complete. Install above ceiling identification prior to acoustical ceilings.
- B. Attachment: Securely attach all mechanical identification to associated pipe, duct, panels and equipment. Locate identification to be readily visible.

### 3.2 PIPING SYSTEM IDENTIFICATION

- A. Install pipe markers on all piping systems in spaces where piping is exposed, concealed only by removable ceiling system, and where accessible at manholes and access panels.
- B. Locate pipe markers near points where piping continues into shafts, underground, floor or wall; at 25' spacing along exposed runs (15' in congested areas), at valves, equipment and control devices, and where there could be question of flow pattern.
- C. Install marker over pipe insulation segment on hot non-insulated pipes.

### **3.3 UNDERGROUND PIPING IDENTIFICATION**

- A. During back-filling, install continuous underground pipe markers over all buried piping, 6" to 8" below finished grade. Where multiple pipes are in a trench up to 16" wide, install single line marker. For tile fields and similar installations, mark only edge pipe lines of field.

### **3.4 DUCTWORK IDENTIFICATION**

- A. Install duct markers on all supply, return, exhaust, intake and relief ductwork where duct is exposed, concealed only by removable ceiling system, and where accessible at access panels.
- B. Locate duct markers near points where ductwork originates or continues into shafts, floor or wall, and at 25' spacing along exposed runs.
- C. Install duct access door markers on all access doors. Access doors for fire or smoke dampers shall be permanently identified on the exterior by a label having minimum 0.5 inch high lettering reading: FIRE/SMOKE DAMPER, SMOKE DAMPER or FIRE DAMPER.

### **3.5 EQUIPMENT IDENTIFICATION**

- A. Provide equipment markers on scheduled equipment.

### **3.6 VALVE IDENTIFICATION**

- A. Install valve tags on all new valves, except for check valves, valves within factory-fabricated equipment, plumbing fixture faucets, hose bibs, and valves located directly at the equipment served. Number valves in a logical sequence relative to location installed.
- B. List each tagged valve in valve schedule for each piping system. Include a copy of the valve tag schedule in the Operation and Maintenance manuals and mount a laminated copy as directed by the Owner.
- C. Where building has previously tagged valves, coordinate numbering with old schedule, and note changes made to previously tagged valves on new schedule.

### **3.7 ADJUSTING**

- A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

### **3.8 CLEANING**

- A. Clean faces of mechanical identification devices and glass frames of valve schedules.

**END OF SECTION 20 0553**



## **SECTION 20 0700 - MECHANICAL SYSTEMS INSULATION**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. This Section includes:
  - 1. Piping insulation materials and installation methods
  - 2. Ductwork insulation materials and installation methods
  - 3. Mechanical equipment insulation materials and installation methods
  - 4. Ductwork acoustical lining materials and installation methods
  - 5. Ductwork fire wrap materials and installation methods

#### **1.3 ASBESTOS ABATEMENT**

- A. All asbestos within the contract bounds shall be removed per the requirements described in Division 02. Refer to drawings for items containing asbestos insulation. Re-insulate all piping, ductwork and equipment to remain from which asbestos has been removed.

#### **1.4 QUALITY ASSURANCE**

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Codes and Standards
  - 1. ASHRAE 90.1-2013

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

- A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.
- B. Protect materials against weather and contact with damp or wet surfaces from time of delivery through time of installation. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes.
- C. Deliver materials only when environmental conditions meet requirements specified for installation areas. If materials must be stored in other than installation areas, store only where environmental conditions meet requirements specified for installation areas.
- D. Do not store materials near other materials that may off-gas or emit harmful fumes, such as kerosene heaters, fresh paint, adhesives, etc.
- E. When storing prior to installation, raise off floor on pallets, stack flat with protective material between to eliminate chance of creating nicks, scratches, and other imperfections and damage to finish surfaces, wrap weather-tight, and provide for air circulation within and around stacks and under temporary coverings.

- F. Do not allow materials to become damp. Maintain temperatures at 60°F or higher, and humidity between 20% and 60% prior to, during and after installation.

## **1.6 SUBMITTALS**

- A. Product Data: Submit schedule indicating product used, where it is used, and thickness. For each type of product indicated, include thermal conductivity, water-vapor permeance, thickness, and jackets (both factory and field applied if any).

## **PART 2 - PRODUCTS**

### **2.1 GENERAL INSULATION REQUIREMENTS**

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
  - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
  - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.
- B. Insulation thermal conductivity: No greater than value listed, in Btu-inch/hour-square foot-degrees F at 75 degrees F mean temperature.
- C. Water Vapor Permeance (ASTM E97 or E96, Procedure A): No greater than value listed, in perms. Water vapor permeability (ASTM C355): No greater than value listed, in perm-inch.
- D. Puncture resistance (ASTM D781): No less than value listed
- E. Flame spread classification (ASTM E84, NFPA 255): No greater than value listed. Smoke density classification (ASTM E84, NFPA 255): No greater than value listed. Composite listing includes insulation, jacket, and adhesive.
- F. Density no less than value listed, in pounds per cubic foot.

### **2.2 PIPING INSULATION – FIBERGLASS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Johns-Manville; Micro-Lok HP
  - 2. Knauf; Earthwool 1000
  - 3. Owens/Corning; ASJ/SSL-II
- B. Fiberglass insulation with factory-applied vapor barrier jacket with self-sealing laps. ASTM C547 Class 1 insulation, conductivity of 0.23 at 75F. Vapor barrier jacket: laminated white kraft paper, aluminum foil, glass fiber reinforcement, water vapor permeance of 0.02 perms, and puncture resistance of 50 units. Composite flame spread/ smoke density of 25/50.

### **2.3 PIPING INSULATION SPECIALTIES**

- A. PVC Jackets: Provide pre-molded, high impact, 20 mil thickness, UV resistant, 0-150F service temperature.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Zeston
    - b. Proto
- B. Aluminum Jackets: Provide 0.016" thick alloy 3003 aluminum jacketing with longitudinal lock seam and butt strap circumferential joints.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers
    - b. Pabco
- C. Removable Insulation Jackets: Provide removable insulation jackets with fiberglass insulation, flexible fabric jacket and Velcro fasteners.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Advance Thermal Corp
    - b. Q Master

### **2.4 DUCTWORK INSULATION – RIGID FIBERGLASS INSULATION BOARD**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Johns Manville Type 817 Spin-Glas Insulation Board
  - 2. Knauf Earthwool ASJ Insulation Board
  - 3. Owens/Corning Type 705 ASJ-25 Insulation Board
- B. Rigid fiberglass insulation board with factory-applied vapor barrier. Insulation: ASTM C612 Class 2, conductivity of 0.26, density of 3.0 pcf. Vapor barrier: laminated white kraft paper, aluminum foil, glass fiber reinforcement, permeance of 0.02, and puncture resistance of 50 units. Composite flame spread/ smoke density of 25/50.

### **2.5 DUCTWORK INSULATION – FIBERGLASS BLANKET**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. CertainTeed Type 75 FSK Standard Duct Wrap
  - 2. Johns Manville R Series Microlite with FSK
  - 3. Knauf Duct Wrap with Multi-Purpose FSK
  - 4. Owens/Corning All Service Faced Duct Wrap.
- B. Fiberglass blanket-type insulation with factory-applied vapor barrier, and 2" stapling and taping flange along one edge. Insulation: ASTM C553, density of 0.75 pcf, conductivity of 0.30. Vapor barrier: laminated white kraft paper, aluminum foil, glass fiber reinforcement, permeance of 0.02, and puncture resistance of 50 units. Composite flame spread/ smoke density of 25/50.

## **2.6 DUCTWORK JACKETING – SELF-ADHERING SHEET MEMBRANE**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. MFM Building Products Corp FlexClad-400
  - 2. Other approved equivalent
- B. Apply self-adhering sheet-type membrane over rigid board insulation for weatherproofing.
- C. Submit manufacturer's data sheets, preparation instructions/recommendations, installation methods, and manufacturer's certification letter that materials comply with specified requirements and are suitable for intended application. (Should be under 1.6 Submittals if kept)
- D. Membrane General: Prefabricated self-adhering, sheet-type protective membrane. The outer layer is an embossed, UV-resistant aluminum weathering surface. Under the aluminum are multiple layers of high-density cross-linked polymer film. Under the polymer film is a uniform layer of rubberized asphalt adhesive which sticks directly to metal, insulation faces and most other clean, dry surfaces.
- E. Release liner: The self-adhesive surface is protected by a disposable release liner.
- F. Technical Properties:
  - 1. Material Thickness (ASTM D 1970): 45 Mils (1.0 mm) Nominal
  - 2. Flexibility at -20 degrees F (-29 degrees C) (ASTM D 1970): Pass
  - 3. Vapor Permeance (ASTM E 96): .01 perms
  - 4. Nail Sealability (ASTM D 1970): Pass
  - 5. Heat Aging (ASTM D 794): Pass
  - 6. Elongation (ASTM D 412): 450 percent
  - 7. Tear Resistance (ASTM D 1424): 660 grams
  - 8. Meets 25/50 Flame/Smoke Rating (ASTM E 84)
  - 9. Maximum Temperature: 175 degrees F (79 degrees C)
  - 10. Installation Temperature Range: Greater than 40 degrees F (4.5 degrees C)

## **2.7 EQUIPMENT INSULATION – CLOSED CELL ELASTOMERIC SHEET**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Armacell AP Armaflex Sheet Insulation
  - 2. Aeroflex; Aerocel
  - 3. K-Flex; INSUL-SHEET
- B. Closed cell elastomeric insulation sheet. ASTM C534, conductivity of 0.25, water vapor permeability of 0.05 perm-inch, composite flame spread/ smoke density of 25/50.
- C. Elastomeric insulation sheet contact adhesive.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Armacell; Armaflex 520 Adhesive
    - b. Aeroflex; Aeroseal
    - c. K-Flex

## **2.8 SEALING MASTICS FOR PIPE AND DUCT INSULATION**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Childers
  - 2. Foster
  - 3. Vimasco
  - 4. Mon-Eco Industries
- B. Provide mastics to seal insulation joints and to provide a continuous vapor barrier. The permeance of the mastic shall be equal to or less than the permeance of the vapor barrier of the insulation it is applied to. The ASTM E84 flame spread and smoke density classification shall not exceed 25/50. Mastics shall be mercury and asbestos free, selected for the temperature range of the service, and selected for uses recommended by the manufacturer. Mastics used outdoors shall be outdoor rated, waterproof, and U.V. resistant.

## **2.9 DUCTWORK ACOUSTICAL LINING – CLOSED CELL ELASTOMERIC DUCT LINER**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Armacell AP Armaflex SA Black Duct Liner
  - 2. Aeroflex; Aerocel AC
  - 3. K-Flex; DUCT Liner Gray
- B. Closed cell elastomeric duct liner. ASTM C177 or C518, conductivity of 0.27. Water vapor permeability of 0.08 per ASTM E 96 Procedure A. Composite flame spread/ smoke density of 25/50.

## **PART 3 - EXECUTION**

### **3.1 INSULATION GENERAL REQUIREMENTS**

- A. Insulate piping, ductwork and equipment unless indicated as not to be insulated in subsequent paragraphs.
- B. Re-insulate items from which asbestos insulation was removed.
- C. Insulate connection points between new and existing items.
- D. Repair or replace insulation damaged during construction.
- E. Provide fire rated duct wrap insulation where indicated on the drawings per specifications in this Section
- F. All systems shall be tested and approved before being insulated.
- G. The insulation shall be applied over clean, dry surface.
- H. Full lengths of insulation shall be used except at end of straight sections and as required to accommodate fittings. Insulation shall be applied with the joints tightly fitted together. Cracks or voids shall be filled with insulation. The edges and seams at all visible locations shall be finished in a neat and workmanlike manner. Manufacturer's recommended installation procedures shall be strictly adhered to.

### 3.2 PIPING INSULATION THICKNESS TABLE

Minimum insulation thickness in inches, shall comply with the table below for the associated piping system and pipe sizes. Values are based on an R value of 4 per inch thickness. Overall conductance shall comply with ASHRAE 90.1

System Description	Temp Range Deg F	<1"	Thru 1-1/4"	Thru 3"	Thru 6"	8" & above
LPS (15#)	201-250	2.5	2.5	2.5	3.0	3.0
MPS (16#-120#)	251-350	3.0	4.0	4.5	4.5	4.5
Hot Water	141-200	1.5	1.5	2.0	2.0	2.0
Hot Water	105-140	1.0	1.0	1.5	1.5	1.5
Cold Water & Coil Condensate	Any	0.5	0.5	0.5	0.5	0.5
Storm (horizontal piping only)	Any	0.5	0.5	0.5	0.5	0.5
Chilled Water	Any	0.5	1.0	1.0	1.0	1.5
Refrigerant Suction	Any	1.0	1.5	1.5	---	---
Energy Recovery	Any	1.0	1.0	1.0	1.0	1.0
Heat Pump Water Loop	Any	0.5	0.5	0.5	0.5	0.5
Fluid Cooler Water/Glycol	Any	1.0	1.0	1.0	1.0	1.5

### 3.3 PIPING INSULATION APPLICATION

#### A. Piping-Indoor:

1. Type: Fiberglass
2. Thickness: See Piping Insulation Thickness Table
3. Jacket: Factory ASJ

#### B. Piping-Outdoor:

1. Type: Fiberglass or Closed Cell Elastomeric
2. Thickness:
  - a. For outdoor piping systems with fluid temperature above 200 deg F, apply insulation 1/2" thicker than listed in Piping Insulation Thickness Table
  - b. For outdoor piping systems with fluid temperature at or below 200 deg F, apply insulation in the same thicknesses listed in Piping Insulation Thickness Table
3. Jacket: PVC if not indicated on drawings to be Aluminum

#### C. Piping Items not to be Insulated:

1. Unions
2. Flexible connectors, flexible metal hose, flexible neoprene hose
3. Control valves 2" and smaller
4. Safety valves
5. Discharge vent piping
6. Vacuum breakers
7. Thermostatic vent valves
8. Steam traps 3/4" and smaller
9. Sanitary, waste and vent piping
10. Compressed air piping
11. Natural gas piping
12. Lab vacuum piping
13. Refrigerant liquid lines
14. Vertical portion of rain water conductors

15. Condenser/Cooling tower water piping (unless it is used for winter time water side economizer)
  16. Below-grade piping, unless otherwise indicated
  17. Chrome-plated pipes and fittings, unless potential for personnel injury
  18. Air Chambers
- D. At fittings and flanges, insulate with wrapped fiberglass insulation of same thickness as adjacent pipe, and cover with pre-molded PVC jackets. Seal edge of jacket with self-sealing vapor barrier tape.
- E. For valves, strainers, suction diffusers and other accessories that require maintenance: In hot piping, insulate similar to fittings and flanges. In cold piping, insulate with closed cell elastomeric insulation, installed to be removable for maintenance access.
- F. Wherever necessary to seal insulation and provide a complete and continuous vapor barrier, apply two coats of insulating mastic
- G. For closed cell elastomeric insulation, seal all butt joints and seams by joining cut edges with adhesive as supplied by the insulation manufacturer
- H. Expansion Joints Insulation: Expansion joints shall be insulated with prefabricated insulation blankets, installed in a manner to allow for the repacking of the joints without removing blanket. Hold blankets in place with permanently attached Velcro fasteners
- I. Removable Insulation Jackets: Where indicated on drawings, provide removable insulation jackets.

### **3.4 DUCTWORK INSULATION APPLICATION**

- A. Ductwork – Indoor Exposed: In mechanical equipment rooms and all other areas where visible without removing ceilings or opening access panels.
1. Type: Rigid Fiberglass Insulation Board
  2. Thickness: 1-1/2"
  3. Jacket: Factory ASJ
- B. Ductwork – Indoor Concealed: In ceiling spaces, building shafts, and other locations where not visible
1. Type: Fiberglass Blanket
  2. Thickness: 1-1/2"
  3. Jacket: Factory FSK
- C. Ductwork Items Not To Be Insulated:
1. Indoor return air ductwork in conditioned areas
  2. Exhaust air ductwork (insulate indoor duct between damper and exterior of building)
  3. Exhaust air plenums (insulate indoor plenum between damper and building exterior)
  4. Economizer relief air ductwork (insulate indoor duct between damper and building exterior)
  5. Indoor neutral air (70F to 75F) ductwork that are part of a dedicated outdoor air system.
  6. The following spaces are normally considered conditioned areas: return air plenums above ceilings, heated penthouse, mechanical and electrical rooms
- D. All exposed ductwork insulation shall be applied with edges butted. Insulation shall be impaled over stick clips or pins welded to the duct and secured with speed clips. Spacing of pins shall be as required to hold insulation firmly in place but not less than one pin per square foot. All joints and penetrations of the vapor barrier shall be sealed with a 3" wide strip of the same material, supplied with vapor barrier adhesive to both surfaces as recommended by adhesive manufacturers.

- E. Blanket insulation shall be tightly sealed at all joints and seams. Insulation shall be cut longer than ductwork perimeter to allow maximum thickness on all areas and to avoid excessive compression. All joints shall be over-lapped at least 2" and stapled in place. The stapled seams shall be sealed with a minimum 3" wide pressure sensitive tape designed for use with the duct insulation. All breaks in the vapor barrier facing shall be sealed with the tape. The underside of ductwork 18" or greater in width, and vertical surfaces 48" or greater shall have the insulation additionally secured with mechanical fasteners and speed clips spaced approximately 12" on center. The protruding ends of the fasteners shall be cut off flush after the speed clips are installed, and then sealed with the same tape as specified above.

### **3.5 DUCTWORK ACOUSTICAL LINING APPLICATION**

- A. Ductwork Acoustical Lining
  - 1. Type: Closed Cell Elastomeric Duct Liner
  - 2. Thickness: 1"
  - 3. Jacket: None
- B. For the first 10 feet of supply air ductwork connected to equipment, acoustically line the duct with 1" closed cell elastomeric duct liner if indicated on the Drawings.
- C. For the first 10 feet of return air ductwork connected to equipment (and for the return air boot for heat pumps that have no return air ductwork), acoustically line the duct or return air boot with 1" of closed cell elastomeric duct liner if indicated on the Drawings.
- D. Other locations indicated on the Drawings.

**END OF SECTION 20 0700**



## **SECTION 20 1100 - PLUMBING AND HVAC PIPING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. This Section specifies pipe materials, fittings, joining methods, piping specialties and installation methods. In addition, pressure testing and flushing/cleaning procedures are outlined.
  - 1. Plumbing piping systems
  - 2. Pipe joints
  - 3. Mechanically formed tee connections in copper piping
  - 4. Unions
  - 5. Pipe sleeves
  - 6. Dielectric fittings
  - 7. Strainers
  - 8. Pipe anchors
  - 9. Piping transitions
  - 10. Pipe sleeve seal systems

#### **1.3 SUBMITTALS**

- A. Product Data: Include manufacturer, catalog illustrations, model, rated capacities, performance, dimensions, component sizes, rough-in requirements, materials of construction, and operating and maintenance clearance requirements. Additionally include:
  - 1. Provide a piping material schedule that indicates, by service, pipe material, pipe manufacturer, fitting type and manufacturer, joint type and manufacturer.
  - 2. Solder and brazing material data sheets.
  - 3. Grooved fittings, couplings, and accessories data sheets.
  - 4. Data sheets for all products listed in this section including fittings, flanges and gaskets.
  - 5. For underground pressurized and steam condensate piping systems, provide a simplified drawing of the piping system identifying pipe depth and slope, location and type of each joint and restraint, valve, and similar accessories, and dimensions of any expansion loops

#### **1.4 QUALITY ASSURANCE**

- A. Manufacturers and Products: The products and manufacturers specified in this Section establish the standard of quality for the Work. Subject to compliance with all requirements, provide specified products from the manufacturers named in Part 2.
- B. Reference Standards: Products in this section shall be built, tested, and installed in compliance with the specified quality assurance standards; latest editions, unless noted otherwise.
  - 1. All piping, (including vacuum piping), unless noted otherwise, shall comply with ANSI Standard B31.9 - Building Service Piping.
  - 2. All steam piping above 15 psig, and all steam condensate piping shall comply with ANSI Standard B31.1 - Power Piping.
  - 3. National Sanitation Foundation NSF/ANSI-61, including Annex G (listed as  $\leq 0.25\%$  weighted average lead content)(and/or NSF/ANSI-372)and Annex F. Applies to any item in contact with domestic (potable) water.
  - 4. U.S. Safe Drinking Water Act (any item in contact with domestic (potable) water)

5. AWWA C600 Standard for Installation of Ductile-Iron Water Mains and their Appurtenances.
  6. AWWA C606 Grooved and Shouldered Joints.
  7. Mill certifications indicating country of origin and compliance to ASTM/ANSI/NSF and other required compliance standards verified by independent third party based in the United States shall be promptly provided whenever requested.
  8. NFPA 54 - National Fuel Gas Code
- C. Regulatory Requirements For Refrigerant Piping Systems: Comply with provisions of the following codes:
1. ANSI B31.5: ASME Code for Pressure Piping - Refrigerant Piping.
  2. ANSI/ASHRAE Standard 15: Safety Code for Mechanical Refrigeration.
  3. ASHRAE Standard 34: Number Designation and Safety Classification of Refrigerants.
  4. EPA requirements in Section 608: Prohibition of Venting and Regulation of CFC Requirements.
  5. UL Standard: Provide products complying with UL 207, "Refrigerant-Containing Components and Accessories, Nonelectrical"; or UL 429, "Electrically Operated Valves".
- D. Regulatory Requirements For Natural Gas Piping Systems: Comply with provisions of the following codes:
1. Comply with the requirements of NFPA 54 - National Fuel Gas Code, for gas piping materials and components, and gas piping systems installation, inspection, testing, and purging.
- E. Regulatory Requirements For Steam and Condensate Piping Systems: Comply with provisions of the following codes:
1. Welding: Qualify processes and operators according to the ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications".
  2. ASME Compliance: Comply with ASME B31.1, "Power Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp flash tanks to comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1

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

- A. Store piping materials and accessories off the floor/ground on pallets and protected with coverings to prevent damage or contamination due to weather and construction activities. Provide temporary protective caps on pipe ends. Maintain caps installed at all times until just prior to assembly, and recap open pipe ends at the conclusion of each work day. Store in areas that prevent damage due to freezing and extreme temperatures or sunlight. Arrange coverings to provide air circulation to avoid damage from condensation or chemical build-up. Protect from damage, dirt and debris at all times.

## **1.6 WARRANTY**

- A. Provide a complete warranty for parts and labor for a minimum of one year from the date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL PIPING REQUIREMENTS**

- A. See Part 3 for application of piping type and material.
- B. All piping materials shall be compatible for temperature, pressure and service.
- C. Provide long radius elbows and returns on welded steel pipe.

## 2.2 PIPE JOINTS

- A. Soldered Joints: ASTM B32; Alloy Sb5, (95% Tin, 5% Antimony, maximum 0.20% Lead). When recommended by the component manufacturer, use manufacturer's recommended flux. Unless noted otherwise, joints may be screwed or flanged to suit valves and equipment. Manufacturers: Engelehard "Silverbrite 100", Harris "Bridgit"
- B. Brazed Joints: ASTM B32, silver brazed joints with 1000F minimum melting point, conforming to AWS - A5.8, "Specification for brazing filler metal". Classification BAg-1. For domestic potable water applications, maintain a nitrogen purge during brazing to prevent deposit formation inside the pipe. Unless noted otherwise, joints may be screwed or flanged to suit valves and equipment. Manufacturers: Lucas-Milhaupt Inc. "Sil-Fos", J.W. Harris "Stay-Silv 15" and "Safety Silv"
- C. Screwed Joints: Tapered thread, ASME B1.20.1, joined with compatible compound or sealant tape applied to male thread only.
- D. Welded Joints: Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials appropriate for the wall thickness and chemical analysis of the pipe being welded. Pipe and fittings shall be beveled and butt welded.
- E. Grooved Joints - for Copper Piping, maximum pipe size 8": Rolled grooves, peroxide cured EPDM gaskets, ductile iron housing (ASTM A 532 or A 536), wrought copper (ASTM B 75, ANSI B16.22) or cast bronze fittings, rated for minimum 300 psi working pressure at 250°F, when used with grooves that comply with AWWA C606. Grooved system/components shall provide rigid installation. UL and UPC approved. Utilize manufacturer's recommended gasket lubricant. Brazed Class 150 ANSI B16.24 cast bronze flanges (or copper companion flange by CTS Fabrication USA) must be used at any component requiring a flanged connection. Clamp-on branch outlets are prohibited. Exact gasket material and style shall be as recommended by the coupling manufacturer for the service, and NSF/ANSI-61 Annex G and NSF/ANSI-372 listed when used for potable water. On potable water service, provide non-standard gasket styles that close off and isolate gasket cavities from the water in the pipe. The manufacturer of the couplings and the fittings shall be the same. The same grooved component manufacturer shall be provided for the entire scope of the work, for each system.
  - 1. The following manufacturers and coupling model numbers are permitted, provided they comply with all the above: Victaulic Style 607; Tyco Grinnell 672 or 640.
  - 2. For copper piping in utility tunnels: Victaulic Style 607 only.
- F. Grooved Joints - for Steel Piping, for maximum pipe size of 12": Rolled or cut grooves, peroxide cured EPDM gaskets, ductile iron coupling and fittings (ASTM A532 or A536), rated for minimum 400 psi working pressure at 250°F, when used with grooves that comply with AWWA C606. Grooved system/components shall provide rigid installation. UL and FM approved. Utilize manufacturer's recommended gasket lubricant. Welded flanges must be used at any component requiring a flanged connection. Clamp-on branch outlets are prohibited. Exact gasket material and style shall be as recommended by the coupling manufacturer for the service. The manufacturer of the couplings and the fittings shall be the same. The same grooved component manufacturer shall be provided for the entire scope of the work, for each system.
  - 1. The following manufacturers and coupling model numbers are permitted, provided they comply with all the above: Victaulic Style 07 or 107; Tyco Grinnell Fig. 740 or 772.
- G. Grooved Joints - for Stainless Steel Piping, for maximum pipe size of 12": Rolled grooves, peroxide cured EPDM gaskets, galvanized ductile iron (indoor piping only) or stainless steel couplings, minimum sch. 10 stainless steel fittings. Provide stainless steel nuts and bolts when couplings are stainless steel. Couplings and fittings rated for a minimum 300 psi working pressure at 250°F. Grooved system/components shall provide rigid installation. NSF/ANSI-61 Annex G and NSF/ANSI-372 listed when used for potable water. On potable water service, provide non-standard gasket styles that close off and isolate gasket cavities from the water in the pipe. Welded flanges must be used at any component requiring a flanged connection. Clamp-on branch outlets are prohibited. Exact gasket material and style shall be as recommended by the coupling manufacturer for the service. Utilize manufacturer's recommended gasket lubricant. The

manufacturer of the couplings and the fittings shall be the same. The same grooved component manufacturer shall be provided for the entire scope of the work, for each system. Use the manufacturer's required roll sets for stainless steel pipe.

1. The following manufacturers and coupling model numbers are permitted, provided they comply with all the above: Victaulic Style 89 (indoor), Style 489 (outdoor); Tyco Grinnell Fig. 770 (indoor), Fig. 772 (indoor), Fig. 472 (outdoor).

H. Press Joints:

1. Limited to a maximum pipe size of 4".
2. Rated for a minimum 200 PSI working pressure from -4°F to 250°F.
3. Compatible with seamless type K, L, and M copper tube conforming to ASTM B88.
4. Fittings shall be a minimum 78% copper and a maximum of 15% zinc, alloyed to prevent dezincification.
5. Fittings shall conform to the material and sizing requirements of ASME B16.18 or ASME B16.12.
6. Seals/O-rings shall be peroxide cured EPDM.
7. Joints shall be pressed using the tool approved by the manufacturer.
8. Provide press fittings from the same manufacturer for the entire scope of the work, for each system.
9. For piping 2" and smaller, non-fitting components such as valves, strainers, check valves, etc. manufactured by the press fitting manufacturer may be used provided:
  - a. the press fitting manufacturer is approved for those components elsewhere in the specifications
  - b. such components fully comply to the requirements of the respective specification section for the component.
10. Approved fitting, tool, and process:
  - a. Viega ProPress
  - b. NIBCO Press System.
  - c. Apollo Xpress

J. Flanged Joints:

1. Select flange and gasket materials to suit service of piping and to comply with the respective ASME B31.1 or B31.9 piping standard.
2. For steel pipe, provide raised face ANSI B16.5 compliant steel flanges.
3. For copper pipe, provide Class 150 flat face ANSI B16.24 cast bronze flanges, brazed to the copper tube.
  - a. Alternative: Copper companion flange by CTS Fabrication USA rated 450 PSI minimum working pressure from -66°F to 272°F. ANSI B16.5 compliant, powder coated, with an EPDM insulator adhered to the plate steel flange protruding inside of the flange to prevent contact with the copper companion flange adapter. Flange adapter shall be manufactured to ASME B16.22, brazed to the copper tube.
4. Gaskets shall conform to respective ANSI Standards, A21.11, B16.20, B16.21. Gaskets in steam and condensate lines shall be "FLEXALLIC", 316 L stainless steel with "FLEXICARB" filler. Flange gaskets for domestic hot water shall be 100% PTFE. For butterfly valves on replaceable seat side with interfering set-screws, provide Garlock Style 9800.
5. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated. Central Power Plant and Tunnels: Provide ASTM A193 B7 bolts and studs with ASTM A194 grade 2H heavy hex nuts.

- K. Hubless Joints for Cast Iron No-Hub Pipe: Heavy duty ASTM C1540 couplings with stainless steel shield with stainless steel bands and tightening devices, ASTM C564 rubber sleeve with integral center pipe stop.
  - 1. When connecting cast iron no-hub pipe to dis-similar pipe: Provide ASTM C1460 couplings specifically designed for both pipe types, with stainless steel shield with stainless steel bands and tightening devices, with ASTM C564 rubber sleeve with integral center pipe stop. Unshielded couplings shall not be used. Connections between dis-similar pipe materials shall be restrained. Submit coupling and restraint methods for approval
  - 2. Approved Manufacturers:
    - a. Anaco/Huskey
    - b. Clamp-All Corp.
    - c. Fernco Inc.
    - d. Ideal Tridon
    - e. Mission Rubber Company (MCP Industries Inc.)
- L. Gasket Joint Lubricant - for use with grooved and hubless joints: Provide manufacturer's recommended gasket lubricant.
- M. Solvent Cement Joints: Select materials suitable for pipe materials joined and compatible with fluid served. Conform to respective ASTM Standards D-2235, D-2564, D-2855 and D-3138.

## **2.3 MECHANICALLY FORMED TEE CONNECTIONS IN COPPER PIPING**

- A. Contractor may use mechanically formed Tee connections in copper piping in lieu of tee fitting only where main piping is 2 1/2" or larger and where branch connection is 3/4" or smaller. Joint must be brazed. Tool manufacturer: T-Drill.

## **2.4 UNIONS**

- A. Unions in steel piping systems shall be malleable iron with ground joints made between two bronze inserts.
- B. Unions in copper piping systems shall be wrought copper or brass with sweat ends.

## **2.5 PIPE SLEEVES**

- A. Provide pipe sleeves where required, including the following locations:
  - 1. Where required by code
  - 2. Where required as part of rated penetration, to maintain fire and smoke rating
  - 3. To support vertical piping (to support riser clamps)
  - 4. Where required to maintain water seal and prevent water penetration
  - 5. Where pipe movement is anticipated (especially due to thermal expansion) at the penetration
- B. Fire protection piping, compressed air piping and other un-insulated piping: Sleeves are generally not required, unless required to maintain integrity of rated walls or floors.
- C. Chilled water and cold water: Sleeves are required for all piping 2" and larger penetrating walls and floors.
- D. Steam, condensate, heating hot water, and other hot insulated piping: Sleeves are required for all piping penetrating walls and floors
- E. For underground exterior wall penetrations, piping penetrations must be watertight. For new construction, provide cast-in-place sleeve with integral water-stop, oversized for the use of a pipe sleeve seal.

## **2.6 DIELECTRIC FITTINGS**

- A. For pipe 2 inch and less: Provide brass coupling. (Dielectric unions are not acceptable).
- B. For pipe 2-1/2 inch and larger: Provide flange union with dielectric gasket and bolt sleeves. On copper pipe, copper companion flanges by CTS Fabrication USA shall be used.
- C. Dielectric waterways are prohibited for all joint systems.

## **2.7 STRAINERS**

- A. Body shall be bronze, cast steel or cast iron, to match piping materials. Strainers shall be same size as piping, with screwed connections on piping 2" and smaller, and flanged connections on piping 2-1/2" and larger. Where grooved piping is specified, grooved joint strainers may be used. Screen free area shall be a minimum of twice the internal cross sectional area of the piping where installed. Pressure rating shall be that of piping system, minimum Class 125. Provide 3/4" ball valve blow down with hose end connection on all strainers 2" and larger.
- B. For water service, screen material stainless steel, with maximum openings of 1/16 (0.062) inches for pipes 2" and smaller and 1/8 (0.125) inches for pipe sizes 2-1/2" and larger.
- C. For steam and condensate service, screen material stainless steel, with maximum openings of 1/32 (0.031) inches for pipes 2" and smaller and 3/64 (0.047) inches for pipe sizes 2-1/2" and larger.
- D. For air and gas service, screen material stainless steel, with maximum openings of 0.006 inches for pipes 2" and smaller and 0.009 inch for pipe sizes 2-1/2" and larger.
- E. Approved Manufacturers: Armstrong, Anvil International, Keckley, Metraflex, Mueller, Spirax-Sarco, Victaulic, Watts, Yarway.

## **2.8 FLEXIBLE PIPING CONNECTORS**

- A. Refer to Section 22 0548 Vibration Control

## **2.9 PIPE ANCHORS**

- A. Provide pipe anchors where shown and as detailed on drawings.

## **2.10 PIPING TRANSITIONS**

- A. For dissimilar metal connections, see "Dielectric Fittings".
- B. When two different pipe materials must be joined such as cast iron, clay, steel, copper or plastic, provide transition fittings specifically designed for that purpose and that are manufactured in compliance with the standards relevant for the pipes joined. Transitions shall have equal corrosion resistance to the pipes joined.

## **2.11 PIPE SLEEVE SEAL SYSTEMS**

- A. Approved Manufacturers:
  - 1. EnPro Industries "Link Seal"
  - 2. Advance Products & Systems, Inc.
  - 3. Metraflex Company.
  - 4. Proco Products, Inc.

- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve. Shall provide a water-proof seal between the pipe and sleeve at up to 20 psig head pressure. Each link and pressure plate shall include permanent identification of size and manufacturer's name. Manufactured in an approved ISO-9001:2000 facility.
- C. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe.
- D. Pressure Plates: Molded of glass reinforced nylon.
- E. Connecting Bolts and Nuts: Mild steel with a 60,000 psi minimum tensile strength and 2-part Zinc Dichromate coating per ASTM B-633 and Organic Coating, tested in accordance with ASTM B-117 to pass a 1,500-hour salt spray test. Of length required to secure pressure plates to sealing elements.
- F. Sleeves:
  - 1. Galvanized steel, ASTM A53/A53M, Schedule 40, with plain ends and welded steel collar, zinc coated. Steel Sleeve sizes 12" and larger shall be 0.375" thick or standard pipe wall thickness. Sleeves through wall shall be cast in place and the pipe shall be installed centered in the sleeve. Provide 2" collar (water-stop) of steel to match sleeve, welded all around on both sides to the sleeve at the point on the sleeve that positions it at the mid-point of the structural wall when the sleeve is in place.
  - 2. Molded non-metallic high density polyethylene sleeves (HDPE) with integral hollow, molded water-stop ring four inches larger than the outside diameter of the sleeve itself. End caps and reinforcing ribs, manufactured in an approved ISO-9001:2000 facility.

## **PART 3 - EXECUTION**

### **3.1 GENERAL PIPING INSTALLATION REQUIREMENTS**

- A. Work shall be done in accordance with applicable ordinances and codes. Arrange for inspections.
- B. For domestic potable water applications, maintain a nitrogen purge during brazing to prevent deposit formation inside the pipe, so that the inner pipe surface remains clean. Properly ventilate the area outside the pipe to avoid unsafe levels of nitrogen.
- C. Install pipe components and joining systems in accordance with the manufacturer's installation instructions.
- D. Install piping to permit complete draining. Provide capped hose end ball type drain valves at all low points.
- E. If water (flushing water, blow down, etc.) or hydronic system fluids have a pH between 5.0 and 10.0 and meet the requirements of the local municipality Sewer Use Ordinance, it may be discharged to the sanitary sewer. If the water does not meet the sewer discharge limits, then provide for alternate disposal means approved by local and state jurisdictions.
- F. Installed piping shall be free from sagging. Provide for expansion and contraction of piping in an approved and safe manner by means of loops or offsets, where mechanical expansion joints are not specifically called for.
- G. Branch connections from horizontal steam, steam condensate, and gaseous system mains shall be taken off the top, up at a 45 degree angle, or off the side.
- H. Branch connections from horizontal hydronic system mains shall not be taken off the main bottom, or at less than 45 degrees from horizontal.
- I. Branch piping shall be valved at the branch connection points.

- J. Provide fittings and specialties necessary to properly interconnect all items, whether or not shown in detail.
- K. Piping shall remain protected and capped until just prior to connection. Immediately after assembly, restore all protection and cap unprotected ends to prevent odors, dust, moisture, and other debris from entering the piping system.
- L. Clean and swab-out all piping before installation.
- M. Lay out pipe lines straight, plumb and in true alignment. Offset as required to avoid interference with other work, to conceal piping, to allow maximum headroom and to avoid interference with windows and doors. Lay out all pipes and establish their levels from bench marks, existing floors or finished grades.
- N. Piping shall be concealed unless indicated otherwise on drawings. Do not conceal piping until it has been inspected, tested, flushed and approved.
- O. Use eccentric reducing fittings to increase or decrease pipe sizes. Bushings are not acceptable. Orient reducers to prevent trapping of water.
- P. Lubricate flange bolts and install with hardened flat washers. Use a torque wrench to tighten flange bolts to the gasket manufacturer's recommended torque.
- Q. Locate groups of pipe parallel to each other, spaced to permit applying insulation and servicing of valves. Install hot and cold water lines at least 6 inches apart.
- R. Install piping at least 3 inches clear of electrical conduit. Do not install pipe within the National Electrical Code (NEC) working space zone of electrical equipment. Examples:
  - 1. Above the footprint of electrical equipment in the zone extending 6' above the installed height of the equipment.
  - 2. Within the NEC working space in front of the electrical equipment. NEC working space varies depending on voltage and other factors. Typically for equipment 600 volts or less it extends from the floor to the height of the equipment or 6'-6", whichever greater, 3'-6" in front of the equipment, and for the width of the equipment or 30", whichever is greater.
  - 3. Verify NEC clearance requirements prior to installing work. Note that variable frequency drives are considered electrical equipment.
- S. Pipe extending into finished areas shall have chrome plated escutcheons large enough to cover pipe sleeves and shall fit snugly over pipe or insulation.
- T. Pitch piping as follows, but not less than required by code:
  - 1. Hydronic piping up in direction of flow at 1/16" per foot
  - 2. Steam piping down in direction of flow at 1/16" per foot
  - 3. Vent piping back toward waste at 1/16" per foot
  - 4. Waste, condensate and compressed air piping down in direction of flow at 1/8" per foot.
- U. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
  - 1. Support vertical pipe at no less than every floor level, at the base of each riser, and at every riser offset.
  - 2. Support horizontal pipe 5" diameter and greater with a minimum of two pipe hangers between couplings, except sections of pipe less than 4 feet in developed length are permitted to be supported with no less than one hanger between couplings.
  - 3. All horizontal piping 5" diameter and greater shall be restrained or braced to prevent movement at each joint at every direction change and at each branch connection.



4. Provide pipe hangers to support every horizontal branch connection; provide sway bracing when pipe is suspended in excess of 18" by non-rigid hangers, and comply with all other bracing, support, and installation recommendations and suggestions in the CISPI Handbook.
  5. Provide hangers and supports to eliminate all misalignment at couplings.
  6. Tighten all clamps to coupling manufacturer's recommended torque, using a torque wrench.
  7. Joints between dissimilar pipe materials shall be restrained
- V. Sanitary and storm piping shall be anchored upstream of the first coupling at the point of building exit (interior side) to prevent movement due to back surges, by permanent blocks, bracing, threaded rodding anchored to the exterior wall, or other suitable means.
- W. Pipe Sleeves: Furnish and set pipe sleeves per details on drawings
- X. Pipe Anchors: Furnish and install pipe anchors where shown and as detailed on drawings

### 3.2 PLUMBING PIPING SYSTEMS APPLICATION

- A. Domestic Cold Water, Hot Water and Hot Water Return - Above Ground (including non-potable)
1. For piping through 6":
    - a. Pipe: Type L Copper, hard drawn, ASTM B88
    - b. Fittings: Wrought Copper, ANSI B16.22
    - c. Joints:
      - 1) Soldered: through 2"
      - 2) Brazed: for 2-1/2" through 6"
      - 3) Grooved: for cold water piping 2-1/2" through 6", may be used excluding inaccessible locations, *(not allowed on hot or hot return)*.
      - 4) Press-to-Connect: for cold water, hot water and hot water return piping through 4", may be used excluding inaccessible locations.
- B. Domestic Cold Water - Under Ground (including non-potable)
1. For piping through 4":
    - a. Pipe: Type K Copper, hard drawn, ASTM B88
    - b. Fittings: Wrought Copper, ANSI B16.22
    - c. Joints: Brazed
  2. For piping 5" and larger:
    - a. Pipe: Ductile Iron, AWWA C115 or AWWA C151 with C104 cement mortar lining, polyethylene encased per ANSI/AWWA C105/A21.5.
    - b. Fittings: AWWA C110 or AWWA C153, 150 psi rating with C104 cement mortar lining.
    - c. Joints: AWWA C111 rubber gaskets.
- C. Compressed Air - Above Ground
1. For piping through 6":
    - a. Pipe: Type L Copper, hard drawn, ASTM B88
    - b. Fittings: Wrought Copper, ANSI B16.22
    - c. Joints:
      - 1) Soldered: through 2"
      - 2) Brazed: for 2-1/2" through 6"

2. For piping through 2" in areas subject to physical abuse:
  - a. Pipe: Black Steel, Schedule 40, ASTM A53 ERW or seamless grade B
  - b. Fittings: Malleable iron 150 lb ASTM A 197; unions: 250 lb ASTM A 197
  - c. Joints: Screwed
- D. Sanitary Waste and Vent - Above Ground
  1. For piping through 12":
    - a. Pipe: Cast Iron, Service Weight, CISPI Standard 301, ASTM A74, ASTM A888
    - b. Fittings: Cast Iron, drainage pattern, ASTM A74, ASTM C564
    - c. Joints: Hubless - Heavy duty, ASTM C1540 shielded couplings
  2. For piping through 12":
    - a. Pipe: PVC Schedule 40, ASTM D 2665, NSF approved, type DWV
    - b. Fittings: PVC, ASTM D 3311
    - c. Joints: Solvent weld, ASTM D2564
- E. Sanitary Waste and Vent - Under Ground
  1. For piping through 12":
    - a. Pipe: Cast Iron, Service Weight, CISPI Standard 301, ASTM A74, ASTM A888
    - b. Fittings: Cast Iron, drainage pattern, ASTM A74, ASTM C564
    - c. Joints: Hubless - Heavy duty, ASTM C1540 shielded couplings
  2. For piping through 12":
    - a. Pipe: PVC Schedule 40, ASTM D 2665, NSF approved, type DWV
    - b. Fittings: PVC, ASTM D 3311
    - c. Joints: Solvent weld, ASTM D2564
- F. Equipment Condensate Drains, including coils and energy recovery devices - Above Ground
  1. For piping through 6":
    - a. Pipe: Type DWV Copper, hard drawn, ASTM B306
    - b. Fittings: Wrought Copper, ANSI B16.22
    - c. Joints: Soldered
- G. Storm - Above Ground
  1. For piping through 12":
    - a. Pipe: Cast Iron, Service Weight, CISP Standard 301, ASTM A74, ASTM A888
    - b. Fittings: Cast Iron, drainage pattern, ASTM A74, ASTM C564
    - c. Joints: Hubless - Heavy duty, ASTM C1540 shielded couplings
  2. For piping through 12":
    - a. Pipe: PVC Schedule 80, ASTM D 2665, NSF approved, type DWV
    - b. Fittings: PVC, ASTM D 3311
    - c. Joints: Solvent weld, ASTM D2564

H. Storm – Under Ground

1. For piping through 12”:

- a. Pipe: Cast Iron, Service Weight, CISP Standard 301, ASTM A74, ASTM A888
- b. Fittings: Cast Iron, drainage pattern, ASTM A74, ASTM C564
- c. Joints: Hubless - Heavy duty, ASTM C1540 shielded couplings

**3.3 UNDERGROUND PIPING INSTALLATION REQUIREMENTS**

- A. Piping below grade intersecting tunnel walls, basement walls, or penetrating floors, shall be run through a sleeve seal system.
  - 1. Size sleeves and select sleeve seal links per sleeve seal manufacturer’s recommendations.
  - 2. Install sleeves and seals per manufacture’s recommendations. Center sleeve water stops at midpoint of wall/floor thickness. Provide temporary support to avoid sleeve collapse during pours.
- B. Record as-built sketches and dimensions prior to backfilling.

**3.4 WELDING**

- A. All welding shall be performed by registered welders qualified to perform welding operations in accordance with the National Certified Pipe Welding Bureau’s procedures and standards, ASME Code Standards and the HPACCNA Standard Manual of Welding.
- B. Submit a certified copy of “Record of Pipefitter Welder Performance Qualification Test” of any employees who will be doing welding on this project.
- C. No welding to building work shall be allowed without approval of Engineer.
- D. Except where prohibited by the Reference Standards, code, or ordinance, Black steel piping larger than 6 inch diameter may be welded with chill rings.
- E. Mitered turns will not be allowed. Turns shall be made with factory-made ASME B16.9 long radius wrought steel butt welding fittings.
- F. Except where prohibited by the Reference Standards, code, or ordinance, branch take-offs with manufactured formed nipples will be permitted provided nipple size is at least two pipe sizes smaller than the main size. Formed nipples shall be Bonney Forge “Weldolets”, “Threadolets”, “Sockolets”. In all other cases, use factory-made ASME B16.9 wrought steel butt welding tee fittings.
- G. Shop welded pipe assemblies shall have all welds plainly stamped by the welding operator for inspection by the Engineer before installation.

**3.5 GROOVED PIPING**

- A. Where grooved joints are indicated as permitted, such joints are only permitted in accessible locations. The following locations are considered inaccessible: shafts, above dry wall ceilings.
- B. Install couplings from the same manufacturer as the grooved fittings. The same grooved component manufacturer shall be utilized for products installed for the entire scope of the work, for each system.
- C. Groove pipe per manufacturer’s requirements. Grooving tools shall be provided by the same manufacturer as the couplings and fittings. Use special roll sets for copper and stainless steel pipe when required by the manufacturer.

- D. Lubricate gaskets with manufacturer's recommended gasket lubricant. Use NSF-61 approved lubricant for domestic water piping.
- E. Allow room for pipe expansion for couplings that allow pipe ends to separate before the joint acts in a fully restrained manner, for example, certain couplings used on stainless steel pipe.
- F. Tighten coupling as recommended by the manufacturer. Use a torque wrench and tighten bolts to required torque level when required by the manufacturer

### **3.6 PROTECTION AGAINST FREEZING**

- A. At any time that any of the piping is full of water for testing purposes or otherwise prior to actual heated operation, the system shall be protected against freezing by the introduction of pre-mixed propylene glycol type anti-freeze which will be flushed out before acceptance. Provision for introducing anti-freeze shall be made by means of valved connections to the system in an acceptable manner.

### **3.7 INSTALLATION OF PIPE HANGERS AND SUPPORTS**

- A. Arrange pipe hangers and supports to permit proper pitch of piping, free to move with pipe expansion, installed at proper intervals to prevent sagging and attached to building construction through approved means. Hangers shall be located near or at changes in piping direction and concentrated loads. Valves, strainers, in line pumps and other heavy equipment shall be supported independent of the pipes. After systems have been installed and filled, adjust hangers and supports to evenly distribute weight, and maintain proper pitch.
- B. Vertical Piping: When support locations are not indicated on the drawings, support piping at every floor level.
- C. Horizontal Piping Hanger Spacing: Space hangers in compliance with applicable codes, or per MSS SP-89, which ever results in shortest spacing.
- D. For cold piping, install hangers and supports to maintain an effective continuous thermal and vapor barrier between cold piping and hangers and supports.
- E. Plastic Piping: Hang and support in compliance with manufacturer's recommendations. At hangers and supports, including channel supports, install to prevent plastic pipe contact with metal (exception: angle iron may be used for continuous support, provided all sharp edges are removed). Anchor piping only where required for expansion loops or to protect against pressure surges, etc. Compression style clamps/supports shall not be used. Use plastic pipe sleeves or equivalent as guides at all other locations, to allow longitudinal thermal expansion and to prevent lateral pipe movement. Compression style riser clamps shall not be used, use other support methods such a supporting at fitting shoulders. Support valves and other significant weight components independent of pipe. Space hangers no farther than manufacturer's recommendations for the application temperature but in no case farther than recommended for 100 deg. F application temperature. Continuously support all piping 1.5-inch nominal diameter or less (exception: PVC pipe connected to sump pumps). Provide thrust restraints where piping is subject to cyclic pressure surges, e.g. on/off pump applications.

### **3.8 INSTALLATION OF PIPE SLEEVES**

- A. Install pipe sleeves where piping passes through building construction including all walls, floors and ceilings.
- B. For new wall construction, promptly and accurately locate and securely set sleeves in forms before concrete is poured. For masonry construction, set the sleeves over the piping for Masonry Contractor to build around.

### **3.9 INSTALLATION OF STRAINERS**

- A. Provide Y-strainers in steam, condensate, or water piping preceding control valves, traps, pumps, pressure regulating valves and elsewhere as shown on drawings.
- B. Install strainer elements prior to flushing piping. Remove, clean and reinstall after flushing.

### **3.10 TRENCHING AND BACKFILLING**

- A. All trenching and backfilling required for the proper installation of the work shall be done as prescribed in other Divisions.
- B. Excavate trenches so that pipe can be installed at proper depth. Lay pipe on a firm bed bearing its full length except at the bell. Where sewers are installed in backfilled areas, provide machine tamping and be responsible for any settling at, or rupture to the sewer work. Keep trenches water free and as dry as possible during bedding, laying and jointing. After the joints are made, place sufficient backfill along each side of pipe to offset conditions that might tend to move the pipe off line and grade.
- C. Backfill only after pipes have been tested, inspected and approved.
- D. Piping encountered in excavating, (if shown on the drawings or not), shall be supported, and protected from damage. If utility lines are encountered, notify the Owner's Representative and do not disturb the lines unless so directed. If existing utility lines are damaged during excavations, immediately repair the lines at no cost to the Owner.
- E. Storm and sanitary piping may be installed side by side in same trench. Water piping may be installed in same trench with drainage piping, provided trench is benched so the water pipe may be laid on a shelf of firm earth not less than eighteen inches (18") above top of drain pipe.
- F. No excavation for pipe shall be made in filled or disturbed earth until it has been compacted as directed.
- G. Restore street pavements, curbs and sidewalks disturbed in the performance of this work. Restore in a manner prescribed by authorities having jurisdiction.
- H. Where mains are to pass under roadways or in any locations where open ditches are dangerous or undesirable, the work is to be installed by tunneling. In all other locations, excavations shall be done by the open trench method and to the depths and widths as may be necessary. All material excavated shall be deposited on the sides of the trenches and beyond the reach of slides.
- I. Supports:
  - 1. Where lines pass under footings for walls or columns, or lower than adjacent footings, backfill trenches with concrete up to the level of the bottom of the footings.
  - 2. Where pipes pass over column footings, or are laid in filled ground, or above the original natural grade, or in soil of insufficient bearing quality, or in other cases where necessary, they shall be supported by creosoted timbers carried by brick piers or piles or other approved supports carried down to firm bearing as approved.
- J. Provide shoring, bracing or sheet piling necessary to maintain the banks of the excavations, or tunnels. Take same out as the work is backfilled. Shoring must prevent any movement of the trench banks and strains on the piping and utility lines.

### **3.11 FLUSHING AND CLEANING OF PIPING**

- A. Flush the following piping systems:
  - 1. Domestic Cold Water

2. Domestic Hot Water
  3. Steam and Condensate
  4. Chilled Water Supply and Return
  5. Heating Hot Water Supply and Return
  6. Heat Pump Water Supply and Return
  7. Fluid Cooler Water/Glycol
- B. Clean the following piping systems:
1. Chilled Water Supply and Return
  2. Heating Hot Water Supply and Return
  3. Heat Pump Water Supply and Return
  4. Fluid Cooler Water/Glycol
  5. Steam and Steam Condensate
- C. Develop plan for flushing and cleaning piping. Submit plan for approval prior to completion of piping. Provide all temporary and permanent piping, equipment, materials necessary to complete flushing and cleaning.
- D. Prior to flushing, swab out underground piping to remove all particulate.
- E. Prior to flushing, temporarily remove, isolate or bypass dirt sensitive equipment and devices, including the following:
1. Automatic flow control valves
  2. Heating and cooling coils
  3. Boilers
  4. Chillers
  5. Heat exchangers
  6. Flow measuring devices
- Reinstall after flushing is complete.
- F. Prior to flushing, install fine mesh construction strainers at inlet to all equipment. Install fine mesh construction element in permanent strainers. During flushing and cleaning, remove and clean strainers periodically. At completion of final flush, clean permanent strainers, remove construction strainers.
- G. Flushing for new piping: Flush all piping with cold water (or fire protection system where approved by owner) for a minimum of one hour, until water runs clear. Water supply shall be equivalent to piping to be flushed. Use (2) 2-1/2" fire hose connections for piping 3" and larger. Drain all low points.
- H. Chemical Cleaning for new and existing hydronic piping: Where flushing could not be completed at 6 feet per second, or where chemical cleaning is required for new and existing piping, circulate flush water and clean strainers prior to installing cleaning chemicals. Provide cleaning chemicals, under the direction of the owner's chemical supplier. Following flushing, install cleaning chemicals and circulate through the entire system for a minimum of one hour, or as directed by chemical supplier. Take water sample for owner's use. Drain system, including all low points. Flush, drain and fill system, circulate for one hour, sample for owner's use. Drain, flush, fill, circulate and sample until system is free of cleaning chemicals, as indicated by owner's analysis of samples.
1. Estimated system volume for Hot Water Heating System:
  2. Estimated system volume for Chilled Water System:
  3. Estimated system volume for Condenser Water System:

### **3.12 PIPING SYSTEM PRESSURE TESTING**

A. General:

1. Test new systems only, from point of connection to the existing systems. Perform initial tests and correct deficiencies prior to requesting acceptance test.
2. Perform acceptance pressure tests in the presence of the authorities having jurisdiction. Acceptance tests must be satisfactorily completed before piping surfaces are concealed.
3. Pneumatic tests shall be conducted using dry, oil free compressed air, carbon dioxide or nitrogen. Evacuate personnel not directly involved in testing prior to performing pneumatic testing. Perform testing in two stages, initial and acceptance. Conduct initial testing at 5 PSI or less. Swab joints with a commercial leak detector. Repair deficiencies prior to testing at higher pressures. Under no circumstances shall plastic piping of any type be pneumatically tested, including pre-acceptance tests.
4. Components shall be removed or isolated during testing if damage may occur due to test pressure and/or test media.
5. Existing steam and hot water piping connected to piping to be tested shall be shutoff, drained and cooled before testing.

B. Acceptance Pressure Testing:

1. Perform acceptance testing at 1.5 times the maximum system design pressure but not less than 100 psig or to the satisfaction of the authority having jurisdiction.
2. Remake leaking gasket joints with new flange bolting. Where welded joints fail, submit proposed method of repair for approval by the Owner's representative and authorities having jurisdiction.
3. For each system tested, provide a certificate testifying that the system was satisfactorily tested and passed, using owner furnished forms.

### **3.13 FLUSHING, DISINFECTING, AND TESTING DOMESTIC WATER PIPING**

A. Flush, disinfect and test domestic water piping as follows:

1. Prior to disinfection, flush all domestic water piping as described under Flushing and Cleaning of Piping.
2. Purge and disinfect domestic water piping per plumbing code and local municipality requirements. Do not use excessive amounts of disinfectant, as it may damage piping seals.
3. Submit water samples in sterile bottles to the local municipality. Repeat the procedure if the biological examination made by the local municipality shows evidence of contamination.

B. Prepare reports for all purging and disinfecting activities. Furnish owner final copy of test results for acceptance.

**END OF SECTION 20 1100**

## **SECTION 22 1119 – PLUMBING SPECIALTIES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SCOPE OF WORK**

- A. This Section includes the following plumbing specialties:
  - 1. Garbage Disposers
  - 2. Water Regulators
  - 3. Balancing Valves
  - 4. Thermostatic Water Mixing Valves
  - 5. Strainers
  - 6. Key-Operation Hydrants
  - 7. Wheel-Handle Wall Hydrants
  - 8. Drain Valves
  - 9. Backwater Valves
  - 10. Miscellaneous Piping Specialties
  - 11. Sleeve Penetration Systems
  - 12. Flashing Materials
  - 13. Cleanouts
  - 14. Floor Drains.
  - 15. Trench Drains
  - 16. Trap Seal Protection Devices
  - 17. Downspout Nozzles
  - 18. Oil Interceptors
  - 19. Flexible Connections
  - 20. Water Meters
- B. Provide piping, fittings and specialties up to 5 feet beyond the building for the following systems:
  - 1. Domestic Cold Water.
  - 2. Domestic Hot Water.
  - 3. Sanitary and Vent.
  - 4. Storm.

#### **1.3 DEFINITIONS**

- A. The following are industry abbreviations for plumbing specialties:
  - 1. ABS: Acrylonitrile-butadiene-styrene plastic.
  - 2. CI: Cast iron.
  - 3. CPVC: Chlorinated polyvinyl chloride plastic.
  - 4. EPDM: Ethylene-propylene-diene terpolymer.
  - 5. NBR: Acrylonitrile-butadiene rubber.
  - 6. PA: Polyamide (nylon) plastic.
  - 7. PE: Polyethylene plastic.
  - 8. PEX: Crosslinked polyethylene plastic.
  - 9. PP: Polypropylene plastic.
  - 10. PVC: Polyvinyl chloride plastic.



#### 1.4 PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing domestic water piping systems, sanitary and storm drainage systems with the following minimum working-pressure ratings, unless otherwise indicated:
  - 1. Combined Fire-Protection and Domestic Water Service Piping: **[200 psig] [250 psig]**.
  - 2. Domestic Water Service Piping: 160 psig.
  - 3. Domestic Water Distribution Piping: 125 psig.
  - 4. Domestic Water Service Piping: 100 psig.
  - 5. Domestic Water Distribution Piping: 80 psig.
  - 6. Soil, Waste, and Vent Piping: 10-foot head of water.
  - 7. Sanitary Sewer, Force-Main Piping: 100 psig.

#### 1.5 SUBMITTALS

- A. Product Data: Include rated capacities and shipping, installed, and operating weights. Indicate materials, finishes, dimensions, required clearances, and methods of assembly of components; and piping and wiring connections for all specialty items included in this specification section.
- B. Maintenance Data: For plumbing specialties to include in maintenance manuals. Include the following:
  - 1. Backflow preventers and water regulators
  - 2. Water filters
  - 3. Thermostatic water mixing valves
  - 4. Hose stations and hydrants
  - 5. Grease interceptors, oil interceptors, and solids interceptors

#### 1.6 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of plumbing specialties and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for piping materials and installation.
- D. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic, potable domestic water piping and components. **[Include marking "NSF-pw" on piping.]**
- E. Comply with NSF 61, "Drinking Water System Components-Health Effects; Sections 1 through 9," for potable domestic water piping and components.

#### 1.7 ASSEMBLY DESCRIPTIONS

- A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14 for plastic sanitary waste piping specialty components.

#### 1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Water Filter Cartridges: Equal to 200 percent of amount installed for each type and size indicated.

2. Operating Key Handles: Equal to 100 percent of amount installed for each key-operated hose bibb and hydrant installed.

## **PART 2 - PRODUCTS**

### **2.1 GARBAGE DISPOSERS**

- A. Garbage Disposer, GD-1: Corrosion proof polymer or stainless steel hopper and grinding chamber. Compact shell, 14 in. maximum overall height. Sound insulated. Jam-resistant, cutlery- or stainless-steel grinder or shredder with NPS 1-1/2 outlet. Motor is a 3/4 HP, 120V single phase permanently lubricated with overload protection, manual reset button and cord and plug. Provide stainless steel 3-bolt sink flange connection, quick-mounting, anti-splash guard; stainless steel stopper, and dishwasher drain connection. For operation with wall switch (continuous feed). Garbage disposers shall comply with ASSE 1008 and UL 430.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. In-Sink-Erator, model LC-50.
    - b. Waste King.
  2. Units: Sound-insulated chamber and stainless-steel outer shell.
  3. Warranty: 5 year in-school service.

### **2.2 WATER REGULATORS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Cla-Val Company
  2. Conbraco Industries, Inc.
  3. FLOMATIC Corporation
  4. Watts Industries, Inc.; Water Products Division
  5. Zurn Industries, Inc.; Wilkins Division
- B. General: ASSE 1003, water regulators, rated for initial working pressure of 150 psig minimum. Include integral factory-installed or separate field-installed, Y-pattern strainer.
  1. NPS 2 and Smaller: Bronze body with threaded ends.
  2. General Duty Service: Single-seated, direct operated, unless otherwise indicated.
  3. Booster Heater Water Supply: Single-seated, direct operated with integral bypass.
  4. NPS 2-1/2 and Larger: Bronze or cast-iron body with flanged ends. Include AWWA C550 or FDA-approved, interior epoxy coating for regulators with cast-iron body.
  5. Type: Single-seated, direct operated.
- C. Type: Pilot-operated, single- or double-seated, cast-iron-body main valve, with bronze-body pilot valve.
  1. Interior Components: Corrosion-resistant materials.
  2. Exterior Finish: Polished chrome plate if used in chrome-plated piping system.

### **2.3 BALANCING VALVES**

- A. Calibrated Balancing Valves: Adjustable, with two readout ports and memory setting indicator. Include manufacturer's standard hoses, fittings, valves, differential pressure meter, and carrying case.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ITT Industries; Bell & Gossett Division.
    - b. Taco, Inc.

- c. Tour & Andersson, Inc.
    - d. Flow Design, Inc.
  - 2. NPS 2 and Smaller: Bronze body with brass ball, adjustment knob, calibrated nameplate, and threaded or solder-joint ends.
  - 3. NPS 2 and Smaller: Bronze, Y-pattern body with adjustment knob and threaded ends.
  - 4. NPS 2-1/2 and Larger: Cast-iron, Y-pattern body with bronze disc and flanged or grooved ends.
- B. Memory-Stop Balancing Valves, NPS 2 and Smaller: MSS SP-110, ball valve, rated for 400-psig minimum CWP. Include two-piece, copper-alloy body with standard or full-port, chrome-plated brass ball, replaceable seats and seals, threaded or solder-joint ends, and vinyl-covered steel handle with memory-stop device.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Conbraco Industries, Inc.
    - b. Crane Company; Crane Valve Group; Crane Valves
    - c. Crane Company; Crane Valve Group; Jenkins Valves
    - d. Crane Company; Crane Valve Group; Stockham Division
    - e. Grinnell Corporation
    - f. Hammond Valve
    - g. Milwaukee Valve Company
    - h. NIBCO INC.
    - i. Red-White Valve Corporation

## **2.4 THERMOSTATIC WATER MIXING VALVES**

- A. General Requirements:
- 1. Provide a thermostatic mixing valve at all sinks and public lavatories including at accessible plumbing fixtures.
    - a. At other locations identified in the Michigan Plumbing Code, provide individual water temperature limiting devices (thermostatic mixing valves) to individual fixtures.
  - 2. Provide mixing valves based on the following selection criteria:
    - a. Mixing valve serving a single fixture: Valve pressure drop shall not exceed 5 psi at 1 GPM flow rate.
    - b. Mixing valves serving sink faucets (all types, including service sinks), valve pressure drop shall not exceed 5 psi at 4 GPM flow rate.
  - 3. Manually adjustable thermostatically controlled domestic water tempering valve.
  - 4. ASSE 1070 listed to control down to 0.5 GPM flow rate.
  - 5. All bronze or brass body, rough finish, chrome plated if exposed. Brass and stainless steel internal components.
  - 6. Chloramine resistant seals.
  - 7. Integral check valves and stainless steel strainers (screens) in hot and cold water inlet connections.
  - 8. Tamper resistant temperature adjustment handle.
  - 9. Union with male or female NPT connections, or compression fittings.
  - 10. Valves shall operate properly:
    - a. At supply pressures between 20 PSIG and 125 PSIG.
    - b. With up to 20 percent pressure differential between hot and cold water supplies.
    - c. Outlet temperature shall be adjustable to within 10 deg. F of inlet hot water temperature.
    - d. Hot inlet operating range: 140 deg. F.
    - e. Lower temperature adjustment range: not more than 95 deg. F.
    - f. Upper temperature adjustment range: not more than 140 deg. F.

- B. Primary, Thermostatic, Water Mixing Valve: ASSE 1017, manually adjustable, thermostatic water mixing valve with bronze body with corrosion-resistant interior components. Include check stop and union on hot- and cold-water-supply inlets, adjustable temperature setting, and thermometer.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Leonard Valve Company
    - b. Symmons Industries, Inc.
    - c. Armstrong "Rada"
  2. Type: Bimetal thermostat, operation and pressure rating 125 psig minimum.
  3. Type: Liquid-filled motor, operation and pressure rating 100 psig minimum.
  4. Piping, valves, and unions. Include thermometer if not in cabinet.
  5. Piping Component Finish: Satin spray.
  6. Cabinet: **[Recessed]** **[Surface]**-mounting steel box with steel hinged door, white enameled finish, and thermometer in front
- C. Manifolder, Thermostatic Water Mixing-Valve Assemblies: Factory-fabricated unit consisting of parallel arrangement of thermostatic water mixing valves.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Armstrong.
    - b. Leonard Valve Company.
    - c. Powers, a Watts Brand.
    - d. Watts.
  2. Arrangement: One large-flow, thermostatic water mixing valve with flow-control valve, pressure regulator, inlet and outlet pressure gages, and one small-flow, thermostatic water mixing valve with flow-control valve. Include outlet thermometer, factory- or field-installed inlet and outlet valves, and other indicated options.
  3. Thermostatic Mixing Valves: Comply with ASSE 1017. Include check stops on hot- and cold-water inlets and shutoff valve on outlet.
  4. Pressure Rating: 125 psig minimum unless otherwise indicated.
  5. Include piping, valves, and unions.
  6. Piping Component Finish: Stainless Steel.
  7. Cabinet: **[Recessed]** **[Surface]**-mounting steel box with steel hinged door, white enameled finish, and thermometer in front.
- D. Hydrotherapy, Thermostatic Water Mixing-Valve Assemblies: Factory-fabricated, thermostatic water mixing valve; two shutoff valves and one volume-control valve; unions; check stops; thermometer; atmospheric vacuum breaker; piping; escutcheons; and cabinet.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Leonard Valve Company.
    - b. Whitehall Manufacturing.
  2. Thermostatic Mixing Valves: Comply with ASSE 1017. Include check stops on hot- and cold-water inlets and shutoff valve on outlet.
  3. Pressure Rating: 125 psig minimum unless otherwise indicated.
  4. Include piping, valves, and unions.
  5. Piping Component Finish: Satin spray.
  6. Cabinet: **[Recessed]** **[Surface]**-mounting steel box with steel hinged door, white enameled finish, and thermometer in front.

- E. Photographic-Process, Thermostatic Water Mixing-Valve Assemblies: ASSE 1017, Factory-fabricated, bronze body with corrosion-resistant interior components, thermostatic water mixing valve; volume-control valve; unions; check stops; thermometer; atmospheric vacuum breaker; piping; escutcheons; and panel enclosure.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Symmons Industries, Inc.
    - b. Watts.
  2. Sizes and Arrangement: Controls mounted shall be in front of panel cover with factory- or field-installed inlet valves. Assembly shall control outlet-water temperature within 0.5 deg F throughout temperature and flow operating ranges.
  3. Pressure Rating: 125 psig minimum unless otherwise indicated.
  4. Cabinet: Factory fabricated, stainless steel, for surface mounting; with controls and thermometer mounted on front.
  5. Cabinet Mounting: **[Recessed] [Surface]**.
- F. Individual-Fixture, Water Tempering Valves: ASSE 1070, thermostatically controlled, water tempering valve, 125 psig minimum pressure rating, bronze body with corrosion-resistant interior components, adjustable temperature control with threaded inlet and outlet, and rough finish.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Heat-Timer Corporation
    - b. Holby Valve Company, Inc.
    - c. Watts Industries, Inc.; Water Products Division
    - d. Conbraco Industries, Apollo Division
- G. Water-Temperature Limiting Devices: ASSE 1070 thermostatically controlled, bronze body with corrosion-resistant interior components and rough bronze finish. Pressure rating of 125 psig with threaded union inlets and outlets, and adjustable, temperature-control handle.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Acorn Controls.
    - b. Apollo.
    - c. Powers.
    - d. Symmons.
    - e. Watts.
    - f. Wilkins.
    - g. Zurn.

## **2.5 STRAINERS**

- A. Domestic Strainers: Y-pattern, unless otherwise indicated, and full size of connecting piping. Include ASTM A 666, Type 304, stainless-steel screens with 3/64-inch round perforations, unless otherwise indicated.
1. Pressure Rating: 125 psig minimum working pressure, unless otherwise indicated.
  2. NPS 2 and Smaller: Bronze body, with female threaded ends.
  3. NPS 2-1/2 and Larger: Cast-iron body, with interior AWWA C550 or FDA-approved, epoxy coating and flanged ends.
- B. Y-Pattern Strainers: Screwed screen retainer with centered blowdown.
1. Drain: Field-installed, hose-end drain valve.

- C. T-Pattern Strainers: Malleable-iron or ductile-iron body with grooved ends; access end cap with drain plug and access coupling with rubber gasket.
- D. Basket Strainers: Bolted flange or clamp cover, and basket with lift-out handle.
  - 1. Type: **[Simplex with one basket] [Duplex with bronze or stainless-steel diverter valve and two baskets]**.
  - 2. Drain: Field-installed, hose-end drain valve.
- E. Drainage Basket Strainers: Non-pressure-rated, cast-iron or coated-steel body; with bolted flange or clamp cover and drain with plug.
  - 1. Basket: Bronze or stainless steel with 1/8 or 3/16 inch diameter holes and lift-out handle.
  - 2. Female threaded ends for NPS 2 and smaller and flanged ends for NPS 2-1/2 and larger.

## 2.6 KEY-OPERATION HYDRANTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Josam Company
  - 2. Jay R. Smith
  - 3. Simmons Manufacturing Company
  - 4. MIFAB Manufacturing, Inc.
  - 5. Watts Industries, Inc.
  - 6. Woodford Manufacturing Company
  - 7. Zurn Industries, Inc.
- B. General: ASME A112.21.3M, key-operation hydrant with pressure rating of 125 psig.
  - 1. Inlet: NPS 3/4 or NPS 1 threaded or solder joint.
  - 2. Outlet: ASME B1.20.7, garden-hose threads.
  - 3. Operating Keys: One with each key-operation hydrant.
- C. Non-freeze Concealed-Outlet Wall Hydrants, WH-1: ASSE 1019, self-drainable with flush-mounting box with cover, integral non-removable hose-connection vacuum breaker, casing and operating rod to match wall thickness, concealed outlet, and wall clamp.
  - 1. Classification: Type A, for automatic draining with hose removed or Type B, for automatic draining with hose removed or with hose attached and nozzle closed.
  - 2. Box and Cover Finish: Polished bronze.
- D. Non-freeze Exposed-Outlet Wall Hydrants, WH-2: ASSE 1019, self-drainable with integral non-removable hose-connection vacuum breaker, casing and operating rod to match wall thickness, projecting outlet, and wall clamp.
  - 1. Classification: Type A, for automatic draining with hose removed or Type B, for automatic draining with hose removed or with hose attached and nozzle closed.
  - 2. Nozzle and Wall Plate Finish: Polished bronze.
- E. Hot and Cold, Non-freeze Concealed-Outlet Wall Hydrants, WH-3: With deep flush-mounting box with cover; hot- and cold-water casings and operating rods to match wall thickness; bronze body, brass interior parts, replaceable seat washers, screwdriver operated stops handle operated valves, concealed outlet; wall clamps; and factory- or field-installed, non-removable and manual drain-type, hose-connection vacuum breaker complying with ASSE 1011.
  - 1. Box and Cover Finish: Polished bronze.

## **2.7 WHEEL-HANDLE WALL HYDRANTS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. MIFAB Manufacturing, Inc.
  2. NIBCO, Inc.
  3. Watts Industries, Inc.
  4. Woodford Manufacturing Company
  5. Zurn Industries, Inc.
- B. Non-freeze Concealed-Outlet Wall Hydrants, WH-4: Frost-proof design similar to ASME A112.21.3M, for wall mounting with wheel-handle operation, NPS 3/4 threaded or solder-joint inlet, casing and operating rod to match wall thickness, and projecting outlet with ASME B1.20.7 garden-hose threads on outlet. Include wall clamp; integral vacuum breaker or non-removable, drainable hose-connection vacuum breaker complying with ASSE 1011; and garden-hose threads complying with ASME B1.20.7 on outlet.
- C. Hot and Cold Mixing Wall Hydrant, WH-5: Shall be encased hot and cold wall hydrant with top feed for narrow wall installation. Hydrant shall have bronze body, brass interior parts, replaceable seat washers, screwdriver operated stops handle operated valves, 3/4" male hose connection with vacuum breaker, stainless steel box with removable hinged cover with cylinder lock. Provide with mounting hardware.

## **2.8 DRAIN VALVES**

- A. Ball Valve Hose-End Drain Valves: MSS SP-110, NPS 3/4 ball valve, rated for 400-psig minimum CWP. Include two-piece, copper-alloy body with standard port, chrome-plated brass ball, replaceable seats and seals, blowout-proof stem, and vinyl-covered steel handle.
1. Inlet: Threaded.
  2. Outlet: Short-threaded nipple with ASME B1.20.7, garden-hose threads and cap.
- B. Stop-and-Waste Drain Valves: MSS SP-110, ball valve, rated for 200-psig minimum CWP or MSS SP-80, Class 125, gate valve; ASTM B 62 bronze body, with NPS 1/8 side drain outlet and cap.

## **2.9 BACKWATER VALVES**

- A. Backwater Valve (in-line): Bronze fitted cast-iron, bolted cover. Flapper shall provide a maximum 1/4 inch clearance between flapper and seat for air circulation.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Smith 7022
    - b. Wade
    - c. Zurn
- B. Horizontal Backwater Valves: ASME A112.14.1, cast-iron body, with removable bronze swing-check valve and threaded or bolted cover.
- C. Closed-Position Check Valve: Factory assembled or field modified to hang closed unless subject to backflow condition.
- D. Open-Position Check Valve: Factory assembled or field modified to hang open for airflow.
1. Extension: ASTM A 74, Service class; full-size, cast-iron, soil-pipe extension to field-installed cleanout at floor, instead of cover.
- E. Drain Outlet Backwater Valves: ASME A112.14.1, cast-iron or bronze body, with removable ball float, threaded inlet, and threaded or spigot outlet for installation in bottom outlet of floor drain.

## **2.10 MISCELLANEOUS PLUMBING SPECIALTIES**

- A. Water Hammer Arresters: Certified per PDI Standard WH-201. Bellows type, with stainless steel casing and bellows, pressure rated for 250 psi. Piston type, precharged to 60 psig, suitable for installation in any position.
1. Manufacturers (Bellows): Subject to compliance with requirements, provide products by one of the following:
    - a. Zurn Shoktrol
    - b. J. R. Smith
    - c. Wade
  2. Manufacturers (Piston): Subject to compliance with requirements, provide products by one of the following:
    - a. Sioux Chief
    - b. Zurn
    - c. J. R. Smith
    - d. Wade
- B. Atmospheric Vacuum Breaker: Single float and disc with large atmospheric port. Angle pattern brass body, with chrome plated finish, ½" inlet and outlet unless otherwise noted. ASSE Standard 1001 certified.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Watts 288A Series
    - b. Chicago Water Saver Model L-102
    - c. Bell & Gossett
- C. Hose-Connection Vacuum Breakers: ASSE 1011, nickel-plated, with non-removable and manual drain features, and ASME B1.20.7, garden-hose threads on outlet. Units attached to rough-bronze-finish hose connections may be rough bronze.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Apollo.
    - b. Jay R. Smith.
    - c. Watts LF8 Series
    - d. Zurn.
- D. Pressure Type Vacuum Breaker: Spring loaded single float and disc with independent first check valve, manufacturer's standard materials, with test cocks and ball type isolation valves. ASSE Standard 1020 certified.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Apollo.
    - b. Bell & Gossett
    - c. Conbraco
    - d. Febco
    - e. Watts LF800 Series
  2. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.



- E. Pressure-Regulating Valves: Single-seated, direct-operated type, having bronze body with integral strainer and complying with requirements of ASSE Standard 1003. Select proper size for maximum flow rate and inlet and outlet pressures indicated.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Bell & Gossett
    - b. Conbraco
    - c. Watts
    - d. Hoffman
    - e. Keckley
    - f. Leslie
    - g. Spirax-Sarco
- F. Combined Pressure-Temperature Relief Valves: Bronze body, test lever, thermostat, ANSI Z21.22. Factory set at 210 degrees F, and 150 psig. Size valves in accordance with ASME Boiler and Pressure Vessel Codes.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Watts; series 40, 140, 240, 340
    - b. Spirax-Sarco
    - c. Leslie
- G. Hose Bibbs HB-1: Bronze body with replaceable seat disc complying with ASME A112.18.1M for compression-type faucets. Include NPS 3/4 threaded joint inlet, of design suitable for pressure of at least 125 psig; integral, non-removable, drainable hose-connection vacuum breaker; and garden-hose threads complying with ASME B1.20.7 on outlet.
1. Manufacturers:
    - a. Chicago
    - b. J. R. Smith
    - c. Woodford
    - d. Zurn
  2. Finish for Equipment Rooms: Rough bronze.
  3. Finish for Service Areas: Rough bronze.
  4. Finish for Finished Rooms: Chrome or nickel-plated.
  5. Operation for Equipment Rooms: Wheel handle.
  6. Operation for Service Areas: Wheel handle.
  7. Operation for Finished Rooms: Operating key.
  8. Include operating key with each operating-key hose bibb.
  9. Include integral wall flange with each chrome- or nickel-plated hose bibb.
- H. Air Vents: Float type for automatic air venting.
1. Bolted Construction: Bronze body with replaceable, corrosion-resistant metal float and stainless-steel mechanism and seat; threaded NPS 1/2 minimum inlet; 125-psig minimum pressure rating at 140 deg F; and threaded vent outlet.
  2. Welded Construction: Stainless steel body with corrosion-resistant metal float, stainless-steel mechanism and seat, threaded NPS 3/8 minimum inlet, 150-psig minimum pressure rating, and threaded vent outlet.
- I. Stack Vent Valve: ASSE 1050, designed for installation as terminal on soil, waste, and vent stacks, instead of stack vent extending through roof, in NPS 2 to NPS 4.

- J. Fixture Vent Valve: ASSE 1051, designed for installation on waste piping, instead of vent connection, for single fixture, in NPS 1-1/4 to NPS 2.
- K. Roof Flashing Assemblies: Manufactured assembly made of 4-lb/sq. ft., 0.0625-inch thick, lead flashing collar and skirt extending at least 10 inches from pipe with galvanized steel boot reinforcement, and counterflashing fitting.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Acorn Engineering Company; Elmdor/Stoneman Division
    - b. Other approved
  - 2. Open-Top Vent Cap: Without cap.
  - 3. Low-Silhouette Vent Cap: With vandal-proof vent cap.
  - 4. Extended Vent Cap: With field-installed, vandal-proof vent cap.
- L. Open Drains: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting, joined with ASTM C 564, rubber gaskets.
- M. Deep-Seal Traps: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap seal primer valve connection.
  - 1. NPS 2: 4-inch- minimum water seal.
  - 2. NPS 2-1/2 and Larger: 5-inch- minimum water seal.
- N. Floor-Drain Inlet Fittings: Cast iron, with threaded inlet and threaded or spigot outlet, and trap seal primer valve connection.
- O. Fixed Air-Gap Fittings: Manufactured cast-iron or bronze drainage fitting with semi-open top with threads or device to secure drainage inlet piping in top and bottom spigot or threaded outlet larger than top inlet. Include design complying with ASME A112.1.2 that will provide fixed air gap between installed inlet and outlet piping.
- P. Sleeve Flashing Device: Manufactured, cast-iron fitting, with clamping device that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend **2 inches** above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
  - 1. Size: As required for close fit to riser or stack piping.
- Q. Stack Flashing Fittings: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
- R. Vent Caps: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and set-screws to secure to vent pipe.
- S. Vent Terminals: Commercially manufactured, shop- or field-fabricated, frost-proof assembly constructed of galvanized steel, copper, or lead-coated copper. Size to provide 1-inch enclosed air space between outside of pipe and inside of flashing collar extension, with counterflashing.
- T. Downspout Boots: ASTM A 48, gray-iron casting, with NPS 4 outlet; shop-applied bituminous coating; and inlet size to match downspout.
- U. Downspout Boots: ASTM A 74, Service class, hub-and-spigot, cast-iron soil pipe.

## **2.11 SLEEVE PENETRATION SYSTEMS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Metraflex
  - 2. ProSet Systems, Inc.
- B. Description: UL 1479, through-penetration firestop assembly consisting of sleeve and stack fitting with firestopping plug.
  - 1. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
  - 2. Stack Fitting: ASTM A 48, gray-iron, hubless-pattern, wye-branch stack fitting with neoprene O-ring at base and gray-iron plug in thermal-release harness in branch. Include PVC protective cap for plug.
  - 3. Special Coating: Include corrosion-resistant interior coating on fittings for plastic chemical waste and vent stacks.

## **2.12 FLASHING MATERIALS**

- A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
  - 1. General Use: 4-lb/sq. ft., 0.0625-inch thickness.
  - 2. Vent Pipe Flashing: 3-lb/sq. ft., 0.0469-inch thickness.
  - 3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.
- B. Copper Sheet: ASTM B 152, of the following minimum weights and thicknesses, unless otherwise indicated:
  - 1. General Applications: 12 oz./sq. ft.
  - 2. Vent Pipe Flashing: 8 oz./sq. ft.
- C. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.
- D. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.
  - 1. Fasteners: Metal compatible with material and substrate being fastened.
  - 2. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
  - 3. Solder: ASTM B 32, lead-free alloy.
  - 4. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

## **2.13 CLEANOUTS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Jay R. Smith
  - 2. Wade.
  - 3. Zurn.
- B. Floor Cleanout: Cast iron body, round, adjustable, scoriated, secured, nickel-bronze top, threaded and slotted bronze closure plug, medium duty load classification, and outlet connection to suit application. For carpeted floors, provide nickel bronze carpet clamping frame and cover. Comply with ASME A112.36.2M.

- C. Wall Clean-Out: Treaded bronze plug in cast iron tee or ferrule, with stainless steel cover. Comply with ASME A112.36.2M.
- D. Exposed Clean-Out: Threaded plug, of material compatible with system piping. Comply with ASME A112.36.2M.

## **2.14 FLOOR DRAINS**

- A. General floor drain requirements: Unless otherwise noted, provide round strainer/ grate, cast iron body, seepage flange and clamping collar, bottom outlet same size as pipe served, with caulked, no-hub or neoprene gasket connection. Load classifications per ASME A112.21.1M. Waterproofing: 40 mils sheet membrane, chlorinated polyethylene, Chloraloy 240.
- B. Provide funnel type floor drain cover for floor drains used for cooling coil condensate drains, equipment drains and wherever shown on drawings.
- C. Standard Floor Drain, FD-1:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Jay R. Smith Model No. 2005Y.
    - b. Josam Company.
    - c. Mifab, Inc.
    - d. Sioux Chief.
    - e. Wade.
    - f. Zurn Industries, Inc., Model No. ZN-415S.
  - 2. Exposed Surfaces and Interior Lining: Not required.
  - 3. Sediment Bucket: Cast Iron.
  - 4. Top or Strainer Material: Polished nickel bronze.
  - 5. Top of Body and Strainer Finish: Polished nickel bronze.
  - 6. Top Shape: Square.
  - 7. Dimensions of Top or Strainer: 6 x 6 inch.
  - 8. Top Loading Classification: Medium Duty.
  - 9. Funnel: Not required.
  - 10. Inlet Fitting: Not required.
  - 11. Trap Material: Cast iron.
  - 12. Trap Pattern: Standard-seal P-trap.

## **2.15 TRENCH DRAINS**

- A. Modular Channel 6" Trench Drain, TD-1: Channels shall be minimum 39" long, nominal, 6" wide, and have a 4" wide throat. Modular channel sections shall be made of high-density polyethylene (HDPE), structural foam polyethylene or polypropylene, have interlocking ends, and radiuses bottom. Channel shall be provided with a minimum 0.7 built-in slope. Channels shall be available with inverts ranging from 3.5" to 12.50". Channels shall have clips molded into the sides of the channel to accommodate vertical rebar for positioning and anchoring purposes. Extra heavy-duty ductile iron grates shall be Class D, available with H-20 load ratings and ADA compliance with mechanical lockdown devices. End caps and catch basins shall be available to complement the channels and grates. Bottom outlets and side outlets shall be available in 3" or 4" diameters. Construction shall comply with ASME A112.21.1M and ASME A112.3.1.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Josam Company.
    - b. MIFAB Inc., Series T1400.
    - c. Jay R. Smith.

- d. Zurn Model Z886.
- e. NDS, Inc (National Diversified Sales). "Dura Slope" Series DS-100.
- 2. Grate: ADA HPD Ductile Iron
- 3. Grate Lockdown Assemble: Required.
- 4. Heavy Duty Frame Assemble: Required.
- 5. Channel: 6" minimum
- 6. Bottom Dome or Side Outlet Strainer: Required
- 7. Seepage Flange: [Required] [Not required] [Anchor flange].
- 8. Clamping Device: [Required] [Not required]

## **2.16 TRAP SEAL PROTECTION DEVICES**

- A. Trap Seal: ASSE 1072, barrier type trap protection, with the following characteristics:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Jay R. Smith, model Quad Close
    - b. Sureseal, Rector Seal
    - c. Sioux Chief, 835 Series
    - d. Zurn, ZShield

## **2.17 DOWNSPOUT NOZZLES**

- A. Downspout Nozzle, DS-1: Nickel, wall flange, bronze body, threaded face polished nickel bronze.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Jay R. Smith, Model No. 1770T.
    - b. Josam.
    - c. MIFAB Inc., Model No. R1940.
    - d. Sioux Chief.
    - e. Wade.
    - f. Zurn.
- B. Downspout Cover, DC-1: Vandal proof, type 304 stainless steel, hinged perforated bird screen cover, wall flange, extending 2-1/2" past wall surface.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Jay R. Smith, Model No. 1775.
    - b. Josam.
    - c. MIFAB Inc., Model No. R1960.
    - d. Sioux Chief.
    - e. Wade.
    - f. Zurn, Model No. ZS-199-DC.

## **2.18 OIL INTERCEPTORS**

- A. Oil Interceptors, OI-1: Acid resistant coated interior and exterior fabricated steel or polyethylene oil interceptor, with air relief bypass, bronze cleanout plug and visible double wall trap seal, removable combination pressure equalizing/flow diffusing baffle and sediment bucket, horizontal baffle, adjustable oil draw off and vent connections either side, secured gasketed non-skid cover, fabricated steel or polyethylene extension, anchor flange, complete with flow control fitting.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Highland Tank Company.
    - b. Jay R. Smith.
    - c. Josam.
    - d. Striem.
    - e. Zurn.
  2. Type, Size, and Capacity: Refer to Schedule on Drawings.
  3. End Connections: Threaded.
  4. Vents: Two per side.
  5. Mounting: Refer to Schedule on Drawings.
  6. Flow-Control Fitting: Not required.

## **2.19 FLEXIBLE CONNECTORS**

- A. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
1. Working-Pressure Rating: Minimum 250 psig.
  2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
  3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.
- B. Stainless Steel-Hose Flexible Connectors: Corrugated-stainless steel tubing with stainless steel wire-braid covering and ends welded to inner tubing.
1. Working-Pressure Rating: Minimum 250 psig.
  2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
  3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

## **2.20 WATER METERS**

- A. Turbine-Type Water Meters: AWWA C701, turbine, totalization meter, 150 psig working pressure with the following:
1. Registration: In gallons or cubic feet as required by utility company.
    - a. Remote Registration System: Encoder type complying with AWWA C707; modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by utility company.
    - b. System to be capable of transmitting data using AMR/AMI technology.
  2. Case: Bronze for 2 inch or smaller. Epoxy-coated cast iron for 2-1/2 inch or larger.
  3. End Connections: Threaded or flanged.

### **PART 3 - EXECUTION**

#### **3.1 EXCAVATION**

- A. Refer to Division 31 Section "Earthwork" for excavating, trenching, and backfilling requirements.

#### **3.2 EXAMINATION AND PREPARATION**

- A. Verify existing grades, inverts, utilities, obstacles, and topographical conditions prior to installations.
- B. Examine rough-in requirements for plumbing fixtures and other equipment having drain connections to verify actual locations of piping connections prior to installation.
- C. Examine walls, floors, roof, and plumbing chases for suitable conditions where piping and specialties are to be installed.

#### **3.3 INSTALLATION OF PIPING SPECIALTIES**

- A. Fasten wall-hanging plumbing specialties securely to supports attached to building substrate if supports are specified and to building wall construction if no support is indicated.
- B. Fasten recessed-type plumbing specialties to reinforcement built into walls.
- C. Install wood-blocking reinforcement for wall mounting and recessed-type plumbing specialties.
- D. Install individual shutoff valve in each water supply to plumbing specialties. Use ball valve if specific valve is not indicated. Install shutoff valves in accessible locations. Refer to Division 20 Section "Valves" for general-duty ball and check valves.
- E. Install air vents at piping high points. Include ball valve in inlet.
- F. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- G. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.
- H. Backflow Preventers: Install in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
- I. Locate backflow preventers in same room as connected equipment or system.
- J. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
- K. Do not install bypass piping around backflow preventers.
- L. Water Regulators: Install with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gauges on inlet and outlet.
- M. Balancing Valves: Install in locations where they can easily be adjusted. Set at indicated design flow rates.
- N. Install vacuum breakers where required per the Project Specifications and shown on Drawings, in compliance with the plumbing code and authority having jurisdiction.

- O. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to lavatories and sinks, and any fixtures with flush valves, solenoid valves or other quick-closing valves.
- P. Install garbage disposal per manufacturer's recommendations. Coordinate power receptacle location with the electrical contractor
- Q. Install pressure regulators with inlet and outlet shutoff valves and balance valve bypass. Install pressure gages on inlet and outlet.
- R. Install strainers on supply side of each control valve, pressure regulator, and solenoid valve.
- S. Outlet Boxes: Install boxes recessed in wall or surface mounted on wall. Install 1-1/2-by-3-1/2-inch fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Division 06 Section "Rough Carpentry."
- T. Hose Stations: Install with check stops or shutoff valves on inlets and with thermometer on outlet.
- U. Install cabinet-type units recessed in or surface mounted on wall as specified. Install 1-1/2-by-3-1/2-inch fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Division 06 Section "Rough Carpentry."
- V. Ground Hydrants: Install with **1 cu. yd.** of crushed gravel around drain hole. Set ground hydrants with box flush with grade.
- W. Nonfreeze, Draining-Type Post Hydrants: Install with **1 cu. yd.** of crushed gravel around drain hole. Set post hydrants in concrete paving or in **1 cu. ft.** of concrete block at grade.
- X. Nonfreeze, Nondraining-Type Post Hydrants: Set in concrete or pavement.
- Y. Nonfreeze, Draining-Type Roof Hydrants: Install with drain connection piped to nearest floor drain or to the exterior.
- Z. Water-Hammer Arresters: Install in water piping in accordance with PDI-WH 201.
- AA. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.
- BB. Install drain-outlet backwater valves in outlet of drains.
- CC. Install vent-flashing sleeves on stacks passing through roof. Secure over stack flashing according to manufacturer's written instructions.
- DD. Install fixture air-admittance valves on fixture drain piping.
- EE. Install stack air-admittance valves at top of stack vent and vent stack piping.
- FF. Assemble open drain fittings and install with top of hub **1 inch** above floor.
- GG. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- HH. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- NN. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.



- OO. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.

### 3.4 THERMOSTATIC WATER MIXING VALVE INSTALLATION

- A. Temperature-Actuated, Water Mixing Valves: Install with check stops or shutoff valves on inlets and with shutoff valve on outlet.
- B. Install cabinet-type units recessed in or surface mounted on wall as specified.

#### THERMOSTATIC WATER MIXING VALVES/TEMPERING VALVES/TEMPERATURE LIMITING DEVICES

APPLICATION	Temp. Limit	DEVICE STANDARD
Tempered Water	110°F	ASSE 1070 / ASME A112.1070 / CSA B125.70
Temperature Control		ASSE 1017
Tub/Shower	120°	ASSE 1016 / ASME A112.1016 / CSA B125.16
Tub Only	120°	ASSE 1070 / ASME A112.1070 / CSA B125.70 or B123.5
Individual Shower	120°	ASSE 1016 / ASME A112.1016 / CSA B125.16
Gang Showers	120°	ASSE 1069 or CSA B125.3
Emergency Showers	85°	ISEA/ANSI Z358.1
Head Shampoo Faucet	120°	ASSE 1070 / ASME A112.1070 / CSA B125.70
Bidet	120°	ASSE 1070 / ASME A112.1070 / CSA B125.7 or CSA B125.3
Lavatories	110°	ASSE 1070 / ASME A112.1070 / CSA B125.70 or CSA B125.3
Foot and Pedicure Baths	120°	ASSE 1070 / ASME A112.1070 / CSA B125.70 or CSA B125.3

### 3.5 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
- B. Lead Sheets: Burn joints of lead sheets 6-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4-lb/sq. ft., 0.0625-inch thickness or thinner.
- C. Copper Sheets: Solder joints of copper sheets.
- D. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
- E. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
- F. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
- G. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- H. Set flashing on floors and roofs in solid coating of bituminous cement.
- I. Secure flashing into sleeve and specialty clamping ring or device.
- J. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Section "Sheet Metal Flashing and Trim."

- K. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.
- L. Fabricate and install flashing and pans, sumps, and other drainage shapes.

### **3.6 CLEANOUT INSTALLATION**

- A. Provide cleanouts at each change in direction of piping greater than 45 degrees, where indicated on drawings and where required by code. Clean-outs shall be same size as pipe served through 4". For pipes larger than 4 inches, the size of the cleanout shall be not less than 4 inches
- B. Install cleanouts at minimum intervals of 50' for piping 4 inch and smaller and 100' for larger piping, at base of each vertical soil or waste stack.
- C. Encase exterior cleanouts in concrete flush with grade.
- D. Cleanouts shall be aesthetically located with respect to tile patterns, masonry bond and alignment. Coordinate installation with masonry and concrete work.
- E. Prior to acceptance of the system, demonstrate that cleanout plugs are easily removable and can be easily rodded.
- F. When cleanouts are required in above grade floors, flash and clamp cleanouts in floors provided with membrane waterproofing as specified for floor drains.
- G. Install cleanout deck plates with top flush with finished floor, for floor cleanouts for piping below floors.
- H. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.
- I. Install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall, for cleanouts located in concealed piping.
- J. Locate cleanouts at base of each vertical storm piping conductor.

### **3.7 FLOOR DRAIN INSTALLATION**

- A. Install floor drains as indicated on drawings, at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
- B. Provide trap for all floor drains, minimum 3" trap and waste.
- C. Check drainage of surfaces by flooding with the hose.
- D. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
- E. Provide vent for floor drain piping per code.

### **3.8 TRENCH DRAIN INSTALLATION**

- A. Install trench drains at low points of surface areas to be drained.
- B. Set grates of drains flush with finished floor, unless otherwise indicated.
- C. Provide rebar rods for setting drains.

- D. Provide temporary wood spacer to protect drain from debris and support drain sidewall from wrapping during pouring of concrete surround.
- E. Bolt grate to drain body using manufacturers supplied vandal resistant grate lockdown assembly.
- F. Concrete to be provided by concrete contractor. Mechanical contractor shall be present during pour to insure proper installation.

### **3.9 ROOF SUMP, DRAIN AND DOWNSPOUT INSTALLATION**

- A. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions.
- B. Install drain flashing collar or flange so that no leakage occurs between roof drain and adjoining roofing. Maintain integrity of waterproof membranes, where penetrated.
- C. Check drainage of surfaces by flooding with hose.
- D. Install downspout nozzles at exposed bottom of conductors where they spill onto grade.

### **3.10 GREASE, OIL, AND SOLIDS INTERCEPTOR INSTALLATION**

- A. Install interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.
- B. Above-Floor Installation: Set unit with bottom resting on floor, unless otherwise indicated.
- C. Flush with Floor Installation: Set unit and extension, if required, with cover flush with finished floor.
- D. Recessed Floor Installation: Set unit in receiver housing having bottom or cradle supports, with receiver housing cover flush with finished floor.
- E. Install cleanout immediately downstream from interceptors not having integral cleanout on outlet.
- F. Coordinate oil-interceptor storage tank and gravity drain with Section 02554 "Fuel-Oil Distribution."

### **3.11 WATER METER ROUGH-IN**

- A. Rough-in domestic water piping **[for water meter installation] [and install water meters]** according to utility company's requirements. Water meters will be furnished by utility.
- B. Rough-in domestic water piping and install water meters according to utility company's requirements. Refer to Division 20 Section "Thermometers, Pressure Gauges, Meters and Accessories " for water meters.

### **3.12 PIPING CONNECTIONS**

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Piping installation requirements are specified in other Division 20 Sections.
- C. Install piping adjacent to equipment to allow service and maintenance.
- D. Connect plumbing specialties to piping specified in other Division 20 Sections.
- E. Interceptor Connections: Connect piping, flow-control fittings, and accessories.

- F. Grease Interceptors: Connect inlet and outlet to unit, and flow-control fitting and vent to unit inlet piping. Install valve on outlet of automatic draw off-type unit.
- G. Oil Interceptors: Connect inlet, outlet, vent, and gravity draw off piping to unit; flow-control fitting and vent to unit inlet piping; and gravity draw off and suction piping to oil storage tank.
- H. Solids Interceptors: Connect inlet and outlet.

### **3.13 ELECTRICAL CONNECTIONS**

- A. Connect wiring in accordance with Division 26 Sections.
- B. Ground equipment in accordance with Division 26 Sections.
- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- D. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.

### **3.14 IDENTIFICATION**

- A. Refer to Division 20 Section "Mechanical Identification"

### **3.15 CLEANING**

- A. Clean piping specialties during installation and remove dirt and debris as work progresses.

### **3.16 PROTECTION**

- A. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

### **3.17 ADJUSTING**

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.
- C. Adjust each **[pressure vacuum breaker] [reduced-pressure-principle backflow preventer] [double-check, backflow-prevention assembly] [and] [double-check, detector-assembly backflow preventer]** in accordance with manufacturer's written instructions, authorities having jurisdiction and the device's reference standard.
- D. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
- E. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
- F. Operate and adjust disposers. Replace damaged and malfunctioning units.
- G. Adjust calibrated balancing valves to flows indicated.

**3.18 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain **[thermostatic mixing valves] [and] [interceptors]**. Refer to Division 01 Sections "Closeout Procedures" and "Demonstration and Training".

**END OF SECTION 22 1119**

## **SECTION 22 1519 - GENERAL-SERVICE PACKAGED AIR COMPRESSORS AND RECEIVERS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. This Section includes equipment and accessories for building compressed-air systems operating at 200 psig and less.
- B. Section Includes:
  - 1. Reciprocating air compressors - lubricated.
  - 2. Reciprocating air compressors - oil free.
  - 3. Reciprocating air compressors - oil less.
  - 4. Rotary-screw air compressors - oil free.
  - 5. Rotary-screw air compressors - oil flooded.
  - 6. Air filters - inlet type.
  - 7. Compressed-air aftercoolers - air cooled.
  - 8. Compressed-air aftercoolers - water cooled.
  - 9. Compressed-air dryers.

#### **1.3 DEFINITIONS**

- A. Actual Air: Air delivered from air compressors. Flow rate is delivered compressed air measured in acfm.
- B. Standard Air: Free air at 68 deg F and 1 atmosphere before compression or expansion and measured in scfm.
- C. Low-Pressure, Compressed-Air Systems: ASME B31.9, "Building Services Piping," for systems operating at pressure of 125 psig or less and at temperature of 200 deg F or less.
- D. Medium-Pressure, Compressed-Air Systems: ASME B31.1, "Power Piping," for systems operating at pressure between 125 and 200 psig, or at temperature of more than 200 deg F.

#### **1.4 SUBMITTALS**

- A. Product Data: For each model indicated. Include rated capacities of air compressors, aftercoolers, air dryers, and accessories; shipping, installed, and operating weights; furnished specialties; and accessories. Indicate dimensions, required clearances, methods of assembly of components, and piping and wiring connections.
- B. Wiring Diagrams: For each item of equipment with electric power supply. Include ladder-type wiring diagrams for interlock and control wiring required for final installation. Differentiate between factory-installed and field-installed wiring.
- C. Certificates of Shop Inspection and Data Report: As required by ASME Boiler and Pressure Vessel Code.
- D. Maintenance Data: For equipment to include in the maintenance manuals specified in Division 1.

## **1.5 QUALITY ASSURANCE**

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of compressed-air equipment and accessories and are based on specific types and models indicated. Other products with equal performance characteristics, made by specified manufacturers, may be considered. Refer to Division 1 Section "Substitutions."
- B. Electrical Component Standard: NFPA 70.
- C. Provide listing/approval stamp, label, or other marking on equipment made to specified standards.
- D. Listing and Labeling: Provide equipment and accessories specified in this Section that are listed and labeled.
  - 1. Terms "Listed" and "Labeled": As defined in National Electrical Code, Article 100.
  - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.

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

- A. Comply with manufacturer's written instructions for delivery, storage, and handling.

## **1.7 WARRANTY**

- A. Manufacturer Warranty: Manufacturer and installer agree to repair or replace equipment that fail in materials or workmanship within the specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Faulty operation of compressor, gauges, and air dryer.
    - b. Deterioration of metals, metal finishes, and other materials beyond normal use.
  - 2. Warranty Period: One year(s) from date of Substantial Completion.

## **1.8 EXTRA MATERIALS**

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents. Deliver materials to Owner.
  - 1. Air-Compressor, Inlet-Filter Elements: Equal to 100 percent of amount installed.
  - 2. Belts: One for each belt-driven compressor.

## **PART 2 - PRODUCTS**

### **2.1 AIR COMPRESSORS – GENERAL**

- A. General: Factory-assembled and -tested packaged units; simplex, duplex, or multiplex units; and with capacities, features, and electrical characteristics indicated.
- B. Construction of Equipment: ASME B19.1, "Safety Standard for Air Compressor Systems"; or ASME B19.3, "Safety Standard for Compressors for Process Industries," as appropriate.

- C. Control Panels: Automatic control station with load control and protection functions. Comply with NEMA ICS 2, "Industrial Controls and Systems: Controllers, Contactors and Overload Relays, Rated Not More than 200 Volts AC or 750 Volts DC"; and UL 508, "Industrial Control Equipment."
1. Mounting and Wiring: Factory installed and connected as an integral part of equipment package.
  2. Enclosure: NEMA ICS 6, "Industrial Control and Systems: Enclosures," Type 12 control panel, except where a higher degree of enclosure is specified.
  3. Motor Controllers: Full-voltage, combination-magnetic type with undervoltage release feature and motor-circuit-protector-type disconnect and short-circuit protective device.
    - a. Control Voltage: 120 V, ac or less, using integral control power transformer.
    - b. Motor Overload Protection: Overload relay in each phase.
    - c. Starting Devices: Hand-off-automatic selector switch in cover of control panel, plus pilot device for automatic control as indicated.
    - d. Automatic Alternating Starting: Switch lead compressor for duplex air compressors.
    - e. Sequence (Lead-Lead-Lag) Starting: Switch lead compressor for multiplex air compressors.
    - f. Reduced-Voltage Starting: Instead of full-voltage starting, where indicated.
  4. Instrumentation: Include air-receiver pressure gage, discharge-line pressure gage, air-filter maintenance indicator, hour meter, compressor discharge air and coolant temperature gage, and control transformer.
- D. Receiver Tanks: ASME Boiler and Pressure Vessel Code, Section VIII, "Pressure Vessels" construction and bear appropriate code symbols, with pressure gage, pressure-reducing valve, and automatic drain.
1. Exception: Omit receiver tank for freestanding air compressors and include receiver tank as an accessory where indicated.
- E. Factory Piping: Entire unit, except where otherwise indicated.
- F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## **2.2 SAFETY VALVES**

- A. Safety Valves: Poppet type complying with ASME Boiler and Pressure Vessel Code, Section VIII, bear appropriate labeling, and factory sealed after testing.

## **2.3 RECIPROCATING AIR COMPRESSORS - LUBRICATED**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. DeVilbiss Air Compressor Products
  2. Gardner Denver Machinery, Inc.
  3. Ingersoll-Rand Company; Rotary-Reciprocating Compressor Division
- B. Description: Tank-mounted, lubricated, reciprocating air compressors, with inlet silencer filter, safety valve, discharge pressure gage, pressure regulator, and shutoff valve.
- C. Compressor(s): Lubricated, reciprocating-piston type with lubricated compression chamber and crankcase.
1. Submerged gear-type oil pump.
  2. Oil filter.
  3. Combined high discharge-air temperature and low lubrication-oil pressure switch.
  4. Belt guard totally enclosing pulleys and belts.



- D. Receiver: ASME construction steel tank.
  - 1. Arrangement: **[Horizontal]** **[Vertical]**.
  - 2. Interior Finish: Epoxy or galvanized coating.
  - 3. Pressure Rating: **[125 psig]** **[150 psig]** **[200 psig]** minimum.
  - 4. Drain: **[Automatic]** **[Manual]** valve.
- E. Receiver Tank Orientation: Horizontal, except where vertical tank is indicated.
- F. Enclosure: Steel sheet, lined with acoustic material protected by perforated steel sheet, inlet and outlet air silencers, and finned-cylinder head cover.

## **2.4 RECIPROCATING AIR COMPRESSORS - OIL FREE**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Ingersoll-Rand Company; Rotary-Reciprocating Compressor Division
  - 2. Universal Air Products Corporation
- B. Description: Tank-mounted, lubricated, oil-free, reciprocating air compressors, with inlet silencer filter, safety valve, discharge pressure gage, pressure regulator, and shutoff valve, and of construction that prohibits oil from entering compression chamber.
- C. Compressor(s): Oil-free, reciprocating-piston type with nonlubricated compression chamber, lubricated crankcase, and of construction that prohibits oil from entering compression chamber.
  - 1. Submerged gear-type oil pump.
  - 2. Oil filter.
  - 3. Combined high discharge-air temperature and low lubrication-oil pressure switch.
  - 4. Belt guard totally enclosing pulleys and belts.
- D. Receiver: ASME construction steel tank.
  - 1. Arrangement: **[Horizontal]** **[Vertical]**.
  - 2. Interior Finish: Epoxy or galvanized coating.
  - 3. Pressure Rating: **[125 psig]** **[150 psig]** **[200 psig]** minimum.
  - 4. Drain: **[Automatic]** **[Manual]** valve.
- E. Receiver Tank Orientation: Horizontal, except where vertical tank is indicated.
- F. Enclosure: Steel sheet, lined with acoustic material protected by perforated steel sheet, inlet and outlet air silencers, and finned-cylinder head cover.

## **2.5 RECIPROCATING AIR COMPRESSORS - OIL LESS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Fluid Energy
  - 2. Thomas Industries, Inc.; Pneumotive Division
- B. Description: Tank-mounted, non-lubricated, oilless, reciprocating air compressors, with inlet silencer filter, safety valve, discharge pressure gage, pressure regulator, and shutoff valve, and with sealed, oil-free bearings.

- C. Compressor(s): Oil-less (nonlubricated), reciprocating-piston type, with sealed oil-free bearings, that deliver air of quality equal to intake air.
  - 1. High discharge-air temperature switch.
  - 2. Belt guard totally enclosing pulleys and belts.
- D. Receiver: ASME construction steel tank.
  - 1. Arrangement: **[Horizontal]** **[Vertical]**.
  - 2. Interior Finish: Epoxy or galvanized coating.
  - 3. Pressure Rating: **[125 psig]** **[150 psig]** **[200 psig]** minimum.
  - 4. Drain: **[Automatic]** **[Manual]** valve.
- E. Receiver Tank Orientation: Horizontal, except where vertical tank is indicated.
- F. Enclosure: Steel sheet, lined with acoustic material protected by perforated steel sheet, inlet and outlet air silencers, and finned-cylinder head cover.

## 2.6 ROTARY-SCREW AIR COMPRESSORS - OIL FREE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Atlas Copco Compressors, Inc.
  - 2. Fluid Energy
  - 3. Gardner Denver Machinery, Inc.
- B. Description: Single-stage, heavy-duty, asymmetrical, oil-free, rotary-screw air compressors with non-lubricated air-cooled screws. Include construction that prohibits oil from entering compression chamber.
- C. Compressor(s): Oil-free, rotary-screw type with nonlubricated helical screws and lubricated gear box, and of construction that prohibits oil from entering compression chamber.
  - 1. Bearings: Separate axial and thrust antifriction bearings.
  - 2. Coupling: Nonlubricated, flexible type.
  - 3. Cooling/Lubrication System: Unit-mounted, air-cooled exchanger package prepiped to unit; with air pressure circulation system with coolant stop valve, full-flow coolant filter, and thermal bypass valve.
  - 4. Air Filter: Dry type, with maintenance indicator and cleanable, replaceable filter element.
  - 5. Air/Coolant Receiver and Separation System: 150 psig (1035 kPa) rated steel tank with ASME safety valve, coolant-level gauge, multistage air-coolant separator element, minimum pressure valve, blowdown valve, discharge check valve, coolant stop valve, full-flow coolant filter, and thermal bypass valve.
  - 6. Capacity Control: Capacity modulation between zero and 100 percent air delivery, with operating pressures between 50 and 100 psig. Include necessary control to hold constant pressure. When air demand is zero, unload compressor by using pressure switch and blowdown valve.
- D. Receiver: ASME construction steel tank.
  - 1. Arrangement: **[Horizontal]** **[Vertical]**.
  - 2. Interior Finish: Epoxy or galvanized coating.
  - 3. Pressure Rating: **[125 psig]** **[150 psig]** **[200 psig]** minimum.
  - 4. Drain: **[Automatic]** **[Manual]** valve.
- E. Enclosure: Steel with sound-attenuating material lining.
- F. Description: Single-stage, heavy-duty, asymmetrical, oil-flooded, rotary-screw air compressors with oil-cooled and oil-flooded lubricated screws.

- G. Description: Single-stage, heavy-duty, asymmetrical, water-injected, rotary-screw air compressors with water-cooled and water-flooded non-lubricated screws. Include construction that prohibits oil from entering compression chamber.

## **2.7 ROTARY-SCREW AIR COMPRESSORS - OIL FLOODED**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Gardner Denver Machinery, Inc.
  2. Ingersoll-Rand Company; Rotary-Reciprocating Compressor Division
  3. Universal Air Products Corporation
- B. Description: Single-stage, heavy-duty, asymmetrical, oil-flooded, rotary-screw air compressors with oil-cooled and oil-flooded lubricated screws.
- C. Compressor(s): Oil-flooded, rotary-screw type with lubricated helical screws and lubricated gear box.
1. Coupling: Nonlubricated, flexible type.
  2. Cooling/Lubrication System: Unit-mounted, air-cooled exchanger package prepiped to unit; with air pressure circulation system with coolant stop valve, full-flow coolant filter, and thermal bypass valve.
  3. Air Filter: Dry type, with maintenance indicator and cleanable, replaceable filter element.
  4. Air/Coolant Receiver and Separation System: 150 psig (1035 kPa) rated steel tank with ASME safety valve, coolant-level gauge, multistage air-coolant separator element, minimum pressure valve, blowdown valve, discharge check valve, coolant stop valve, full-flow coolant filter, and thermal bypass valve.
  5. Capacity Control: Capacity modulation between zero and 100 percent air delivery, with operating pressures between 50 and 100 psig. Include necessary control to hold constant pressure. When air demand is zero, unload compressor by using pressure switch and blowdown valve.
- D. Receiver: ASME construction steel tank.
1. Arrangement: **[Horizontal]** **[Vertical]**.
  2. Interior Finish: Epoxy or galvanized coating.
  3. Pressure Rating: **[125 psig]** **[150 psig]** **[200 psig]** minimum.
  4. Drain: **[Automatic]** **[Manual]** valve.
- E. Enclosure: Steel with sound-attenuating material lining.
- F. Description: Single-stage, heavy-duty, asymmetrical, water-injected, rotary-screw air compressors with water-cooled and water-flooded non-lubricated screws. Include construction that prohibits oil from entering compression chamber.

## **2.8 COMPRESSED-AIR AFTERCOOLERS - AIR COOLED**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Hankison International
  2. Ingersoll-Rand Company; Rotary-Reciprocating Compressor Division
  3. Saylor-Beall Manufacturing Company
- B. Description: Electric-motor-driven, fan-operation, finned-tube unit; rated at 250 psig and leak tested at 350 psig minimum air pressure; in capacities indicated. Size units to cool compressed air in compressor-rated capacities to 10 deg F above summertime maximum ambient temperature. Include moisture separator and automatic drain.

- C. Aftercoolers, Water-Cooled: Fixed-bundle, tubular aftercoolers, rated at 250 psig and leak tested at 350 psig minimum air pressure, in capacities indicated. Size units to cool compressed air in compressor-rated capacities to 10 deg F above summertime maximum water temperature.

## **2.9 COMPRESSED-AIR AFTERCOOLERS - WATER COOLED**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Hankison International
  - 2. Ingersoll-Rand Company; Rotary-Reciprocating Compressor Division
  - 3. Saylor-Beall Manufacturing Company
- B. Description: Shell-and-tube unit, rated at 250 psig and leak tested at 350 psig minimum air pressure, in capacities indicated. Include moisture separator and automatic drain. Size units to cool compressed air in compressor-rated capacities to 10 deg F above summertime maximum water temperature.

## **2.10 AIR DRYERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Air Dryers:
    - a. Deltech Engineering, Inc.
    - b. Hankison International
    - c. Ingersoll-Rand Company; Rotary-Reciprocating Compressor Division
- B. Air Dryers, Refrigerated Type: Noncycling, air-cooled, electric-motor-driven unit with steel enclosure and capability to deliver 35 deg F, 100 psig air at dew point. Include automatic ejection of condensate from airstream, step-down transformers, disconnect switches, inlet and outlet pressure gauges, thermometers, automatic controls, and filters. Capacities and with characteristics indicated. Equip with drain connection.
- C. Air Dryers, Deliquescent Type: Single tower, charged with an absorbent desiccant, in capacities and with characteristics indicated. Equip with drain connection.
- D. Air Dryers, Regenerative Type: Twin-tower unit with purge system, mufflers, and capability to deliver plus 10 deg F, 100 psig air at dew point. Include dew point controlled purge, step-down transformers, disconnect switches, inlet and outlet pressure gauges, thermometers, automatic controls, and filters. Charged with an adsorbent desiccant, in capacities and with characteristics indicated. Equip with drain connection.

## **2.11 ACCESSORIES**

- A. General: Include accessories with working-pressure rating not less than system pressure at location where used and compatible with equipment and piping system used.
- B. Intercoolers: Air-cooled, fixed-bundle, tubular intercoolers, rated at 250 psig and leak tested at 350 psig minimum air pressure, in capacities indicated. Size units to cool compressed air in compressor-rated capacities to 10 deg F above summertime maximum ambient temperature.
- C. Intercoolers: Water-cooled, fixed-bundle, tubular intercoolers, rated at 250 psig and leak tested at 350 psig minimum air pressure, in capacities indicated. Size units to cool compressed air in compressor-rated capacities to 10 deg F above summertime maximum water temperature.
- D. Separators: Conical-shaped, centrifugal air-line separators in sizes and capacities indicated. Equip with water-removal trap and drain. Size units for maximum pressure drop through units of 3 psig from air inlet to outlet.

- E. Receivers: ASME stamped; cylindrical, vertical or horizontal installation as indicated; galvanized steel; with safety valves in sizes, working pressures, and temperatures indicated, and with drain connection.

- 1. Pressure Rating: Not less than maximum discharge pressure.

## **2.12 SPECIALTIES**

- A. Safety Valves: ASME Boiler and Pressure Vessel Code, Section VIII, "Pressure Vessels" construction, National Board certified, labeled, and factory sealed; constructed of bronze body with poppet safety valve for compressed-air service.

- 1. Pressure Settings: Higher than discharge pressure and same or lower than receiver pressure rating.

- B. Automatic Drain Valves: Corrosion-resistant metal body and internal parts, rated for 200 psig minimum working pressure, capable of automatic discharge of collected condensate.

- C. Pressure Regulators: Bronze body, direct acting, spring loaded, manual pressure-setting adjustment, and rated for 250 psig inlet pressure, except where otherwise indicated.

- 1. Type: Diaphragm operated.
  - 2. Type: Pilot operated.

- D. Pressure Regulators: Aluminum alloy or plastic body, diaphragm operated, direct acting, spring loaded, manual pressure-setting adjustment, and rated for 250 psig inlet pressure, except where otherwise indicated.

- E. Filters: 2-stage, mechanical-separation type, air-line filters in sizes and ratings indicated. Equip with deflector plates; resin-impregnated-ribbon-type filters with edge filtration, 40 micron thick; and drain cock.

- F. Coalescing Filters: Capacities and types indicated. Equip with activated carbon capable of removing water and oil aerosols, with color-change dye to indicate when carbon is saturated and warning light to indicate when selected maximum pressure drop has been exceeded.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine roughing-in of compressed air piping to verify actual location before air compressor installation.

### **3.2 CONCRETE BASES**

- A. Install concrete bases of dimensions indicated for air compressors and accessories. Refer to Section 03300 "Cast-in-Place Concrete" and Section 15050 "Basic Mechanical Materials and Methods."

### **3.3 EQUIPMENT INSTALLATION**

- A. Equipment Mounting:

- 1. Install air compressors[ **and aftercoolers**] [ **and air dryers**] [, **aftercoolers, and air dryers**] on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Division 03 Section "Cast-in-Place Concrete."
  - 2. Install [ **water-cooled, compressed-air aftercoolers**] [ **and**] [ **desiccant compressed-air dryers**] on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Division 03 Section "Cast-in-Place Concrete."

3. Comply with requirements for vibration isolation devices specified in Division 22 Section "Vibration Controls for Plumbing Piping and Equipment."
- B. Installation of Equipment: Comply with ASME B19.1 or ASME B19.3 as appropriate.
- C. Anchor air compressors, receivers, and other equipment to substrate.
- D. Support air compressors using the following vibration-control devices, unless otherwise indicated. Refer to Section 15071 "Vibration Control."
  1. Install tank-mounted compressors, 5 hp or less, with spring isolators.
  2. Install tank-mounted compressors, more than 5 hp, with concrete inertia base and spring isolators.
  3. Install base-mounted compressors with concrete inertia base and spring isolators.
  4. Install other rotating equipment with spring isolators.
- E. Arrange equipment so controls and devices are accessible for servicing.
- F. Install accessories and specialties as indicated. Set and connect units according to manufacturers' written instructions. Install units plumb, level, and firmly anchored in locations indicated. Maintain manufacturers' recommended clearances. Orient so controls needing service are accessible.

### **3.4 CONNECTIONS**

- A. Install piping next to equipment and accessories to allow service and maintenance.
- B. Connect air piping to equipment and accessories with unions and shutoff valves. Install with strainers where indicated.
  1. Install thermometers on compressor discharge piping, on receiver tanks, and where indicated.
  2. Install pressure gages on compressor discharge piping, on receiver tanks, and where indicated.
- C. Connect water piping to air-compressor water jacket, intercooler, and aftercooler units with union and reduced-pressure-zone-type backflow-preventer assembly having strainer, gate valves, and air gap fitting for indirect waste. Connect each unit with separate drain with union and shutoff valve, and discharge over closest floor drain.
- D. Install safety valves in receiver tanks, in quantity and size to relieve capacity not less than that of connected compressor.
- E. Install automatic drain valves on intercoolers, aftercoolers, separators, receivers, dryers, and other locations indicated. Discharge condensate over nearest floor drain.
- F. Install accessories as indicated.
- G. Ground equipment.
  1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- H. Arrange for electric-power connections to equipment that requires power. Electric power, wiring, and disconnect switches are specified in Division 16 Sections.

### **3.5 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Provide services of a factory-authorized service representative to supervise the field assembly of components and installation of equipment, including piping and electrical connections, and to report results in writing.
- B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

### **3.6 COMMISSIONING**

- A. Perform the following final checks before startup:
  - 1. Verify that specified tests of piping systems are completed.
  - 2. Check that direct potable-water supply connections to equipment have correct type backflow preventer in water supply.
  - 3. Check for piping connection leaks.
  - 4. Check for lubricating oil in lubricated-type equipment.
  - 5. Check V belts for proper tension.
  - 6. Check that compressor inlet filters and piping are clear.
  - 7. Check for equipment vibration-control supports and flexible pipe connectors and that equipment is properly attached to substrate.
  - 8. Check safety valves for correct settings. Ensure settings are greater than air-compressor discharge pressure, but not greater than rating of system components.
  - 9. Check for proper seismic restraints.
  - 10. Test operation of equipment safety controls and devices.
  - 11. Drain receiver tanks.
  - 12. Check for adequate room ventilation.
- B. Starting Procedures: Follow manufacturer's written instructions. If no instructions are prescribed by manufacturer, proceed as follows:
  - 1. Energize circuits.
  - 2. Start and run equipment through complete sequence of operations.
  - 3. Check for excessive vibration and noise. Correct problems.
  - 4. Check air pressures.
  - 5. Manually operate safety valves.
  - 6. Adjust operating controls, including pressure settings.
- C. Operate and adjust operating and safety controls. Replace damaged and malfunctioning controls and equipment discovered by service representative.

### **3.7 DEMONSTRATION**

- A. Startup Services: Engage a factory-authorized service representative to perform startup services and to demonstrate and train Owner's maintenance personnel as specified below.
  - 1. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
  - 2. Review data in the operation and maintenance manuals. Refer to Section 01770 "Closeout Procedures."
  - 3. Review data in the operation and maintenance manuals. Refer to Section 01782 "Operation and Maintenance Data."
  - 4. Schedule training with Owner with at least 7 days' advance notice.

**END OF SECTION 22 1519**

## **SECTION 22 3300 - ELECTRIC DOMESTIC WATER HEATERS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. This Section includes the following for domestic water systems:

- 1. Commercial, electric water heaters
- 2. Expansion tanks
- 3. Accessories

#### **1.3 SUBMITTALS**

- A. Product Data: For each type and size of water heater. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.
- B. Shop Drawings: Detail water heater assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 1. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
- C. Product Certificates: Signed by manufacturers of water heaters certifying that products furnished comply with requirements.
- D. Maintenance Data: For water heaters to include in maintenance manuals specified in Division 1.
- E. Warranties: Special warranties specified in this Section.

#### **1.4 QUALITY ASSURANCE**

- A. Source Limitations: Obtain same type of water heaters through one source from a single manufacturer.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of water heaters and are based on specific units indicated. Other manufacturers' products complying with requirements may be considered. Refer to Division 1 Section "Substitutions."
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. ASME Compliance: Fabricate and label water heater, hot-water storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," Division 1.
- E. ASHRAE Standards: Comply with performance efficiencies prescribed for the following:
  - 1. ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings," for commercial water heaters.



## **1.5 WARRANTY**

- A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Special Warranty: Written warranty, executed by manufacturer agreeing to repair or replace components of water heaters that fail in materials or workmanship within specified warranty period.
  - 1. Failures include heating elements and storage tanks.
  - 2. Warranty Period: From date of Substantial Completion:
    - a. Heating Elements: Three (3) years.
    - b. Storage Tanks: Three (3) years.

## **PART 2 - PRODUCTS**

### **2.1 POINT-OF-USE (1-6 GALLON), STORAGE, ELECTRIC WATER HEATERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Commercial, Storage, Electric Water Heaters:
    - a. A.O. Smith
    - b. Bradford White
    - c. Bock
    - d. Eemax
    - e. Lochinvar
    - f. Rheem
    - g. State Water Heaters
- B. Description: Comply with UL 174 and NSF 372.
- C. Storage Tank Construction: Unit shall be enameled glass lined with single weld design. Water connections and supplied temperature and pressure valve to be located on top of the unit. Unit shall have a status indicator light with adjustable thermostat.
- D. Heating Elements: Immersion type.
  - 1. Temperature Control: Adjustable thermostat for each element with wiring arrangement for simultaneous operation.
  - 2. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.

### **2.2 EXPANSION TANKS**

- A. Description: ASME-code steel, pressure-rated tank constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
- B. Construction: 150 psig working-pressure rating.
- C. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1, pipe thread.
- D. Tank Interior Finish: Materials and thicknesses complying with NSF 61, barrier materials for potable-water tank linings. Extend finish into and through tank fittings and outlets.

E. Tank Exterior Finish: Manufacturer's standard, unless finish is indicated.

F. Air-Charging Valve: Factory installed.

### **2.3 WATER HEATER ACCESSORIES**

A. Combination Temperature and Pressure Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3. Include relieving capacity at least as great as heat input and include pressure setting less than water heater working-pressure rating. Select relief valve with sensing element that extends into tank.

1. Option: Separate temperature and pressure relief valves are acceptable instead of combination relief valve.

B. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE 90.1 or ASHRAE 90.2.

C. Drain Pans: Corrosion-resistant metal with raised edge. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than NPS 3/4 with ASME B1.20.1 pipe threads.

D. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.

E. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester.

F. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.

## **PART 3 - EXECUTION**

### **3.1 WATER HEATER INSTALLATION**

A. Install commercial water heaters on concrete bases.

1. Exception: Omit concrete bases for commercial water heaters if installation on stand, bracket, suspended platform, or direct on floor is indicated.

B. Install water heaters, level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

C. Anchor water heaters to substrate.

D. Install vacuum relief valves in cold-water-inlet piping.

E. Install temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend relief valve outlet with water piping in continuous downward pitch and discharge onto closest floor drain.

F. Install water heater drain piping as indirect waste to spill into open drains or over floor drains. Install hose-end drain valves at low points in water piping for water heaters that do not have tank drains. Refer to Division 22 Section "Plumbing Specialties" for drain valves.

G. Install thermometers on water heater outlet piping. Refer to Division 20 Section "Meters and Gages for Piping" for thermometers.

H. Install pressure gages on water heater piping. Refer to Division 20 Section "Meters and Gages for Piping" for pressure gages.

- I. Arrange for insulation on equipment and piping not furnished with factory-applied insulation.
- J. Install piping-type heat traps on inlet and outlet piping of water heater storage tanks without integral or fitting-type heat traps.
- K. Fill water heaters with water.
- L. Charge expansion tanks with air to required system pressure.

### **3.2 CONNECTIONS**

- A. Piping installation requirements are specified in other Division 20, 22, and 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Connect hot- and cold-water piping with shutoff valves and unions. Connect hot-water-circulating piping with shutoff valve, check valve, and union.
- D. Make connections with dielectric fittings where piping is made of dissimilar metal.
- E. Electrical Connections: Power wiring and disconnect switches are specified in Division 26 Sections. Arrange wiring to allow unit service.
- F. Ground equipment.
  - 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

### **3.3 FIELD QUALITY CONTROL**

- A. Engage a factory-authorized service representative to perform startup service.
- B. In addition to manufacturer's written installation and startup checks, perform the following:
  - 1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  - 2. Verify that piping system tests are complete.
  - 3. Check for piping connection leaks.
  - 4. Check for clear relief valve inlets, outlets, and drain piping.
  - 5. Check operation of circulators.
  - 6. Test operation of safety controls, relief valves, and devices.
  - 7. Energize electric circuits.
  - 8. Adjust operating controls.
  - 9. Adjust hot-water-outlet temperature settings. Do not set above 140 deg F unless piping system application requires higher temperature.
  - 10. Balance water flow through manifolds of multiple-unit installations.

### **3.4 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water heaters.
  - 1. Train Owner's maintenance personnel on procedures for starting and stopping, troubleshooting, servicing, and maintaining equipment.
  - 2. Review data in maintenance manuals. Refer to Division 01 Section "Contract Closeout."

3. Review data in maintenance manuals. Refer to Division 01 Section "Operation and Maintenance Data."
4. Schedule training with Owner, through Architect, with at least seven days' advance notice.

**END OF SECTION 22 3300**

## **SECTION 22 4000 - PLUMBING FIXTURES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. This Section includes the following plumbing fixtures and related components.

1. Fixture Supports
2. Thermostatic Mixing Valves (Hand Washing and High/Low Valve)
3. Protective Shielding Guards
4. Lavatory Faucets
5. Lavatories
6. Sink Faucets
7. Sinks
8. Water Closet Flushometers
9. Toilet Seats
10. Water Closets
11. Service Sink Faucets
12. Service Sinks
13. Electric Water Coolers
14. Garbage Disposer
15. Insulation of Fixtures Supplied by Others for Casework

#### **1.3 DEFINITIONS**

- A. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- B. Fitting: Device that controls flow of water into or out of plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, showerheads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.

#### **1.4 SUBMITTALS**

- A. Product Data: Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports and indicate materials and finishes, dimensions, construction details, and flow-control rates for each type of fixture indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring.
- C. Maintenance Data: For plumbing fixtures to include in maintenance manuals specified in Division 1.

#### **1.5 QUALITY ASSURANCE**

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
  1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; about plumbing fixtures for people with disabilities.
- D. Regulatory Requirements: Comply with requirements in U.S. Architectural & Transportation Barriers Compliance Board's "Uniform Federal Accessibility Standards (UFAS), 1985-494-187" about plumbing fixtures for people with disabilities.
- E. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- F. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- G. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- H. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
  - 1. Enameled, Cast Iron Fixtures: ASME A112.19.1M.
  - 2. Hand Sinks: NSF 2 construction.
  - 3. Plastic Mop-Service Basins: ANSI Z124.6.
  - 4. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
  - 5. Vitreous-China Fixtures: ASME A112.19.2M.
  - 6. Water Closet, Flushometer: ASSE 1037, ANSI/ASME 112.19.6.
  - 7. Water Closet, Flushometer Tank Trim: ASSE 1037.
- I. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
  - 1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
  - 2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
  - 3. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
  - 4. Faucet Hose: ASTM D 3901.
  - 5. Faucets: ASME A112.18.1M.
  - 6. Hose-Connection Vacuum Breakers: ASSE 1011.
  - 7. Hose-Coupling Threads: ASME B1.20.7.
  - 8. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
  - 9. NSF Materials: NSF 61.
  - 10. Pipe Threads: ASME B1.20.1.
  - 11. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
  - 12. Supply and Drain Fittings: ASME A112.18.1M.
- J. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
  - 1. Atmospheric Vacuum Breakers: ASSE 1001.
  - 2. Brass and Copper Supplies: ASME A112.18.1M.
  - 3. Manual-Operation Flushometers: ASSE 1037.
  - 4. Tubular Brass Drainage Fittings and Piping: ASME A112.18.1M.
- K. Comply with the following applicable standards and other requirements specified for miscellaneous components:
  - 1. Disposers: ASSE 1008 and UL 430.

2. Hose-Coupling Threads: ASME B1.20.7.
3. Off-Floor Fixture Supports: ASME A112.6.1M.
4. Pipe Threads: ASME B1.20.1.
5. Plastic Toilet Seats: ANSI Z124.5.
6. Supply and Drain Protective Shielding Guards: ICC A117.1.

- L. Reference Standards: Products in this section shall be built, tested, and installed in compliance with the Michigan Plumbing Code and the following quality assurance standards; latest editions, unless noted otherwise.

1. National Sanitation Foundation NSF/ANSI-61 (potable drinking water) and NSF-61 Annex G (listed as  $\leq 0.25\%$  weighted average lead content) (and/or NSF/ANSI-372) and Annex F.
2. U.S Safe Drinking Water Act.
3. ANSI Z358.1 Standard for Emergency Eyewash and Shower Equipment
4. ADA Standard for Accessible Design
5. ICC A117.1 Accessible and usable Building and Facilities

## **1.6 COORDINATION**

- A. Coordinate roughing-in and final plumbing fixture locations and verify that fixtures can be installed to comply with original design and referenced standards.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. For fixture descriptions in other Part 2 articles where the subparagraph titles "Products," and "Manufacturers" introduce a list of manufacturers and their products or manufacturers only, the following requirements apply for product selection:
1. Products: Subject to compliance with requirements, provide one of the products specified in other Part 2 articles.
  2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified in other Part 2 articles.

### **2.2 FIXTURE SUPPORTS**

- A. Wall Hung Water-Closet Support WCS-1: Water-closet combination carrier designed for accessible mounting height. Include single or double, vertical or horizontal, hubless waste fitting as required for piping arrangement; faceplates; couplings with gaskets; feet; and fixture bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.
1. Manufacturers:
    - a. Zurn
    - b. Josam
    - c. Tyler Pipe, Wade Division
    - d. J. R. Smith
    - e. MI-Fab

### **2.3 THERMOSTATIC MIXING VALVE - HAND WASHING FACILITIES**

- A. Provide a thermostatic mixing valve at all sinks and public lavatories including at accessible plumbing fixtures.
1. At other locations identified in the Michigan Plumbing Code, provide individual water temperature limiting devices (thermostatic mixing valves) to individual fixtures.

B. Provide mixing valves based on the following selection criteria:

1. Mixing valve serving a single fixture: Valve pressure drop shall not exceed 5 psi at 1 GPM flow rate.
2. Mixing valves serving sink faucets (all types, including service sinks), valve pressure drop shall not exceed 5 psi at 4 GPM flow rate.

C. Mixing valve specification:

1. Manually adjustable thermostatically controlled domestic water tempering valve.
2. ASSE 1070 listed to control down to 0.5 GPM flow rate.
3. All bronze or brass body, rough finish, chrome plated if exposed. Brass and stainless steel internal components.
4. Chloramine resistant seals.
5. Integral check valves and stainless steel strainers (screens) in hot and cold water inlet connections.
6. Tamper resistant temperature adjustment handle.
7. Union with male or female NPT connections, or compression fittings.
8. Valves shall operate properly:
  - a. At supply pressures between 20 PSIG and 125 PSIG.
  - b. With up to 20 percent pressure differential between hot and cold water supplies.
9. Outlet temperature shall be adjustable to within 10 deg. F of inlet hot water temperature.
10. Hot inlet operating range: 140 deg. F.
11. Lower temperature adjustment range: not more than 95 deg. F.
12. Upper temperature adjustment range: not more than 140 deg. F.
13. Provide a second set of check valves on the hot and cold water inlet connections in addition to the integral check valves.

D. Acceptable manufacturers and models:

1. Powers Hydroguard, Series LFLM495.
2. Symmons Maxline.
3. Wilkins Aqua-Gard.

## 2.4 THERMOSTATIC HIGH-LOW WATER MIXING VALVE

A. Manufacturers:

1. Powers, Hydroguard XP Series LFMM430
2. Symmons
3. Wilkins
4. Acorn Controls

B. General (TMV-1): Certified ASSE 1017, NSF/ANSI 61 and CSA B125.3 standards, manually adjustable, thermostatic water mixing valve assembly with both high-flow and low-flow mixing valves with bronze or brass body. Include check stops and unions on hot- and cold-water-supply inlets, adjustable temperature setting, and thermometer. Lead-free product.

1. Type: Bimetal thermostat, operation and pressure rating 125 PSIG minimum.
2. Type: Liquid-filled motor, operation and pressure rating 100 PSIG minimum.

C. Mixing valve specification:

1. Manually adjustable thermostatically controlled domestic water tempering valve.
2. ASSE 1017 listed to control down to 1.0 GPM flow rate.
3. All bronze or brass body, rough finish, chrome plated if exposed. Brass and stainless steel internal components.



4. Chloramine resistant seals.
5. Integral check valves and stainless steel strainers (screens) in hot and cold water inlet connections.
6. Tamper resistant temperature adjustment handle.
7. Union with male or female NPT connections, or compression fittings.
8. Valves shall operate properly:
  - a. At supply pressures between 20 PSIG and 125 PSIG.
  - b. With up to 20 percent pressure differential between hot and cold water supplies.
9. Outlet temperature shall be adjustable to within 10 deg. F of inlet hot water temperature.
10. Hot inlet operating range: 140 deg. F.
11. Lower temperature adjustment range: not more than 95 deg. F.
12. Upper temperature adjustment range: not more than 140 deg. F.

## **2.5 PROTECTIVE SHIELDING GUARDS**

- A. Protective Shielding Guard, Barrier Free/BF PSG-1: Manufactured, plastic covering for hot- and cold-water supplies and trap and drain piping and complying with ADA requirements and ASTM E84.
  1. Manufacturers:
    - a. IPS Corporation TrueBro "LavGuard"
    - b. Zurn

## **2.6 LAVATORY FAUCETS**

- A. Lavatory Faucet, LF-1 (Two Handled Manual, 4" Centers): Polished chrome plated brass valves, spout and handles. Deck mounted gooseneck spout with two-handle wrist blade control. ADA compliant. With trim.
  1. Faucet, supplies, and stops shall be NSF/ANSI-61-G listed as  $\leq 0.25\%$  weighted average lead content.
  2. Faucet shall not discharge directly over fixture drain strainer.
  3. Center of body to center of spout: 6" minimum.
  4. Lever style handles, with hot and cold color indicators and vandal resistant mounting screws.
  5. 4" rigid valve body centers (flexible tubing connections between valves and spout not allowed).
  6. 1.5 GPM laminar flow control in base of gooseneck spout.
  7. Heavy duty 6" gooseneck with smooth end (no threads or means to attach an aerator).
  8. Ceramic disc valve cartridges.
  9. Trim: Chrome plated brass flat grid strainer. Rigid supplies with metal handled stops, tailpiece, P-trap with clean-out, waste to wall, escutcheons; all chrome plated brass. Where concealed, trim under sinks may be unplated brass stops, plastic or rough brass supply tubes, PVC trap, and rough brass escutcheons.
  10. Acceptable manufacturers and models:
    - a. American Standard "Monterrey"
    - b. Delta
    - c. Moen
    - d. Chicago Faucets

## **2.7 LAVATORIES**

- A. Lavatories, LAV-1: Wall hanging, enameled, vitreous-china fixture.
  1. Manufacturers:
    - a. Kohler Company "Kingston", model K-2005
    - b. American Standard, Inc.

- c. Crane Plumbing/Fiat Products
  - d. U.S. Industries, Eljer Plumbingware Division
  - e. Mansfield Plumbing Products LLC
  - f. Sloan
- 2. Type: With back.
  - 3. Size: 21 x 18.
  - 4. Faucet Hole Punching: Three, 4-inch centers, hole(s).
  - 5. Faucet Hole Location: Top.
  - 6. Color: White.
  - 7. Faucet:
  - 8. Supplies: NPS 3/8 chrome-plated copper with stops.
  - 9. Drain: Fixed grid strainer.
  - 10. Drain Piping: NPS 1-1/4 by NPS 1-1/2 chrome-plated cast-brass trap; 0.032-inch-thick tubular brass waste to wall; and wall escutcheon.
  - 11. Fixture Support: Concealed arms.
  - 12. Mixing Valve: Water mixing valve, ASSE 1070.

## 2.8 SINK FAUCETS

- A. Sink Faucet, SF-1: Gooseneck, deck mount two handle (wrist blade) mixing with hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes and outlet with spout and fixture receptor.

- 1. Manufacturers:
  - a. Chicago Faucets
  - b. Delta
  - c. Elkay
  - d. Kohler
  - e. Just Manufacturing Company, model JGN-4-W4
  - f. Moen
  - g. Sloan
- 2. Maximum Flow Rate: 2.5 gpm, unless otherwise indicated.
- 3. Body Material: Cast brass.
- 4. Finish: Polished chrome plate.
- 5. Type: Two-handle mixing.
- 6. Centers: 4 inches.
- 7. Mounting: Deck, exposed.
- 8. Handle: Wrist blade, 4 inches.
- 9. Inlet(s): NPS 3/8 tubing, with NPS 1/2 male adaptor.
- 10. Spout: Fixed gooseneck.
- 11. Spout Outlet: Plain end.
- 12. ASSE 1070 mixing valve.

- B. Sink Faucet, SF-2: Gooseneck, Concealed mount two handle (wrist blade) mixing with hot and cold-water indicators; coordinate faucet inlets with supplies and fixture holes and outlet with spout and fixture receptor.

- 1. Manufacturers:
  - a. American Standard
  - b. Delta
  - c. Chicago Faucets
  - d. Elkay
  - e. Just Manufacturing Company, model JWF-200R70-W4
  - f. Moen

2. Maximum Flow Rate: 2.2 gpm, unless otherwise indicated.
3. Body Material: Copper or brass underbody with brass cover plate.
4. Finish: Polished chrome plate.
5. Type: Single compartment sink without spray.
6. Mixing Valve: Two-lever handle.
7. Backflow Protection Device for Hose Outlet: Not required.
8. Backflow Protection Device for Side Spray: Not required.
9. Centers: 8 inches.
10. Mounting: Concealed mount.
11. Handle(s): Wrist blade, 4 inches.
12. Spout: 70° restricted 10" high swing spout with aerator gooseneck.
13. Spout Outlet: Aerator.
14. Vacuum Breaker: Not required.
15. ASSE 1070 mixing valve.

## 2.9 SINKS

- A. Sink, SK-1: Drop-in, counter-mounting, self-rimming, three hole, seamless, "satin" finish, AISI Type 304 stainless steel, 18 gage. Coat underside with sound deadening non-marring mastic.
1. Manufacturers:
    - a. Kohler
    - b. Elkay
    - c. Just Manufacturing Company, model SL-1921-A-GR
    - d. American Standard
  2. Type: Self-rimming.
  3. Overall Rectangular Size: 22 x 19-1/2 overall, 18 x 14 x 7-1/2 deep inside bowl.
  4. Faucet Hole Punching: Four, 4 inch centers, holes.
  5. Faucet: SF-1
  6. Supplies: NPS 3/8 chrome-plated brass with stops.
  7. Drain: Fixed grid strainer.
  8. Drain Piping: NPS 1-1/4 by NPS 1-1/2 chrome-plated cast-brass trap; NPS 1-1/2, 0.045-inch thick tubular brass waste to wall; and wall escutcheon.
  9. Waste Disposal Unit: GD-1.
  10. ASSE 1070.
- B. Sinks, SK-2: Wall mounted, stainless steel fixture, "satin" finish, AISI Type 304 stainless steel, 18 gage. Coat underside with sound deadening non-marring mastic.
1. Manufacturers:
    - a. Elkay Manufacturing Company
    - b. Just Manufacturing Company
    - c. Kohler Company
    - d. American Standard, Inc.
  2. Overall Size: 21 x 18 x 30.
  3. Number of Compartments: One.
  4. Sink Faucet: SF-2.
  5. Supplies: NPS 1-1/2 chrome-plated copper with stops.
  6. Drain Piping: NPS 1-1/2 chrome-plated cast-brass trap, 0.045 inch thick tubular brass waste to wall, continuous waste, and wall escutcheons.
  7. ASSE 1070 mixing valve.

## **2.10 WATER CLOSET FLUSH VALVES**

- A. Flushometer, WC-FLV-1: Manual, dual flush valve. Chrome plated, exposed, diaphragm type, water closet flushometer. ASTM classified as semi-red brass alloy. Chloramine resistant synthetic rubber diaphragms/seals. With 1-1/2 inch top spud, escutcheons, seat bumper, integral screwdriver stop and vacuum breaker. ADA compliant.
1. Lifting Handle up initiates reduced flush 1.1 gpf eliminating liquid waste. Pushing handle down initiates full flush of 1.6 gpf eliminating all waste.
  2. Provide metal wall plate etched with flushing instructions.
  3. With flush valve manufacturers chrome plated split ring wall pipe support accessory.
  4. Acceptable Manufacturers and Models:
    - a. Sloan "UpperCut".
    - b. Zurn "AquaVantage".

## **2.11 TOILET SEATS**

- A. Toilet Seat, TS-1 (white) Solid plastic, with extended back with STA-TITE commercial fastening system.
1. Manufacturers:
    - a. Beneke
    - b. Church
    - c. Bemis
    - d. Sperzel
    - e. Kohler
    - f. Centoco
  2. Configuration: Open front without cover.
  3. Size: Elongated.
  4. Class: Heavy-duty commercial.
  5. Hinge Type: CC/SC, self-sustaining, check with STA-TITE commercial fastening system.
  6. Color: White.

## **2.12 WATER CLOSETS – STANDARD AND BARRIER FREE**

- A. Water Closets, WC-1: Wall mounted, back-outlet, vitreous-china fixture designed for flushometer valve operation.
1. Manufacturers:
    - a. American Standard, Inc. "Afwall"
    - b. Crane Plumbing/Fiat Products
    - c. Kohler Company "Kingston", model no. K-4325
    - d. Sloan
  2. Style: Close coupled.
  3. Bowl Type: Elongated with siphon-jet design. Include bolt caps matching fixture.
  4. Height: Standard, barrier free accessible.
  5. Design Consumption: 1.1 - 1.6 gal. /flush.
  6. Color: White.
  7. Supply: NPS 11/2 chrome-plated brass or copper with loose-key stop.
  8. Flushometer: WCFV-1.
  9. Fixture Support: WCS-1
  10. Toilet Seat: WCS-1.

## **2.13 SERVICE SINK FAUCETS**

- A. Sink Faucet, SS-1: Wall mounted with hot- and cold-water indicators. Coordinate faucet inlets with supplies and fixture holes and outlet with spout and fixture receptor.
1. Manufacturers:
    - a. Just Manufacturing Company
    - b. American Standard, model 8354
    - c. Chicago Faucet
    - d. Speakman
    - e. T & S Brass
    - f. Kohler
    - g. Zurn
    - h. Sloan
    - i. Moen
  2. Maximum Flow Rate @ 60 psi: 2.2 gpm, unless otherwise indicated.
  3. Body Material: Cast brass.
  4. Finish: Polished chrome plate.
  5. Type: Service sink faucet with stops in shanks, vacuum breaker, hose-thread outlet, and pail hook.
  6. Mixing Valve: Two-lever handle.
  7. Centers: 8 inches.
  8. Mounting: Back/wall, concealed with wall support.
  9. Handles: Wrist blade, 4 inches.
  10. Inlets: NPS 1/2 male shank.
  11. Spout: Rigid, cast with wall brace.
  12. Spout Outlet: 5/8" diameter hose, 5 feet long with clamp.
  13. Vacuum Breaker: Required.
  14. Drain: Stopper with chain.
  15. Tempering Device: Not required.

## **2.14 SERVICE SINKS**

- A. Service Sinks, SS-1: Flush-to-wall, floor-mounting molded resin basin with integral drain connection rim guards.
1. Manufacturers:
    - a. The Swan Corporation
    - b. E. L. Mustee and Sons, model 63M
  2. Shape: Square.
  3. Size: 24 x 24 x 10 with dropped front.
  4. Rim Guard: Yes.
  5. Color: Standard, Owner selected.
  6. Faucet: SS-1 faucet.
  7. Drain: Grid with NPS 3 outlet.

## **2.15 ELECTRIC WATER COOLER (FILTERED)**

- A. Electric Water Cooler, EWC-1 (two-level, surface mount, bottle filler): Certified to NSF/ANSI 61-G. Two-level surface mounted units; one mounted high and one mounted at ADA height. Each unit shall deliver a minimum of 8 gph of water at 50 °F, cooled from 80 °F. Each unit shall have front mounted push pads requiring less than 5 pounds force to active water flow. Units shall include automatic stream regulator, elevated anti-squirt bubbler with stream guard and 1-1/4" tail piece. R-134a refrigeration system shall be hermetically sealed with integral air-cooled condenser. Top shall be stainless steel with integral strainer.

Skirts shall be stainless steel. Unit shall be 115V, 1 phase with cord. Upper unit shall have a bottle filling station including touchless electronic sensor and visual user interface display with saved bottle counter. Replaceable NSF-42 and NSF-53 certified filter with life of 1500 gallons or one year. Filter will have quick-disconnect fittings and inlet shut-off valve.

1. Manufacturer:
  - a. Elkay, model LZSTL8WSSK
  - b. Halsey-Taylor
  - c. Haws
  - d. Oasis International

## **2.16 SPECIAL PLUMBING FIXTURES**

- A. Garbage Disposal GD-1: Corrosion proof polymer or stainless steel hopper and grinding chamber. Compact shell, 14 in. maximum overall height. Sound insulated. Stainless steel grind ring, swivel impellers, and turntable. Motor: 3/4 HP, 120V single phase permanently lubricated. Built-in overload protection with manual reset. Stainless steel 3-bolt sink flange connection, stainless steel stopper, and dishwasher drain connection. For operation with wall switch (continuous feed). Provide with cord and plug.

1. Manufacturers:
  - a. In-Sink-Erator, Evolution "Compact"
  - b. Waste King Legend 9940

- B. Non-freeze Concealed-Outlet Wall Hydrants, WH-1: ASSE 1019, self-drainable with flush-mounting box with cover, integral non-removable hose connection vacuum breaker, casing and operating rod to match wall thickness, concealed outlet and wall clamp.

1. Classification: Type A, for automatic draining with hose removed or Type B, for automatic draining with hose removed or with hose attached and nozzle closed.
2. Box and Cover Finish: Polished bronze.
3. Manufacturers:
  - a. Zurn Industries, Inc., Jonespec Division
  - b. Zurn Industries, Inc.; Specification Drainage Operation
  - c. Woodford Manufacturing Company
  - d. Chicago
  - e. Jay R. Smith Manufacturing Company, model no. 5519

4. General: ASME A112.21.3M, key operation hydrant with pressure rating of 125 psig.

- a. Inlet: NPS 3/4 or NPS 1 threaded or solder joint.
- b. Outlet: ASME B1.20.7, garden hose threads.
- c. Operating Keys: One with each key operation hydrant.

- C. Hose Bibbs, HB-1: Bronze body with replaceable seat disc complying with ASME A112.18.1M for compression-type faucets. Include NPS 3/4 threaded joint inlet, of design suitable for pressure of at least 125 psig; integral, nonremovable, drainable hose-connection vacuum breaker; and garden-hose threads complying with ASME B1.20.7 on outlet.

1. Finish for Equipment Rooms: Rough bronze.
2. Operation for Equipment Rooms: Wheel handle.
3. Include integral wall flange with each chrome- or nickel-plated hose bibb.

- 4. Manufacturers:
  - a. Woodford
  - b. Zurn
  - c. Chicago
  - d. J. R. Smith

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine roughing-in for water soil and for waste piping systems and supports to verify actual locations and sizes of piping connections and that locations and types of supports match those indicated, before plumbing fixture installation. Use manufacturer's roughing-in data if roughing-in data are not indicated.
- B. Examine walls, floors, and cabinets for suitable conditions where fixtures are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 FIXTURE INSTALLATION**

- A. Assemble fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. Install water-less urinals per manufacturer's requirements.
- C. For wall-hanging fixtures, install off-floor supports affixed to building substrate.
  - 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
  - 2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
  - 3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- D. Install back-outlet, wall hanging fixtures onto waste fitting seals and attach to supports.
- E. Install wall-hanging fixtures with tubular waste piping attached to supports.
- F. Install counter-mounting fixtures in and attached to casework.
- G. Install fixtures level and plumb according to manufacturers' written instructions and roughing-in drawings.
- H. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
  - 1. Exception: Use ball, gate, or globe valve if stops are not specified with fixture. Refer to Section 15110 "Valves" for general-duty valves.
- I. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- J. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- K. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.
- L. Install toilet seats on water closets.

- M. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- N. Install traps on fixture outlets.
  - 1. Exception: Omit trap on fixtures with integral traps.
  - 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
- O. Install disposer in outlet of sinks indicated to have disposer.
- P. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Refer to Section 15050 "Basic Mechanical Materials and Methods" for escutcheons.
- Q. Set service basins in leveling bed of cement grout. Refer to Section 15050 "Basic Mechanical Materials and Methods" for grout.
- R. Seal joints between fixtures and walls, floors, and counters using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Refer to Section 07920 "Joint Sealants" for sealant and installation requirements.

### **3.3 INSTALLATION OF WATER CLOSETS– STANDARD AND BARRIER FREE**

- A. Mounting Heights:
  - 1. Water Closets – Standard: 15" to 17" from top of toilet seat to finished floor.
  - 2. Water Closets – Barrier Free: 18" from top of toilet seat to finished floor.
  - 3. Electric Water Cooler – Barrier Free: 36" maximum rim height, 27" minimum knee clearance.
- B. Flush Valve: Mount flush valve handle on wide side of stall/room. At every dual flush valve, sign shall be mounted over the center line of the flush valve and screwed to the wall in each corner.
- C. Anti-ligature Flush Valves shall be mounted behind wall surface with proper access.
- D. Install the electric eye plate, flush with the wall as recommended per the manufacturer's installation directions. Mount the dual flush sign to the wall utilizing wall anchors and screws.

### **3.4 INSTALLATION OF LAVATORIES/SINKS - STANDARD AND BARRIER FREE**

- A. General: Unless otherwise noted on drawings, locate lavatory in compliance with ADA requirements.
- B. Countertop: Coordinate with architectural trades.
- C. Wall Hung: Conceal lavatory fixture support arms with deep drawn secure escutcheons. Securely bolt and anchor supports to the supporting surfaces.
- D. Install a water tempering valve for each lavatory, kitchen hand sink and sink faucet. Provide a second set of check valves on the hot and cold water inlet connections in addition to the integral check valves



### 3.5 INSTALLATION OF PLUMBING FIXTURES

- A. Individual water line branches, waste lines, vents and traps for connection to individual fixtures, fixture fittings and specialties shall be per the following schedule or as indicated on drawings, whichever is greater (sizes are given in inches).

<u>Item</u>	<u>Waste</u>	<u>Vent</u>	<u>Trap</u>	<u>Cold</u>	<u>Hot</u>
Urinal	2	1-1/2	--	3/4	--
Water Closet	4	2	--	1-1/4	--
Lavatory	1-1/2	1-1/2	1-1/4	1/2	1/2
Sink	1-1/2	1-1/2	1-1/2	1/2	1/2
Janitor/Service Sink	3	1-1/2	3	1/2	1/2
Electric Water Cooler/Drinking Fountain	1-1/4	1-1/4	1-1/4	1/2	--
Shower (Stall)	2	1-1/2	--	1/2	1/2
Wall Hydrant (Shower Rooms)	--	--	--	3/4	3/4
Wall Hydrant	--	---	--	3/4	--
Hose Bib	--	---	--	3/4	--

### 3.6 CONNECTIONS

- A. Piping installation requirements are specified in other Specification Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect water supplies from water distribution piping to fixtures.
- C. Connect drain piping from fixtures to drainage piping.
- D. Supply and Waste Connections to Plumbing Fixtures: Connect fixtures with water supplies, stops, risers, traps, and waste piping. Use size fittings required to match fixtures. Connect to plumbing piping.
- E. Supply and Waste Connections to Fixtures and Equipment Specified in Other Sections: Connect fixtures and equipment with water supplies, stops, risers, traps, and waste piping specified. Use size fittings required to match fixtures and equipment. Connect to plumbing piping.
- F. Ground equipment.
1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

### 3.7 FIELD QUALITY CONTROL

- A. Verify that installed fixtures are categories and types specified for locations where installed.
- B. Check that fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

### 3.8 ADJUSTING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

- B. Operate and adjust disposers. Replace damaged and malfunctioning units.
- C. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.
- D. Replace washers and seals of leaking and dripping faucets and stops.

**3.9 CLEANING**

- A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
  - 1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
  - 2. Remove sediment and debris from drains.

**3.10 PROTECTION**

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

**END OF SECTION 22 4000**

## **SECTION 23 0593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. This Section includes testing, adjusting, and balancing HVAC systems to produce design objectives, including the following:
  - 1. Balancing airflow and water flow within distribution systems to indicated quantities according to specified tolerances.
  - 2. Adjusting total HVAC systems to provide indicated quantities.
  - 3. Setting quantitative performance of HVAC equipment.
  - 4. Verifying that automatic control devices are functioning properly.
  - 5. Reporting results of the activities and procedures specified in this Section.
- B. Related Sections include the following:
  - 1. Testing and adjusting requirements unique to particular systems and equipment are included in the Sections that specify those systems and equipment.
  - 2. Field quality-control testing to verify that workmanship quality for system and equipment installation is specified in system and equipment Sections.

#### **1.3 DEFINITIONS**

- A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
- B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to design quantities.
- C. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.
- D. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- E. Report Forms: Test data sheets for recording test data in logical order.
- F. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.
- G. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.
- H. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- I. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.

- J. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
- K. Test: A procedure to determine quantitative performance of a system or equipment.
- L. Testing, Adjusting, and Balancing Agent: The entity responsible for performing and reporting the testing, adjusting, and balancing procedures.
- M. TDH: Total Dynamic Head
- N. AABC: Associated Air Balance Council.
- O. AMCA: Air Movement and Control Association.
- P. CTI: Cooling Tower Institute.
- Q. NEBB: National Environmental Balancing Bureau.
- R. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

#### **1.4 SUBMITTALS**

- A. Quality-Assurance Submittals: Within 30 days from the Contractor's Notice to Proceed, submit 2 copies of evidence that the testing, adjusting, and balancing Agent and this Project's testing, adjusting, and balancing team members meet the qualifications specified in the "Quality Assurance" Article below.
- B. Contract Documents Examination Report: Within 45 days from the Contractor's Notice to Proceed, submit 2 copies of the Contract Documents review report as specified in Part 3 of this Section.
- C. Strategies and Procedures Plan: Within 60 days from the Contractor's Notice to Proceed, submit 2 copies of the testing, adjusting, and balancing strategies and step-by-step procedures as specified in Part 3 "Preparation" Article below. Include a complete set of report forms intended for use on this Project.
- D. Certified Testing, Adjusting, and Balancing Reports: Submit 2 copies of reports prepared, as specified in this Section, on approved forms certified by the testing, adjusting, and balancing Agent.
- E. Sample Report Forms: Submit 2 sets of sample testing, adjusting, and balancing report forms.
- F. Warranty: Submit 2 copies of special warranty specified in the "Warranty" Article below.

#### **1.5 BALANCING CONTRACTORS**

- A. Only the following contractors will be allowed to provide air and water testing and balancing.
  - 1. Absolut Balance
  - 2. Air Flow Testing.
  - 3. Ener-Tech Testing.
  - 4. Enviro-Aire/Total Balance, Inc.
  - 5. Hi-Tech Test and Balance
  - 6. International Test and Balance
  - 7. Mechanical Testing Services, Inc.

#### **1.6 QUALITY ASSURANCE**

- A. Agent Qualifications: Testing, adjusting, and balancing agent shall be certified by either AABC or NEBB.

- B. Testing, Adjusting, and Balancing Conference: Meet with the Owner's and the Architect's representatives on approval of the testing, adjusting, and balancing strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of testing, adjusting, and balancing team members, equipment manufacturers' authorized service representatives, HVAC controls Installer, and other support personnel. Provide 7 days' advance notice of scheduled meeting time and location.
1. Agenda Items: Include at least the following:
- a. Submittal distribution requirements
  - b. Contract Documents examination report
  - c. Testing, adjusting, and balancing plan
  - d. Work schedule and Project site access requirements
  - e. Coordination and cooperation of trades and subcontractors
  - f. Coordination of documentation and communication flow
- C. Certification of Testing, Adjusting, and Balancing Reports: Certify the testing, adjusting, and balancing field data reports. This certification includes the following:
- 1. Review field data reports to validate accuracy of data and to prepare certified testing, adjusting, and balancing reports.
  - 2. Certify that the testing, adjusting, and balancing team complied with the approved testing, adjusting, and balancing plan and the procedures specified and referenced in this Specification.
- D. Testing, Adjusting, and Balancing Reports: Use standard forms from AABC's "National Standards for Testing, Adjusting, and Balancing", NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and SMACNA's "HVAC Systems--Testing, Adjusting, and Balancing."
- E. Instrumentation Type, Quantity, and Accuracy: As described in AABC National Standards or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."
- F. Instrumentation Calibration: Calibrate instruments at least every 6 months or more frequently if required by the instrument manufacturer.

## **1.7 PROJECT CONDITIONS**

- A. Full Owner Occupancy: The Owner will occupy the site and existing building during the entire testing, adjusting, and balancing period. Cooperate with the Owner during testing, adjusting, and balancing operations to minimize conflicts with the Owner's operations.
- B. Partial Owner Occupancy: The Owner may occupy completed areas of the building before Substantial Completion. Cooperate with the Owner during testing, adjusting, and balancing operations to minimize conflicts with the Owner's operations.

## **1.8 COORDINATION**

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist testing, adjusting, and balancing activities.
- B. Notice: Provide 7 days' advance notice for each test. Include scheduled test dates and times.
- C. Perform testing, adjusting, and balancing after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

## **PART 2 - PRODUCTS (NOT APPLICABLE)**

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine Contract Documents to become familiar with project requirements and to discover conditions in systems' designs that may preclude proper testing, adjusting, and balancing of systems and equipment.
  - 1. Contract Documents are defined in the General and Supplementary Conditions of the Contract.
  - 2. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- B. Examine approved submittal data of HVAC systems and equipment.
- C. Examine Architect's and Engineer's design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- D. Examine equipment performance data, including fan and pump curves. Relate performance data to project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce the performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.
- E. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.
- F. Examine system and equipment test reports.
- G. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- H. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
- I. Examine air-handling equipment to ensure clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- J. Examine terminal units, such as variable-air-volume boxes and mixing boxes, to verify that they are accessible and their controls are connected and functioning.
- K. Examine plenum ceilings, utilized for supply air, to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.
- L. Examine strainers for clean screens and proper perforations.
- M. Examine 3-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- N. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- O. Examine open-piping-system pumps to ensure absence of entrained air in the suction piping.

- P. Examine equipment for installation and for properly operating safety interlocks and controls.
- Q. Examine automatic temperature system components to verify the following:
  - 1. Dampers, valves, and other controlled devices operate by the intended controller.
  - 2. Dampers and valves are in the position indicated by the controller.
  - 3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
  - 4. Automatic modulating and shutoff valves, including 2-way valves and 3-way mixing and diverting valves, are properly connected.
  - 5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
  - 6. Sensors are located to sense only the intended conditions.
  - 7. Sequence of operation for control modes is according to the Contract Documents.
  - 8. Controller set points are set at design values. Observe and record system reactions to changes in conditions. Record default set points if different from design values.
  - 9. Interlocked systems are operating.
  - 10. Changeover from heating to cooling mode occurs according to design values.
- R. Report deficiencies discovered before and during performance of testing, adjusting, and balancing procedures.

### **3.2 PREPARATION**

- A. Prepare a testing, adjusting, and balancing plan that includes strategies and step-by-step procedures.
- B. Complete system readiness checks and prepare system readiness reports. Verify the following:
  - 1. Permanent electrical power wiring is complete.
  - 2. Hydronic systems are filled, clean, and free of air.
  - 3. Automatic temperature-control systems are operational.
  - 4. Equipment and duct access doors are securely closed.
  - 5. Balance, smoke, and fire dampers are open.
  - 6. Isolating and balancing valves are open and control valves are operational.
  - 7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
  - 8. Windows and doors can be closed so design conditions for system operations can be met.

### **3.3 GENERAL TESTING AND BALANCING PROCEDURES**

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC national standards and this Section.
- B. Perform testing and balancing procedures on each system according to the procedures contained in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems", SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing", and this Section.
- C. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to the insulation Specifications for this Project.
- D. Mark equipment settings with paint or other suitable, permanent identification material, including damper-control positions, valve indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

### **3.4 FUNDAMENTAL AIR SYSTEMS' BALANCING PROCEDURES**

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
- E. Check the airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling unit components.
- L. Check for correct fan rotation.

### **3.5 CONSTANT-VOLUME AIR SYSTEMS' BALANCING PROCEDURES**

- A. The procedures in this Article apply to constant-volume supply-, return-, and exhaust-air systems. Additional procedures are required for variable-air-volume, multizone, dual-duct, induction-unit supply-air systems and process exhaust-air systems. These additional procedures are specified in other articles in this Section.
- B. Adjust fans to deliver total design airflows within the maximum allowable rpm listed by the fan manufacturer.
  - 1. Measure fan static pressures to determine actual static pressure as follows:
    - a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
    - b. Measure static pressure directly at the fan outlet or through the flexible connection.
    - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
    - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
  - 2. Measure static pressure across each air-handling unit component.
    - a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
  - 3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers under final balanced conditions.



4. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
  5. Adjust fan speed higher or lower than design with the approval of the Architect. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
  6. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure no overload will occur. Measure amperage in full cooling, full heating, and economizer modes to determine the maximum required brake horsepower.
- C. Adjust volume dampers for main duct, submain ducts, and major branch ducts to design airflows within specified tolerances.
1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
    - a. Where sufficient space in submains and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
  2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submains and branch ducts to design airflows within specified tolerances.
- D. Measure terminal outlets and inlets without making adjustments.
1. Measure terminal outlets using a direct-reading hood or the outlet manufacturer's written instructions and calculating factors.
- E. Adjust terminal outlets and inlets for each space to design airflows within specified tolerances of design values. Make adjustments using volume dampers rather than extractors and the dampers at the air terminals.
1. Adjust each outlet in the same room or space to within specified tolerances of design quantities without generating noise levels above the limitations prescribed by the Contract Documents.
  2. Adjust patterns of adjustable outlets for proper distribution without drafts.

### **3.6 VARIABLE-AIR-VOLUME SYSTEMS' ADDITIONAL PROCEDURES**

- A. Compensating for Diversity: When the total airflow of all terminal units is more than the fan design airflow volume, place a selected number of terminal units at a maximum set-point airflow condition until the total airflow of the terminal units equals the design airflow of the fan. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.
- B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Set outside-air dampers at minimum, and return- and exhaust-air dampers at a position that simulates full-cooling load.
  2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge duct losses.
  3. Measure total system airflow. Adjust to within 5 percent of design airflow.

4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use the terminal unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow as described for constant-volume air systems.
  - a. If air outlets are out of balance at minimum airflow, report the condition but leave the outlets balanced for maximum airflow.
6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.
7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure adequate static pressure is maintained at the most critical unit.
8. Record the final fan performance data.

### **3.7 MOTORS**

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
  1. Manufacturer, model, and serial numbers
  2. Motor horsepower rating
  3. Motor rpm
  4. Efficiency rating if high-efficiency motor
  5. Nameplate and measured voltage, each phase
  6. Nameplate and measured amperage, each phase
  7. Starter thermal-protection-element rating
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

### **3.8 TEMPERATURE TESTING**

- A. During testing, adjusting, and balancing, report need for adjustment in temperature regulation within the automatic temperature-control system.
- B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of 2 successive 8-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.
- C. Measure outside-air, wet- and dry-bulb temperatures.

### **3.9 TEMPERATURE-CONTROL VERIFICATION**

- A. Verify that controllers are calibrated and commissioned.
- B. Check transmitter and controller locations and note conditions that would adversely affect control functions.
- C. Record controller settings and note variances between set points and actual measurements.
- D. Verify operation of limiting controllers (i.e., high- and low-temperature controllers).

- E. Verify free travel and proper operation of control devices such as damper and valve operators.
- F. Verify sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water-flow measurements. Note the speed of response to input changes.
- G. Confirm interaction of electrically operated switch transducers.
- H. Confirm interaction of interlock and lockout systems.
- I. Verify main control supply-air pressure and observe compressor and dryer operations.
- J. Record voltages of power supply and controller output. Determine if the system operates on a grounded or non-grounded power supply.
- K. Note operation of electric actuators using spring return for proper fail-safe operations.

### **3.10 TOLERANCES**

- A. Set HVAC system airflow and water flow rates within the following tolerances:
  - 1. Supply, Return, and Exhaust Fans: 0 to plus 5 percent.
  - 2. Air Outlets and Inlets: Plus 5 to minus 5 percent.
  - 3. Heating-Water Flow Rate: Plus 5 to minus 5 percent.
  - 4. Cooling-Water Flow Rate: Plus 5 to minus 5 percent.
  - 5. Kitchen and Lab Exhaust: 0 to plus 5 percent.

### **3.11 DUCT LEAKAGE TESTS**

- A. Witness the duct pressure testing performed by Installer.
- B. Verify that proper test methods are used and that leakage rates are within specified tolerances.
- C. Report deficiencies observed.

### **3.12 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS**

- A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.
  - 1. Measure and record the operating speed, airflow, and static pressure of each fan.
  - 2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
  - 3. Check the refrigerant charge.
  - 4. Check the condition of filters.
  - 5. Check the condition of coils.
  - 6. Check the operation of the drain pan and condensate-drain trap.
  - 7. Check bearings and other lubricated parts for proper lubrication.
  - 8. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.
- B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:
  - 1. New filters are installed.
  - 2. Coils are clean and fins combed.
  - 3. Drain pans are clean.

4. Fans are clean.
  5. Bearings and other parts are properly lubricated.
  6. Deficiencies noted in the preconstruction report are corrected.
- C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
1. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed and the face velocity of filters and coils.
  2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
  3. If calculations increase or decrease the airflow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
  4. Balance each air outlet.

### **3.13 REPORTING**

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article above, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

### **3.14 FINAL REPORT**

- A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in 3-ring binder, tabulated and divided into sections by tested and balanced systems.
- B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
1. Include a list of the instruments used for procedures, along with proof of calibration.
- C. Final Report Contents: In addition to the certified field report data, include the following:
1. Pump curves
  2. Fan curves
  3. Manufacturers' test data
  4. Field test reports prepared by system and equipment installers
  5. Other information relative to equipment performance, but do not include approved Shop Drawings and Product Data
- D. General Report Data: In addition to the form titles and entries, include the following data in the final report, as applicable:
1. Title page
  2. Name and address of testing, adjusting, and balancing Agent
  3. Project name
  4. Project location
  5. Architect's name and address
  6. Engineer's name and address

7. Contractor's name and address
  8. Report date
  9. Signature of testing, adjusting, and balancing Agent who certifies the report
  10. Summary of contents, including the following:
    - a. Design versus final performance
    - b. Notable characteristics of systems
    - c. Description of system operation sequence if it varies from the Contract Documents
  11. Nomenclature sheets for each item of equipment
  12. Data for terminal units, including manufacturer, type size, and fittings
  13. Notes to explain why certain final data in the body of reports vary from design values
  14. Test conditions for fans and pump performance forms, including the following:
    - a. Settings for outside-, return-, and exhaust-air dampers
    - b. Conditions of filters
    - c. Cooling coil, wet- and dry-bulb conditions
    - d. Face and bypass damper settings at coils
    - e. Fan drive settings, including settings and percentage of maximum pitch diameter
    - f. Inlet vane settings for variable-air-volume systems
    - g. Settings for supply-air, static-pressure controller
    - h. Other system operating conditions that affect performance
- E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present with single-line diagrams and include the following:
1. Quantities of outside, supply, return, and exhaust airflows
  2. Water and steam flow rates
  3. Duct, outlet, and inlet sizes
  4. Pipe and valve sizes and locations
  5. Terminal units
  6. Balancing stations
- F. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:
1. Unit Data: Include the following:
    - a. System identification
    - b. Location
    - c. Coil identification
    - d. Capacity in Btuh
    - e. Number of stages
    - f. Connected volts, phase, and hertz
    - g. Rated amperage
    - h. Airflow rate in cfm
    - i. Face area in sq. ft.
    - j. Minimum face velocity in fpm
  2. Test Data: Include design and actual values for the following:
    - a. Heat output in Btuh
    - b. Airflow rate in cfm
    - c. Air velocity in fpm
    - d. Entering-air temperature in deg F
    - e. Leaving-air temperature in deg F
    - f. Voltage at each connection
    - g. Amperage for each phase

G. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data: Include the following:
  - a. System identification
  - b. Location
  - c. Make and type
  - d. Model number and size
  - e. Manufacturer's serial number
  - f. Arrangement and class
  - g. Sheave make, size in inches, and bore
  - h. Sheave dimensions, center-to-center and amount of adjustments in inches
2. Motor Data: Include the following:
  - a. Make and frame type and size
  - b. Horsepower and rpm
  - c. Volts, phase, and hertz
  - d. Full-load amperage and service factor
  - e. Sheave make, size in inches, and bore
  - f. Sheave dimensions, center-to-center and amount of adjustments in inches
  - g. Number of belts, make, and size
3. Test Data: Include design and actual values for the following:
  - a. Total airflow rate in cfm
  - b. Total system static pressure in inches wg
  - c. Fan rpm
  - d. Discharge static pressure in inches wg
  - e. Suction static pressure in inches wg

H. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data: Include the following:
  - a. System and air-handling unit number
  - b. Location and zone
  - c. Traverse air temperature in deg F
  - d. Duct static pressure in inches wg
  - e. Duct size in inches
  - f. Duct area in sq. ft.
  - g. Design airflow rate in cfm
  - h. Design velocity in fpm
  - i. Actual airflow rate in cfm
  - j. Actual average velocity in fpm
  - k. Barometric pressure in psig

**3.15 VERIFICATION OF TAB REPORT**

- A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Architect and/or Owner.
- B. Architect/Owner shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.

- C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
- D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
- E. If TAB work fails, proceed as follows:
  - 1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
  - 2. If the second final inspection also fails, Owner may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.
  - 3. If the second verification also fails, Architect may contact AABC Headquarters regarding the AABC National Performance Guaranty, if applicable.
- F. Prepare test and inspection reports.

### **3.16 ADDITIONAL TESTS**

- A. Within 90 days of completing testing, adjusting, and balancing, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial testing, adjusting, and balancing procedures were not performed during near-peak summer and winter conditions, perform additional inspections, testing, and adjusting during near-peak summer and winter conditions.

**END OF SECTION 23 0593**

## **SECTION 23 0900 – INSTRUMENTATION AND CONTROL FOR HVAC**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Related Sections:
  - 1. Division 20: Common Mechanical Requirements
  - 2. Division 22: Plumbing
  - 3. Division 23: Heating, Ventilating and Air-Conditioning (HVAC)
  - 4. Division 26: Electrical
  - 5. Division 28: Electronic Safety and Security

#### **1.2 SUMMARY**

- A. This Section Includes:
  - 1. Building Automation System (BAS), including controls for mechanical equipment to control temperature, humidity, ventilation, pressure, and other functions as indicated.
  - 2. BAS Operator Interface System (OIS) including operator interface for monitoring and control of connected systems and equipment.
  - 3. Refer to Drawings for Sequence of Operations and additional requirements related to this section.
- B. Scope of Work:
  - 1. The Mechanical Systems Controls Contractor (MSCC) shall provide and install all controls, sensors, wiring, control valves, dampers, electrical, and accessories as indicated and as necessary for a complete mechanical controls solution.
  - 2. The MSCC shall complete systems integration of all new custom and packaged mechanical controls devices, and additional devices indicated in the project Drawings and Specifications, into the existing Owner centralized Siemens BAS Operator Interface System (OIS) for the remote monitoring and control of the BAS including but not limited to BAS system point monitoring, developed system graphics, point trends, equipment schedules, and system alarm annunciation.
  - 3. The MSCC shall complete systems integration of all new custom and packaged mechanical controls devices, and additional devices indicated in the project Drawings and Specifications, into the OIS.
  - 4. The MSCC shall complete field installation of devices, wiring, and integration into the central OIS as indicated in project Drawings and Specifications for Units provided with packaged controls by the unit manufacturer.
  - 5. The MSCC shall complete integration of any auxiliary systems (i.e.. Laboratory Controls, Lighting Controls, Power Monitoring, Fire Alarm system, Security Systems, etc.) into the central OIS as indicated in the project Drawings and Specifications. MSCC shall review project Drawings and Specifications as necessary for any requirements and details regarding auxiliary systems integration.

#### **1.3 DEFINITIONS**

- A. AE: Architect/Engineer.
- B. Algorithm: A logical procedure for solving a recurrent mathematical problem. A prescribed set of well-defined rules or processes for solving a problem in a finite number of steps.
- C. Analog: A continuously varying signal value, such as current, flow, pressure, or temperature.



D. BACnet Specific Definitions:

1. BACnet: Building Automation Control Network Protocol, ASHRAE 135. A communications protocol allowing devices to communicate data and services over a network.
2. BACnet Interoperability Building Blocks (BIBBs): BIBB defines a small portion of BACnet functionality that is needed to perform a particular task. BIBBs are combined to build the BACnet functional requirements for a device.
3. BACnet/IP: Defines and allows using a reserved UDP socket to transmit BACnet messages over IP networks. A BACnet/IP network is a collection of one or more IP subnetworks that share the same BACnet network number.
4. BACnet Testing Laboratories (BTL): Organization responsible for testing products for compliance with ASHRAE 135, operated under direction of BACnet International.
5. B-AWS: BACnet Advanced Operator Workstation
6. B-OWS: BACnet Operator Workstation
7. B-OD: BACnet Operator Display
8. B-BC: BACnet Building Controller
9. B-AAC: BACnet Advanced Application Controller
10. B-ASC: BACnet Application Specific Controller
11. B-LD: BACnet Lighting Device
12. B-SS: BACnet Smart Sensor
13. B-SA: BACnet Smart Actuator
14. B-RTR: BACnet Router
15. B-GW: BACnet Gateway
16. B-BBMD: BACnet Broadcast Management Device
17. B-GEN: BACnet General

E. BAS: Building Automation System.

F. Binary: Two-state signal where a high signal level represents "ON" or "OPEN" condition and a low signal level represents "OFF" or "CLOSED" condition. "Digital" is sometimes used interchangeably with "Binary" to indicate a two-state signal.

G. Controller: Generic term for any standalone, microprocessor-based, digital controller residing on a network, used for local or global control. Three types of controllers are indicated: network controllers, programmable application controllers, and application-specific controllers.

H. COV: Changes of value.

I. DDC: Direct Digital Control.

J. EEPROM: Electronically Erasable Programmable Read-Only Memory.

K. EPROM: Erasable Programmable Read-Only Memory.

L. E/P: Voltage to pneumatic.

M. Gateway: Bidirectional protocol translator that connects control systems that use different communication protocols.

N. IP: Internet Protocol.

O. I/P: Current to pneumatic.

P. IT: Information Technology.

Q. LAN: Local Area Network.

- R. LCC: Laboratory Controls Contractor.
- S. LNS: LonWorks Network Services.
- T. LON Specific Definitions:
  - 1. FTT-10: Echelon Transmitter-Free Topology Transceiver.
  - 2. LonMark International: Association comprising suppliers and installers of LonTalk products. Association provides guidelines for implementing LonTalk protocol to ensure interoperability through a standard or consistent implementation.
  - 3. LonTalk: An open standard protocol developed by Echelon Corporation that uses a "Neuron Chip" for communication. LonTalk is a register trademark of Echelon.
  - 4. LonWorks: Network technology developed by Echelon.
  - 5. Node: Device that communicates using CTA-709.1-D protocol and that is connected to a CTA-709.1-D network.
  - 6. Node Address: The logical address of a node on the network, consisting of a Domain number, Subnet number, and Node number. "Node number" portion of an address is a number assigned to device during installation, is unique within a subnet, and is not a factory-set unique Node ID.
  - 7. Node ID: A unique 48-bit identifier assigned at factory to each CTA-709.1-D device. Sometimes called a "Neuron ID."
  - 8. Program ID: An identifier (number) stored in a device (usually, EEPROM) that identifies node manufacturer, functionality of device (application and sequence), transceiver used, and intended device usage.
  - 9. Standard Configuration Property Type (SCPT): Pronounced "skip-it." A standard format type maintained by LonMark for configuration properties.
  - 10. Standard Network Variable Type (SNVT): Pronounced "snivet." A standard format type maintained by LonMark used to define data information transmitted and received by individual nodes. "SNVT" is used in two ways. It is an acronym for "Standard Network Variable Type" and is often used to indicate a network variable itself (i.e., it can mean "a network variable of a standard network variable type").
  - 11. Subnet: Consists of a logical grouping of up to 127 nodes, where logical grouping is defined by node addressing. Each subnet is assigned a number, which is unique within a Domain. See "Node Address."
  - 12. TP/FT-10: Free Topology Twisted Pair network defined by CTA-709.3 and is most common media type for a CTA-709.1-D control network.
  - 13. TP/XF-1250: High-speed, 1.25 Mbps, twisted-pair, doubly terminated bus network defined by "LonMark Interoperability Guidelines" and typically used only to connect multiple TP/FT-10 networks.
  - 14. User-Defined Configuration Property Type (UCPT): Pronounced "u-keep-it." A Configuration Property format type that is defined by device manufacturer.
  - 15. User-Defined Network Variable Type (UNVT): Network variable format defined by device manufacturer. UNVTs create non-standard communications that other vendors' devices may not correctly interpret and may negatively impact system operation. UNVTs are not allowed.
- U. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
- V. Mobile Device: A data-enabled phone or tablet computer capable of connecting to a cellular data network and running a native control application or accessing a web interface.
- W. Modbus TCP/IP: An open protocol for exchange of process data.
- X. MSCC: Mechanical Systems Controls Contractor.
- Y. MSTP: Master/Slave Token Passing.
- Z. Network Controller: Digital controller, which supports a family of programmable application controllers and application-specific controllers, that communicates on peer-to-peer network for transmission of global data.

- AA. Network Repeater: Device that receives data packet from one network and rebroadcasts it to another network. No routing information is added to protocol.
- BB. OIS: Operator Interface System.
- CC. Peer to Peer: Networking architecture that treats all network stations as equal partners.
- DD. PICS: BACnet Protocol Implementation Conformance Statement.
- EE. RAM: Random access memory.
- FF. RF: Radio frequency.
- GG. Router: Device connecting two or more networks at network layer.
- HH. Server: Computer used to maintain system configuration, historical and programming database.
- II. SI: Systems Integrator.
- JJ. TCP/IP: Transport control protocol/Internet protocol.
- KK. UC: Unitary Controller.
- LL. UPS: Uninterruptible power supply.
- MM. USB: Universal Serial Bus.
- NN. User Datagram Protocol (UDP): This protocol assumes that the IP is used as the underlying protocol.
- OO. VAV: Variable air volume.

#### **1.4 SYSTEM DESCRIPTION**

- A. Demolition Work: The MSCC shall visit the job site prior to, and during, the demolition phase to clearly identify and protect control tubes, wires, and devices necessary to keep the remaining systems active during the project phasing. Post construction demolition relative to control infrastructure shall be coordinated by this contractor with the construction manager and demolition contractor. All obsolete control equipment shall be removed from the site, unless otherwise noted on the drawings. The MSCC shall be responsible to repair visible architectural finishes surrounding demolished materials as necessary to match existing. The MSCC shall be responsible to ensure that any demolition activities involving existing site Controls Systems, field device networks, or Operator Interface Systems do not impact or alter the operation or performance of any existing site Systems or Equipment intended to remain. Where any pneumatic controls have been removed, applicable pneumatic tubing shall be removed to source and capped such that there are no pneumatic leaks to remaining building pneumatic air controlled systems and equipment.
- B. New Work: Provide all items, articles, materials, operations, or methods listed, mentioned, or scheduled on drawings and/or herein, including all labor, materials, equipment, and incidentals necessary and required to complete the installation of the controls for equipment as indicated on the drawings and herein described.
- C. Provide a Building Automation System (BAS) incorporating Direct Digital Control (DDC), equipment monitoring, and control consisting of microcomputer based DCC Panels interfacing directly with sensors, actuators and environmental delivery systems (i.e., HVAC units, boilers, etc.); electric controls and mechanical devices for all items indicated on drawings, a primary communication network to allow data exchange from DDC panel to DDC panel; microcomputer based Unitary DDC Controllers (UCs) interfacing with sensors, actuators, and terminal equipment control devices; and a secondary communication network

interfacing UCs to DDC panel network devices. The system shall be based on industry standard open protocols.

1. The Mechanical Systems Controls Contractor (MSCC) shall furnish and install a networked system of HVAC controls. The contractor shall incorporate direct digital control (DDC) for central plant engineering, building ventilation equipment, supplemental heating and cooling equipment and terminal units.
  2. Provide networking to new DDC equipment using communication standards. System shall be capable of BACnet communication according to the most recent version of ASHRAE standard ANSI/ASHRAE 135 for interoperability with smart equipment and for the main IP communication trunk to the BAS server. The system shall not be limited to only standard protocols but shall also be able to integrate to a wide variety of third-party devices and applications via drivers and gateways.
  3. Provide standalone controls where called for on the drawings or sequences.
  4. The installation of the control system shall be performed under the direct supervision of the controls manufacturer with the shop drawings, flow diagrams, bill of materials, component designation, or identification number and sequence of operation all bearing the name of the manufacturer.
  5. Furnish a complete distributed direct digital control system in accordance with this specification section. This includes all system controllers, logic controllers and all input/output devices. Items of work included are as follows:
    - a. Provide a submittal that meets the requirements below for approval.
    - b. Coordinate installation schedule with the mechanical contractor and general contractor.
    - c. Provide installation of all panels and devices unless otherwise stated.
    - d. Provide power for panels and control devices.
    - e. Provide 120VAC circuits, wiring, and raceway as necessary to power all controllers and controls components. Power shall be provided from available circuit(s) within the nearest available electrical panel(s).
    - f. Provide all low voltage control wiring and raceway for the DDC system.
    - g. Provide miscellaneous control wiring for HVAC and related systems regardless of voltage.
    - h. Provide engineering and technician labor to program and commission software for each system and operator interface. Submit commissioning reports for approval.
    - i. Participate in commissioning for all equipment that is integrated into the BAS (refer to commissioning sections of the equipment or systems in other parts of this specification).
    - j. Provide testing, demonstration and training as specified below.
- D. Provide on-site supervision, calibration, and checkout of the control systems.
- E. It is the responsibility of the Contractor to review the Drawings and specifications of all other trades concerning this project to determine what equipment is to be furnished and/or installed and/or connected by the Contractor in addition to that equipment called for in the project Specifications and Drawings.
- F. Provide shop drawings as specified herein.
- G. Provide guarantee as specified herein.
- H. Provide classroom training instructions to Owner's operating and maintenance personnel as specified herein.

## **1.5 SUBMITTALS**

- A. Qualification Data:
1. Systems Provider Qualification Data:
    - a. Resume of project manager assigned to Project.
    - b. Resumes of application engineering staff and technicians assigned to Project.
    - c. Descriptions of past projects completed, demonstrating required experience with projects of similar scope, size, and complexity.

2. Manufacturer's qualification data.

B. Product Data:

1. Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
2. Include ASHRAE BACnet Conformance documents for each DDC system component (panel, zone controller, field devices, and operator workstation) proposed including the following:
  - a. PICS Document
  - b. BACnet Testing Laboratories Product Listing
  - c. BACnet Testing Laboratories Conformance Certificate

C. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
2. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
3. Details of control panel faces, including controls, instruments, and labeling.
4. Written description of sequence of operation.
5. Schedule of dampers including size, leakage, and flow characteristics.
6. Schedule of valves including leakage and flow characteristics.
7. Trunk cable schematic showing programmable control unit locations and trunk data conductors.
8. Listing of connected data points, including connected control unit and input device. Input/output point summary with recommended set points.
9. System graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations.
10. System configuration showing peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
11. Bill of materials to identify each control device.
12. A complete set of shop drawings shall be properly identified with the Engineer's project number and title. Shop drawings shall be 11" x 17" size (minimum).
13. Show interface with Work under other Contracts. Clearly illustrate, identify and define all components, assemblies, subsystems, and systems; relationship, interface, function, action, setting accuracy, range, sequence of operation, normal and abnormal conditions.

D. Commissioning Reports: Indicate results of startup and testing commissioning requirements. Submit copies of checklists.

E. Maintenance Data: For equipment to include in the maintenance manuals specified in Division 01.

F. Warranties: Special warranties specified in this Section.

G. No work shall be executed until the final submittals are approved by the project AE.

H. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors. Revise and submit Shop Drawings to reflect actual installation and operating sequences.

## 1.6 COORDINATION

- A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details prior to installation.

- B. Coordinate with the Mechanical Contractor for equipment provided with packaged controls including but not limited to field installation, wiring, and configuration of any supporting devices as necessary, and to complete integration to packaged unit controllers where indicated.
- C. Coordinate with any auxiliary systems contractors to complete integration of auxiliary systems (i.e. Laboratory Controls, Lighting Controls, Power Monitoring, Security, etc.) into the central site Operator Interface System.
- D. Coordinate locations and requirements for IT Data connections with the Electrical/Technology Contractor.

#### **1.7 ACCEPTABLE MECHANICAL SYSTEMS CONTROLS CONTRACTORS**

- A. Acceptable Mechanical Systems Controls Contractors, subject to compliance with requirements of this specification and the project Drawings. Substitutions are not acceptable:
  - 1. Siemens Industry, Inc.

#### **1.8 QUALITY ASSURANCE**

- A. Installer Qualifications: An experienced installer who is a certified installer of the automatic control system manufacturer for both installation and maintenance of units required for this Project, including a minimum of 2 years of documented experience with projects of similar scope and complexity.
- B. Manufacturer Qualifications: A company experienced in manufacturing automatic temperature-control systems like those indicated for this Project and with a record of successful in-service performance, including a minimum of 5 years of documented experience.
- C. Install all BAS components, devices, and wiring in compliance with NEC and all local electrical codes.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- E. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilation Systems."
- F. Comply with ASHRAE 135 for DDC system control components.

#### **1.9 DELIVERY, STORAGE AND HANDLING**

- A. In strict compliance with the manufacturer's written instructions and recommendations, materials shall be provided to ensure that all equipment and components are completely protected from damage, dirt, or weather during shipping, storage, prior to installation, and after installation for the duration of the construction activities.
- B. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to unit manufacturer.

#### **1.10 WARRANTY**

- A. Contractor guarantees that this installation is free from defects and agrees to replace or repair, free of any charge to the satisfaction of the Owner's Representative any part of this installation including all components, parts and assemblies of the System which may fail within a period of one (1) year after final acceptance, provided that such failure is due to defects in the materials or workmanship or due to a failure to follow the specifications and drawings. The Contractor shall file with the Owner all guarantees from the equipment manufacturers and what operating conditions and performance capacities they are based on.

- B. The Contractor shall initiate the warranty period by formally transmitting to the Owner commencement notification of the period for the system and devices accepted.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Available Manufacturers of DDC Controllers and accessories, subject to compliance with requirements of this specification and the project Drawings:
  - 1. Siemens Building Technologies

### **2.2 GENERAL**

- A. The MSCC shall provide a complete mechanical controls system including but not limited to programming, DDC controllers, software, sensors, transmitters, control valves, dampers, power supplies and wiring, network, gateways, routers, and all other devices required for a complete system.
- B. The MSCC shall complete Systems Integration of all new controls into the existing Owner centralized Tridium/Niagara BAS Operator Interface System (OIS) to facilitate remote monitoring and control of mechanical controls systems including but not limited to developed system graphics, point monitoring, point commanding, point trending, equipment operation schedule management, and system alarm configuration and annunciation.
- C. The MSCC shall provide a BACnet IP and/or MSTP field/floor level network or networks and shall connect all field devices to a BACnet B-BC controller or controllers. The B-BC controller(s) shall communicate with the BAS OIS server via the Owner's IP network.
- D. The system shall be modular in nature and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, DDC Controllers, expansion modules, and operator devices.
- E. System network architecture shall be completed such that each BAS controller shall operate independently by performing its own specified control, I/O, and data collection. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.
- F. Systems requiring multiple controllers (i.e. large chilled water plants) shall not utilize the Owner IP network for communication between common system controllers.
- G. All controllers within a building shall be able to access any data from, or send control commands directly to, any other DDC controller or combination of controllers in the same building without dependence upon a central processing device (peer-to-peer).
- H. All connected devices and systems must meet minimum Owner IT security requirements. The MSCC is responsible for remediation of any network security vulnerabilities identified by the Owner's IT department during the construction period and up to 1 year after project substantial completion.

### **2.3 OPERATOR INTERFACE SYSTEM**

- A. General:
  - 1. The MSCC shall complete Systems Integration of all new controls into the existing Owner centralized Tridium/Niagara BAS Operator Interface System (OIS) to facilitate remote monitoring and control of mechanical controls systems including but not limited to developed system graphics, point monitoring, point commanding, point trending, equipment operation schedule management, and system alarm configuration and annunciation.
  - 2. The MSCC shall review site network security requirements with the Owner's designated IT Support contact person and shall provide network security software and hardware components as necessary

to meet site security requirements. Additionally, the MSCC shall provide network security software and hardware components as necessary to properly secure the BAS network and devices from other LAN connected devices.

- B. Systems Integration: The MSCC shall complete integration of all new mechanical controls devices and devices indicated in the project Drawings and Specifications into the common central OIS, including but not limited to Mechanical Systems Controls, Laboratory Controls, Lighting Controls, Power Monitoring, Fire Alarm System, and Security Systems.

1. Points: Available points from connected field devices shall be integrated into the central OIS as follows:
  - a. Mechanical Infrastructure Systems: Integrate all available points
  - b. Mechanical Terminal Equipment and Packaged Equipment Controllers: Integrate all physical device input and output points, as well as system virtual setpoints and other control points as necessary to enable appropriate equipment operation and monitoring by central system operators. All available system points are not required for integration.
2. Graphics: Graphics shall be created and organized to allow a system operator to fully navigate system graphics via graphic buttons. Graphics shall include the following:
  - a. Homepage including a map view of and click link buttons to all Owner sites connected to OIS.
  - b. Homepage for each building including building photograph and click button links to all connected central building equipment, or equipment summary pages, and links to building floorplan graphics.
  - c. Graphics shall include uploaded building key plan style floorplans for all building floors including room numbers. Floorplan graphics shall include key information (i.e., room temperature) from and click button links to terminal equipment associated with each room.
  - d. Do not display extraneous points (not pertinent) on viewable graphics or display screens.
  - e. Written sequence of operation shall be included and shall be click linked to the associated equipment or system graphic for reference.
  - f. For each building, include a comprehensive network architecture riser diagram including all connected devices for the site and showing connection to the central OIS server. Diagram shall indicate the active connectivity status of each connected device.
  - g. All control contractor as built documents and product cut sheets shall be converted into .pdf files and made available through a link on the OIS graphics.
  - h. Data to be displayed within a unique graphic shall be assignable regardless of physical hardware address, communication channel or point type. Graphics shall be on-line programmable and under password access control. Points shall be assignable to multiple graphics where necessary to facilitate operator understanding of system operation and where specified. Graphics shall also contain calculated or "software" points. Each physical point and each point assigned to a graphic shall be assigned an English descriptor for use in reports.
  - i. Points shall be displayed with dynamic data provided by the system with appropriate text descriptor, status or value, and engineering unit. Coloration shall be used to designate alarm states, and status including point connectivity and override status. Coloration shall be variable for each class of points, as chosen by the Owner.
  - j. Graphics shall include direct links to applicable system trend reports and views.
  - k. An on-line "help" utility shall be provided to facilitate operator training and understanding. The "help" utility shall contain text and graphics to clarify system operation. At a minimum, help shall be available for every menu item and dialogue box.
3. Trends: System point trends shall be configured for connected systems as follows:
  - a. Central Mechanical Equipment: Include trending for all main system points such as temperature, pressure, flow, valve command, damper command, setpoints, motor command and status, etc. Trends shall be change of value (COV) based including a maximum 1 hour time interval between recorded point values.



- b. Terminal Mechanical Equipment: Include trending for current room temperature, any unique terminal monitoring points such as carbon monoxide, carbon dioxide, etc., and any other critical terminal monitoring points as necessary.
  - c. Auxiliary Systems: Include minimum baseline trending of key system operational and monitoring points.
- 4. Alarms: Configure system alarms for monitoring of all key operational parameters of all central mechanical systems and auxiliary systems, and terminal equipment monitoring points as necessary. Several examples of required system alarm points are included below:
  - a. Fan or pump motor status does not match enable command for 10 seconds
  - b. Boiler or chiller status does not match enable command for 10 seconds
  - c. Equipment general alarm point has changed state to alarm status
  - d. Air Handling Unit freeze stat has tripped
  - e. Air Handling Unit discharge air temperature is  $\pm 5^{\circ}\text{F}$  of setpoint during occupied mode
  - f. Air Handling Unit end of duct static pressure is  $\pm 0.5"$  WC of setpoint during occupied mode
  - g. Air Handling Unit return air relative humidity is  $>70\% \text{RH}$  during occupied mode
  - h. Hydronic system liquid temperature is  $\pm 5^{\circ}\text{F}$  of setpoint when the system is enabled
  - i. Hydronic system pressure is  $\pm 5$  psi of setpoint when the system is enabled
  - j. Space/room temperature is  $<50^{\circ}\text{F}$  or  $>90^{\circ}\text{F}$
  - k. Area lighting status does not match enable command for 10 seconds

## 2.4 DDC CONTROLLERS AND ASSOCIATED COMPONENTS

### A. DDC Controllers:

- 1. All BAS controllers shall use the latest version of ANSI/ASHRAE Standard 135 BACnet standard for communications, have passed BACnet Testing Laboratories (BTL) certification and be listed as compliant with UL916 Standard for Energy Management Equipment. BAS controllers used in smoke control applications must also be listed as compliant with UL864 Standard for Control Units and Accessories for Fire Alarm Systems.
- 2. All controllers shall be listed by BTL as conforming to the required standard device profile and support all of the minimum required BACnet Interoperability Building Blocks (BIBBs) associated with this device profile.
- 3. BAS controller types shall be one of three types, a BACnet Building Controller (B-BC), a BACnet Advanced Application Specific Controller (B-AAC) or a BACnet Application Specific Controllers (B-ASC).
  - a. Building Controllers (B-BC) shall be used for all major mechanical equipment and/or systems (i.e. chilled water, heating hot water, large AHU's, etc.).
  - b. Advanced Application Specific Controllers (B-AAC) shall be used, as an extension of a B-BC's performance and capacity, for control of all medium and small mechanical systems and/or terminal equipment.
  - c. Application Specific Controllers (B-ASC) shall only be allowed to be used on terminal equipment including VAV boxes, FCU's, etc.
- 4. BACnet Building Controller (B-BC):
  - a. Provide controllers conforming to the latest version of ANSI/ASHRAE 135 BACnet Building Controller (B-BC) standard device profile and support all of the minimum required BACnet Interoperability Building Blocks (BIBBs) associated with this device profile.
  - b. Controllers shall support Internet Protocol (IP) for communications to other BC's and the OIS and MS/TP communication to B-AAC's and B-ASC's.

- c. Controllers shall have a 32 bit processor with an EEPROM, flash driven operating system. They shall be multi-tasking, multi-user, real-time digital control processors and permit I/O expansion for control / monitoring of up to 48 I/O. Controller size shall be sufficient to fully meet the requirements of this specification. Controllers shall be fully programmable while supporting standard energy management functions, including but not limited to:
  - 1) Alarm detection and reporting
  - 2) Automatic Daylight Saving Time switchover
  - 3) Calendar-based scheduling
  - 4) Closed loop PID control
  - 5) Duty cycling
  - 6) Economizer control
  - 7) Equipment scheduling, optimization and sequencing
  - 8) Event scheduling
  - 9) Historical trend collection
  - 10) Holiday scheduling
  - 11) Logical programming
  - 12) Reset schedules
  - 13) Night setback control
  - 14) Peak Demand Limiting (PDL)
  - 15) Start-Stop Time Optimization (SSTO)
  - 16) Temperature-compensated duty cycling
  - 17) Temporary schedule override
- d. Provide controller with integral power switch. If an integral switch is not provided by the manufacturer, the MSCC shall provide a separate dedicated transformer and switch within each enclosure for each controller present.
- e. The operator shall have the ability to manually override automatic or centrally executed commands at the Building Controller via local, point discrete, hand/off/auto operator override switches for digital control type points and gradual switches for analog control type points. These override switches shall be operable whether the panel processor is operational or not.
- f. Controllers shall provide local LED status indication for power, communications, status and each digital output for constant, up-to-date verification of all point conditions without the need for an operator I/O device.
- g. All points associated with a given mechanical system (i.e., an air handling unit) will be controlled from a single Building Controller or point expansion panel(s) from the respective master. All expansion modules shall be located in the building controller enclosure or an attached enclosure. No points from a given mechanical system may be distributed among multiple panels - points must be run back to a single Building Controller dedicated to that mechanical system. Multiple mechanical systems shall be allowed on a single controller. Closed-loop control must never depend upon network communications. All inputs, program sequences, and outputs for any single BAS control loop shall reside in the same Building Controller.
- h. A variety of historical data collection utilities shall be provided for manual or automatic sampling, storing and displaying system point data.
  - 1) Building Controllers shall store point history data for selected analog and digital inputs and outputs:
- i. Building Controllers shall also provide high resolution sampling capability for verification of control loop performance. Operator-initiated automatic and manual loop tuning algorithms shall be provided for operator-selected PID control. Provide capability to view or print trend and tuning reports.
  - 1) Loop tuning shall be capable of being initiated either locally at the Building Controller or from a network workstation. For all loop tuning functions, access shall be limited to authorized personnel through password protection.

- j. Provide controllers that, upon full system power recovery, all clocks shall be automatically synchronized, and all controlled equipment shall be automatically re-started based on correct clock time and sequence of operation.
  - k. Provide additional controllers or I/O modules if necessary, in each BAS panel so that each panel has at least 20% spare universal I/O capacity for connection of future points. Provide all processors, power supplies, and communication controllers so that the implementation of adding a point to the spare point location only requires the addition of the appropriate expansion modules, sensors/actuators and/or field wiring/tubing.
  - l. Controllers shall provide at least one data communication port for operation of operator I/O devices such as portable laptop operator's terminals. Controllers shall allow temporary use of portable devices without interrupting the normal operation of permanently connected printers or terminals. A USB port shall alternatively be available to support local HMI tools connection.
  - m. Field bus adaptors may be used, as an extension of the B-BC, to facilitate communication between the B-BC and remote field devices (sensors, actuators). Adaptors shall be microprocessor based and utilize advanced diagnostics and configuration. Adaptor shall be housed in panel or junction box enclosure.
  - n. Any provided JACE controllers shall be by Tridium Vykon and shall be fully open for Owner use and configuration without the need for any proprietary software or licenses.
5. BACnet Advanced Application Specific Controller (B-AAC):
- a. Provide controllers conforming to the latest version of ANSI/ASHRAE 135 BACnet Advanced Application Specific Controller (B-AAC) standard device profile and support all of the minimum required BACnet Interoperability Building Blocks (BIBBs) associated with this device profile.
  - b. Controllers shall support MS/TP communication to B-BC's and other B-AAC's and B-ASC's. Also acceptable are B-AAC controllers that support Internet Protocol (IP) for communications to other BC's/ AAC's and the OIS and MS/TP communication to B-AAC's/ ASC's.
  - c. Controller shall be a microprocessor-based, 32 bit, multi-tasking, real-time digital control processor capable of stand-alone operation for medium sized mechanical systems and/ or control of roof-top units, VAV terminal units, CAV terminal units, dual-duct terminal units, fan-coil units, heat pump units.
    - 1) If the hardware point requirements of any medium-sized system should exceed the I/O configuration of available B-AAC offerings then a B-BC must be used. Control of one piece of mechanical equipment may not be performed by more than one controller.
  - d. Controllers shall be peer-to-peer devices with hand/off/auto switches for each digital output. Switch position shall be supervised in order to inform the system that automatic control has been overridden. Switches will only be required for non-terminal applications (not required for VAVs, CAV's and other above terminal devices). All inputs and outputs shall be of the universal type, allowing for additional system flexibility.
  - e. Each controller shall support its own real-time operating system. Controllers without real-time clock functionality will only be permitted for use on terminal or unitary equipment such as VAV boxes, fan coil units and auxiliary monitoring and control.
  - f. Provide each controller with sufficient memory to accommodate point databases and operating programs. All databases and programs shall be stored in non-volatile EEPROM. The controllers shall be able to return to full normal operation without user intervention after a power failure of unlimited duration.
  - g. Controllers must be fully programmable. All programs shall be field-customized to meet the user's exact control strategy requirements. Controllers utilizing pre-packaged or canned programs shall not be acceptable.
  - h. All points used for a single mechanical system shall be connected to the same B-AAC. Points used for control loop reset based on outside air, or space/zone temperature, or extremely remote differential pressure sensors on slow acting control loops are exempt from this requirement.

- i. Provide spare additional I/O such that future use of spare capacity shall require providing only the field device, field wiring, point database definition and operational sequence programming changes as required. Additional point modules may be required to implement use of these spare points.
    - 1) Provide at least one (1) spare universal input and one (1) spare universal output or 15% spare I/O of the total capacity of each B-AAC whichever is greater.
    - 2) If B-AAC I/O is not universal then provide at least one (1) spare analog input, one (1) spare digital input, one (1) spare analog output and one (1) spare digital output or 15% spare I/O of the total capacity for each point type of each B-AAC whichever is greater.
6. BACnet Application Specific Controller (B-ASC):
- a. Provide controllers conforming to the latest version of ANSI/ ASHRAE 135 BACnet Application Specific Controller (B-ASC) standard device profile and support all of the minimum required BACnet Interoperability Building Blocks (BIBBs) associated with this device profile.
  - b. Controllers shall support MS/TP communication to B-BC's, B-AAC's and other B-ASC's.
  - c. Controller shall be a microprocessor-based, 32 bit, multi-tasking, real-time digital control processor capable of stand-alone operation for control of mechanical terminal units, i.e. VAV terminal units, CAV terminal units, air terminal units, dual-duct terminal units, fan-coil units, heat pump units and roof-top units.
  - d. Each controller shall be capable of sharing point information with other B-BC, B-AAC, or B-ASC on a peer-to-peer basis via the BACnet network.
  - e. Controllers shall include all point inputs and outputs necessary to perform the specified control sequences. All inputs and outputs shall be of the universal type (outputs may be utilized either as modulating or two-state). Analog outputs shall be industry standard signals such as 24V floating control and 0-10VDC allowing for interface to a variety of modulating actuators.
  - f. Provide each controller with sufficient memory to accommodate point databases and operating and application programs. All databases and programs shall be stored in non-volatile EEPROM. The controllers shall be able to return to full normal operation without user intervention after a power failure of unlimited duration.
  - g. Each controller shall perform its primary control function independent of other BAS controller communications, or if communication is interrupted. Reversion to a fail-safe mode of operation during network interruption is not acceptable. Controller shall receive its real-time data from the Building Controller time clock to ensure network continuity.
  - h. Each controller shall include algorithms incorporating proportional, integral and derivative (PID) values for all applications. All PID values and biases shall be field-adjustable by the user via operator terminals.
  - i. Controllers shall provide diagnostic LEDs for power, communications and processor status. The controller shall continually check the status of its processor and memory circuits
  - j. All points used for a single mechanical terminal unit shall be connected to a dedicated B-ASC. Points used for control loop reset based on outside air, or space/zone temperature, or extremely remote differential pressure sensors on slow acting control loops are exempt from this requirement.
  - k. Controllers shall perform and manage historical data collection. Minimum sampling time shall be configurable with a minimum sample rate of once per second. Controller shall store point history files for all analog and binary I/O's.
7. Controllers used for air terminal units (VAV's, CAV's, dual-duct mixing boxes):
- a. Provide electronic damper operators compatible with the controller and the air terminal units provided. Actuator shall utilize a brushless DC operator, min 35 in-lbs. of torque, floating control (unless noted otherwise).
  - b. Controllers shall have an internal differential pressure transducer(s) capable of utilizing the total and static pressure signals from the air terminal unit's velocity sensor. Transducer shall be capable of 5% accuracy throughout its range of 0-1"wc. Associated velocity sensor shall be furnished by air terminal unit manufacturer.

- c. Each controller shall have electronic outputs compatible with the electronically operated air terminal unit tempering coil control valve and perimeter radiation control valve where applicable.
    - d. Provide a discharge air sensor, mounted on the discharge of the terminal box reheat coil and/or the outlet of dual duct mixing boxes, interfaced with the controller.
    - e. Each controller shall include provisions for automatic calibration of the differential pressure transducer in order to maintain stable control and prevent drift over time. The method of stroking the terminal unit damper to a 0% position shall not be permitted should the controlled space(s) require constant pressurization that would be compromised if the controller would require closing the VAV box damper. MSCC shall provide alternate controllers, programming and/or auxiliary devices (i.e. an 'auto-zero' auxiliary device(s) which functions to temporarily disengage the transducer from the air velocity sensor so that a 0 cfm air volume reading is forced without changing the damper position) when serving these spaces to prevent negatively affecting room pressurization.
    - f. If coordinated with mechanical contractor, controllers shall be furnished to the unit manufacturer for factory mounting; otherwise, controls shall be field installed.
    - g. MSCC shall provide controllers with metal enclosure, complete with conduit knockouts.
  - 8. Provide and fully implement the following application function (algorithms) in the BAS Panel. The following functions shall be operator assignable to each BAS panel.
    - a. Time and Calendar based Scheduled Operation
    - b. Automatic daylight savings time switchover
    - c. Optimum Start/Stop
    - d. Night Cycle Program
    - e. Night Purge Program
    - f. Reset Program for Set point Adjustment
    - g. Ventilation (Economizer) Program
    - h. Analog and Binary
    - i. Energy Calculations
    - j. Software Interlock
    - k. Trouble Diagnosis
    - l. Direct digital control loops for temperature control functions
- B. Panel Enclosures:
- 1. Unitized cabinet with suitable brackets for wall or floor mounting, located adjacent to each system under automatic control. Enclosures shall not be mounted directly on HVAC equipment such as air handling unit housings. Provide common keying for all panels.
    - a. Fabricate panels of 0.06 inch thick, furniture-quality steel, or extruded-aluminum alloy, totally enclosed, with hinged doors and keyed lock and with manufacturer's standard shop-painted finish.
- C. Networking Devices:
- 1. BACnet IP Routers:
    - a. BACnet router between MS/TP and B/IP (BACnet over IP) as well as a BBMD (BACnet Broadcast Management Device) for transportation of BACnet broadcasts over an IP network with several subnets.
    - b. Router shall comply with latest version of ASHRAE Standard 135 for communications.
    - c. Routers shall be UL864 listed when connected to BACnet MS/TP network segments that contain UL864 listed devices being used in a smoke control application.
    - d. Device shall be capable of routing BACnet packets over layer 3 IP network and shall support both the router and BACnet Broadcast Management Device (BBMD) networking options. BBMD shall support registrations by Foreign Devices.

- e. 24 VAC power supply required for router(s) shall be provided by the MSCC.
- f. Device shall be password protected with customizable password and security settings.

D. Power Supplies:

- 1. Power to controllers and associated controlled devices shall be 24 VAC, provided by the MSCC. Unless otherwise noted, power source (i.e. normal vs. emergency power) shall match that of the equipment being controlled.
- 2. Provide each DDC panel with a line filter, surge suppressor, electrical disconnect, control fuse, and control transformer. All sized and provided by the MSCC.
- 3. Provide fully enclosed power supplies located inside control enclosures with external 24 Vac terminals, on/off control, equipment overcurrent protection, power indication, high/low voltage separation, and convenience 120VAC outlets.
- 4. Provide insulated, modular, feed-through, clamp-style terminal blocks suitable for rail-mounting with end plates and partitions for the termination of all field wiring in control enclosures. Field wiring to equipment with integral terminals and/or unitary equipment (i.e., VAV's, EF's, etc.) shall not be required to have terminal blocks.
- 5. Provide a minimum of 72 battery backup hours for complete system RAM memory and clock, with automatic battery charger. The backup power source shall have sufficient capacity to maintain volatile memory in event of an AC power failure.

## 2.5 ACTUATORS AND OPERATORS

A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action as indicated.

- 1. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
- 2. Non-spring Return Motors for Valves Larger than NPS 2-1/2: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
- 3. Spring-Return Motors for Valves Larger than NPS 2-1/2: Size for running and breakaway torque of 150 in. x lbf.
- 4. Non-spring Return Motors for Dampers Larger than 25 Sq. Ft.: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
- 5. Spring-Return Motors for Dampers Larger than 25 Sq. Ft.: Size for running and breakaway torque of 150 in. x lbf.

B. Electronic Damper or Large-Valve Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.

- 1. Valves: Size for torque required for valve close-off at maximum pump differential pressure.
- 2. Dampers: Size for running torque calculated as follows:
  - a. Parallel-Blade Damper with Edge Seals: 7 inch pounds/sq. ft. of damper.
  - b. Opposed-Blade Damper with Edge Seals: 5 inch pounds/sq. ft. of damper.
  - c. Parallel-Blade Damper without Edge Seals: 4 inch pounds/sq. ft. of damper.
  - d. Opposed-Blade Damper without Edge Seals: 3 inch pounds/sq. ft. of damper.
  - e. Dampers with 2 to 3 Inches wg of Pressure Drop or Face Velocities of 1,000 to 2,500 FPM: Multiply the minimum full-stroke cycles above by 1.5.
  - f. Dampers with 3 to 4 Inches wg of Pressure Drop or Face Velocities of 2,500 to 3,000 FPM: Multiply the minimum full-stroke cycles above by 2.0.
- 3. Coupling: V-bolt and V-shaped, toothed cradle.
- 4. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
- 5. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on non-spring-return actuators.
- 6. Temperature Rating: Minus 22 to plus 122 deg F.

7. Temperature Rating (Smoke Dampers): Minus 22 to plus 250 deg F.
8. Run Time: Maximum 90 seconds
9. Fast Acting Actuator Run Time: Maximum 10 seconds

## **2.6 CONTROL DAMPERS**

- A. Dampers: AMCA-rated, airfoil type parallel and opposed-blade design by an ISO 9001 accredited manufacturer; 13 gauge minimum, galvanized-steel frames; damper blades shall not be less than 16 gauge galvanized steel or aluminum with maximum blade size of 8 inches wide and 48 inches long.
1. Unless otherwise noted, dampers intended for two position operation shall be parallel blade, and dampers intended for modulating control shall be opposed blade.
  2. Face and bypass dampers shall be sized to pass 100% of the associated unit rated airflow.
  3. Provide required drive axles, linkage, jackshafts, and accessories for proper damper operation. All linkages shall be located outside of the airstream.
  4. Damper blades, frames, linkages, jackshafts and other parts of the damper actuation system shall not distort or rack during operation.
  5. Dampers shall close tightly, and operate in a smooth, hesitation and slack-free manner over the entire range of travel, at the maximum air pressure and velocity at the mounting location.
  6. Multiple section dampers shall operate in unison section-to-section.
  7. Dampers shall include blade and edge seals as necessary to achieve maximum leakage of 4 CFM per sq. ft. of damper area at 1.0" WC pressure.
  8. Operating Temperature Range: From minus 40 to plus 200 deg F.
  9. Static Pressure Rating: Shall be selected to withstand the maximum pressure to be encountered upon closure at the installation location, but not less than 4.0" WC.
  10. Dampers shall be supported by properly reinforcing the ductwork at damper locations to carry the weight of the dampers, or shall be supported independent of ductwork, from the structure or floor as conditions at the site dictate. Both sides of damper frame shall be caulked.
  11. Dampers which will be exposed directly to weather shall have stainless steel axles, bearings, bushings, and fittings. Dampers which open directly to outdoors from a room such as mechanical or electrical room ventilation, shall include 1" of 1-1/2 lb. density insulation sandwiched in 16 gauge zinc coated steel blades. Bearings shall be oilite bronze.
  12. Manufacturers: Dampers shall be Ruskin, Vent Products, or approved equal. Use insulated dampers as indicated on the drawings.

## **2.7 TEMPERATURE AND HUMIDITY INSTRUMENTS**

- A. Temperature Sensors:
1. Resistance Temperature Detectors (RTD): Platinum.
    - a. Single point duct mounted RTD shall be rigid bulb type, with probe length selected accordingly for measurement near center of the duct cross sectional area
    - b. Averaging point duct mounted RTD sensor probe(s) shall be selected to appropriately cover the full duct/coil cross sectional area at the location of installation
    - c. Outside air RTD shall have sun shield to minimize solar effects and shall be mounted to minimize building outside air film effects
    - d. Immersion Type - shall be suitable for immersion into fluids in pipes with separable well and heat transfer compound, which shall be compatible with the sensors
    - e. Space temperature with a range of 55 to 95 degF, plus or minus 0.5 degF resolution, for conditioned space. Space temperature sensors installed at building exterior entrances shall include temperature sensing down to 20 degF for freeze risk monitoring.
    - f. Duct temperature with a range of 20 to 120 degF, plus or minus 0.5 degF resolution
    - g. Outside Air (OA) temperature with a range of minus 40 to plus 130 degF, plus or minus 2 degF resolution
    - h. Liquid immersion temperature sensors shall include probe with SS well, and weather tight enclosure. Sensors shall include a calibrated span of 20 to 120 degF or 30 to 250 degF for heating applications.

2. Sensors installed in wet service locations (i.e. natatorium, piping tunnels, etc.) shall be waterproof and shall be resistant to chlorine and other cleaning agents. Sensors shall have rust proof and waterproof covers.

B. Low-Limit Temperature Protection (Freeze-Stat):

1. Freeze detection controller shall open a switch (auxiliary contact for BAS alarm indication) in series with fan starter holding coil when temperature falls to controller setpoint. Controller shall be equipped with a minimum of 20 feet of copper capillary tube, which shall be placed to the downstream face of the protected coil. Controller shall be manually reset and shall open the circuit when any 12" length of the capillary reaches setting temperature. Install capillary in a horizontal pattern only. Use multiple detectors as required, do not exceed the manufacturer's maximum coverage area. Use one thermostat for every 20 sq. ft. of coil surface. Install freezestat on face and bypass coils precisely per the face and bypass manufacturer's instructions. The capillary tube shall cover only one vertical section of coil and shall not extend across any bypass portion.

C. Humidity Sensors:

1. Humidity sensor shall use a thin film capacitive sensing element to measure the relative humidity (RH) over a range of 0% to 100% RH. Accuracy shall be +/-2% RH.
2. Humidity transmitters shall be suitable for one or more of the following mounting methods:
  - a. Room Type: Shall be suitable for wall mounting with enclosure where located in a finished space.
  - b. Insertion Type: Shall be suitable for insertion into air ducts at any angle and shall have a minimum insertion of 6 inches.
3. Sensors installed in wet service locations (i.e. natatorium, piping tunnels, etc.) shall be waterproof and shall be resistant to chlorine and other cleaning agents. Sensors shall have rust proof and waterproof covers.

D. Thermostat:

1. DDC Thermostat: Thermostat for connection to DDC controllers.
  - a. Space temperature sensor with a range of 55 to 95 degF, plus or minus 0.5 degF resolution. Thermostats installed at building exterior entrances shall include temperature sensing down to 20 degF for freeze risk monitoring.
  - b. Digital temperature display
  - c. Temperature setpoint adjustment
  - d. Override button
  - e. Provide with auxiliary communications port to allow remote connection to DDC controllers.
  - f. Thermostat shall be provided with additional options and features as necessary to accommodate functions detailed in the project drawings.
2. Combination Thermostat and Fan Switches: Line-voltage thermostat with two-position, push-button or lever-operated fan switch. These line voltage thermostats control heating, cooling or year round air conditioning units in commercial, industrial or residential installations. Typical uses are for unit heaters, fan coils, blast coils, refrigerated storage room, electric heat, duct furnaces, greenhouses, etc.
  - a. Concealed auto-off-fan selector switch
  - b. Thermostat shall be placed where air circulates around it freely
  - c. Never install the thermostat on or near an outside wall
  - d. Keep the thermostat away from windows and doors
  - e. Do not locate the thermostat away from windows and doors
  - f. Do not locate the thermostat too close to a strong light or any other false source of heat such as direct sunlight, steam lines, etc.



- g. Mount the thermostat on a post or partitioning wall, but make sure that there are no pipes or ductwork in that wall or in the other side of the wall
  - h. Mount in a vertical position
- 3. Electric solid-state, microcomputer-based room thermostat.
  - a. Automatic switching from heating to cooling
  - b. Preferential rate control to minimize overshoot and deviation from set point
  - c. Set up for four separate temperatures per day
  - d. Instant override of set point for continuous or timed period from 1 hour to 31 days
  - e. Short-cycle protection
  - f. Programming based on [weekdays, Saturdays and Sundays] [every day of week]
  - g. Selection features include deg F or deg C display, 12- or 24-hour clock, keyboard disable, remote sensor, fan on-auto
  - h. Battery replacement without program loss
  - i. Thermostat display features include the following:
    - 1) Time of day
    - 2) Actual room temperature
    - 3) Programmed temperature
    - 4) Programmed time
    - 5) Duration of timed override
    - 6) Day of week
    - 7) System mode indications include "heating," "off," "fan auto," and "fan on"
- 4. Low-Voltage, On-Off Thermostats: NEMA DC 3, 24-V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater.
- 5. Line-Voltage, On-Off Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch type, or equivalent solid-state type, with heat anticipator, integral manual on-off-auto selector switch.
  - a. Equip thermostats, which control electric heating loads directly, with off position on dial wired to break ungrounded conductors.
    - 1) Dead Band: Maximum 2 deg F.
- 6. Immersion Thermostat: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range and adjustable set point.
- 7. Airstream Thermostats: Two-pipe, fully proportional, single-temperature type, with adjustable set point in middle of range and adjustable throttling range, plug-in test fitting or permanent pressure gage, remote bulb, bimetal rod and tube, or averaging element.
- 8. Unless otherwise noted, thermostats and space sensors shall not be located on exterior walls. When installation on exterior walls is required, devices shall be provided with insulated mounting bases.
- E. Outside air sensors shall be installed away from exhaust or relief vents, shall not be installed in an outside air intake, and shall generally be located to provide the best possible sensing of actual outside air conditions, free from influence from the building or operational activities. Sensors shall be installed on a North exterior building wall or an otherwise continuously, year-round shaded location. Outside air temperature sensor shall be provided with a sun shield.

## **2.8 GAS DETECTION INSTRUMENTS AND SYSTEMS**

- A. Carbon Dioxide Sensors:
  - 1. Single detectors, using solid-state infrared sensors, suitable over a temperature range of 32 to 120 deg F, calibrated for 0 to 2 percent, with continuous or averaged reading, 4 to 20 mA output.
  - 2. Space mounted Carbon Dioxide Sensors shall not include a local display.
  - 3. Manufacturer: ACI, Telaire, Vaisala, Veris

B. Carbon Monoxide Sensors:

1. Single or multichannel, dual-level detectors, using solid-state sensors with 3-year minimum life, maximum 15-minute sensor replacement, suitable over a temperature range of 32 to 120 deg F, calibrated for 50 and 100 ppm, with maximum 120-second response time to 100-ppm carbon monoxide.

C. Enclosed Parking Garage Gas Detection System:

1. Provide complete design, equipment, and installation of hazardous material gas detection and alarm system where indicated on drawings. System design and content shall meet or exceed current state and federal codes and standards; including but not limited to Michigan Building Code, Michigan Mechanical Code, and International Fire Code.
2. Provide a complete installation of a toxic gas detection system including a main control panel, sensors and audible/visual alarm devices that can be linked to a Fire Alarm and/or a Building Automation System (BAS). The system shall be manufactured by Critical Environment Technologies, Honeywell Analytics, or approved equal.
3. In addition to requirements elsewhere in this specification, submittal shall include a floorplan layout indicating equipment locations and sensing area coverage of the applicable space.
4. The system shall include the following primary components:
  - a. Main control panel with future expandability, display of toxic and flammable gas concentrations, ability to modify alarms and setpoints, automatic and manual fan start/stop, display of alarm status.
  - b. Carbon Monoxide and Nitrogen Dioxide detectors, powered by the control panel power supply. The gas transmitter will incorporate an electrochemical cell for toxic gas monitoring and a catalytic bead sensor for combustible gasses. Detectors shall be installed and configured as indicated in the table below or as determined necessary for code requirements:

GAS MONITORED	A1	A2	MOUNTING HEIGHT
Carbon Monoxide (CO)	25 PPM	50 PPM	5'6" AFF
Nitrogen Dioxide (NO <sub>2</sub> )	3 PPM	5 PPM	5'6" AFF

- c. Provide alarm horns and stackable flashing LED beacons with optional tone module inside and outside of each control area/zone and at each entrance into a control area/zone as applicable. Beacons and horns shall be general purpose, NEMA 4x for outdoors, Class 1, Div. 1 or Div. II rated explosion proof as required: red, amber and blue. Red shall be high level % LEL alarm or high level toxic alarm, Amber shall be warning level for all, Blue shall be system Malfunction/Trouble.
- d. Provide sufficient devices for mounting within the area being monitored as well as outside of each entrance to the area.
- e. Warning signs to be located at each audible and visual device indicating correct response. Signage configuration, material, and verbiage shall be reviewed with and confirmed by the Owner. Tags shall be provided for all field devices.

## 2.9 FLOW INSTRUMENTS

A. Airflow:

1. Duct Mounted Airflow Measuring Station:
  - a. Provide where indicated, airflow measuring station(s) capable of continuously monitoring the air volume capacities in which they serve.
  - b. Individual airflow traverse probes are not acceptable.
  - c. Station shall not be provided with integral air straightener, unless required by ductwork location. If installed ductwork cannot facilitate manufacturer recommended straight duct lengths without straightener, Contractor shall submit an RFI to the project Engineer for direction.

d. Velocity Pressure Type Airflow Measurement:

- 1) Each airflow traverse probe mounted within the station shall contain multiple total and static pressure sensors located along its exterior surface, and internally connected to their respective averaging manifolds. The flow sensors shall not protrude beyond the surface of the probe(s), and shall be the offset (Fechheimer) type for static pressure and the chamfered impact type for total pressure measurement. The airflow station's measured accuracy shall not be affected by directional flow having yaw and/or pitch angles up to 30°.
- 2) The airflow measuring station(s) shall have a 14 ga. [18 ga. for circular units] galvanized steel, 6" deep welding casing with 90deg connecting flanges. Total and static pressure sensors shall be located at the centers of equal areas (for rectangular ducts) or at equal concentric area centers (for circular ducts) across the station's face area.
- 3) Stations shall be AMCA certified and be capable of measuring the airflow rates within an accuracy of  $\pm 2\%$  without the use of correction factors. The maximum allowable unrecovered pressure drop caused by the station shall not exceed .025" w.c. at 2000 FPM, or .085" w.c. at 4000 FPM.
- 4) The transmitter shall be capable of receiving flow signals (total and static pressure) from an airflow station or probe array and produce dual outputs linear and scaled for air volume, velocity, differential pressure, etc.
- 5) The transmitter shall contain an integral multi-line digital display for use during the configuration and calibration process, and to display one transmitter output during normal operating mode. All transmitter configuration, parameter setting, zero and span calibration, plus display formatting and scaling will be performed digitally in the on-board microprocessor via input pushbuttons.
- 6) The transmitter will be available in multiple natural spans covering the range of 0.05 IN w.c. to 10.0 IN w.c. with an accuracy of 0.1% of natural span. The transmitter shall be furnished with a transducer automatic zeroing circuit and be capable of maintaining linear output signals on applications requiring 10 to 1 velocity (100 to 1 pressure) turndown.
- 7) The transmitter shall be capable of having its operating span electronically selected without having to perform recalibration involving an external pressure source.

2. Fan Inlet Mounted:

- a. Provide where indicated, airflow probes mounted in the fan inlets capable of continuously measuring the air handling capacity (air volume) of the respective fan(s).
- b. Velocity Pressure Type Airflow Measurement:
  - 1) The fan inlet airflow traverse probes shall contain multiple total and static pressure sensors placed at concentric area centers along the exterior surface of the cylindrical probes and internally connected to their respective averaging manifolds. Sensors shall not protrude beyond the surface of the probe, nor be adversely affected by particle contamination normally present in building system airflows.
  - 2) The fan inlet airflow traverse probes shall have symmetrical averaging signal takeoffs, and shall be of aluminum construction with hard anodized finish [copper construction] with galvanized steel mounting hardware.
  - 3) The fan inlet airflow traverse probes shall not significantly impact fan performance or contribute to fan generated noise levels. The probes shall be capable of producing steady, non-pulsating signals of standard total and static pressure, without need for flow corrections or factors, with an accuracy of 3% of actual flow over a fan operating range of 6 to 1 capacity turndown.
  - 4) The transmitter shall be capable of receiving flow signals (total and static pressure) from airflow probes and produce dual outputs linear and scaled for air volume, velocity, differential pressure, etc.
  - 5) The transmitter shall contain an integral multi-line digital display for use during the configuration and calibration process, and to display one transmitter output during normal operating mode. All transmitter configuration, parameter setting, zero and span

calibration, plus display formatting and scaling will be performed digitally in the on-board microprocessor via input pushbuttons.

- 6) The transmitter will be available in multiple natural spans covering the range of 0.05 IN w.c. to 10.0 IN w.c. with an accuracy of 0.1% of natural span. The transmitter shall be furnished with a transducer automatic zeroing circuit and be capable of maintaining linear output signals on applications requiring 10 to 1 velocity (100 to 1 pressure) turndown.
- 7) The transmitter shall be capable of having its operating span electronically selected without having to perform recalibration involving an external pressure source.

**B. Utility Monitoring**

**1. Domestic Water Flowmeter**

- a. The meter system shall consist of a primary flowmeter and local display module, factory configured for connection to specific flowmeter. Meters of pipe size 1/2 inch to 2 1/2 inch shall be Inline Ultrasonic type as specified below. Meters of pipe size 3 inch and greater shall be Electromagnetic type as specified under "Liquid Flow" above.
- b. Ultrasonic type flow meter shall be an inline flowmeter complete with direct beam wetted ultrasonic transducers, temperature sensor, mounting hardware and calibration certificate. Ultrasonic flow sensing element shall utilize matched direct path, wetted ultrasonic transducers and 1000 OHM Platinum RTD.
  - 1) Construction: Flowmeter shall consist of a drop forged corrosion resistant metal flow body with process connections, integral transducers and a processor / transmitter. All wetted materials shall be ANSI/NSF 61 & 372 compliant.
  - 2) Maximum Pressure Rating: 400 psi
  - 3) Maximum Temperature Rating: 250°F
  - 4) Accuracy:  $\pm 1\%$  of flowrate over a 25:1 turndown
- c. Provide a phenolic tag for each flowmeter to identify service and meter ID number
- d. Manufacturer: Onicon, Rosemount (or approved equal)

**2.10 PRESSURE INSTRUMENTS**

**A. Air Pressure Sensors:**

1. Accuracy: 1% of full scale
2. Duct Mounted Sensors:
  - a. Provide duct mounted static pressure probe including minimum 3" duct insertion and pressure transmitter connected via pneumatic tubing.
  - b. Pressure transmitter shall be selected and calibrated for operations between 0 and 200% of the maximum normal operating pressure.
3. Space Pressure Sensors:
  - a. Provide two ceiling or wall mount static pressure pickups including filter and differential pressure transmitter connected via pneumatic tubing. Transmitter shall be located to minimize pneumatic tubing length.
  - b. Sensing range: -0.10 to +0.10" WC
4. Pressure Switches:
  - a. Shall provide electrical switching action upon a sensed pressure differential increase between two points. Sensitivity shall be suitable for the application. Set point shall be adjustable over

the full range of the device. Switching action shall SPDT. Electrical switch rating shall be 10 amps at 120 VAC, minimum.

- b. Pressure rating of switch and connecting tubing:

- 1) Fan - Rated for 12 inches WC.
- 2) Pump – Maximum deadhead system pressure.

- c. Switches used for safety shutdown applications shall be of the manual reset type.

B. Pressure Switches:

1. Shall provide electrical switching action upon a sensed pressure differential increase between two points. Sensitivity shall be suitable for the application. Set point shall be adjustable over the full range of the device. Switching action shall SPDT. Electrical switch rating shall be 10 amps at 120 VAC, minimum.
2. Pressure rating of switch and connecting tubing:
  - a. Fan - Rated for 12 inches WC.
  - b. Pump – Maximum deadhead system pressure.
3. Switches used for safety shutdown applications shall be of the manual reset type.

## 2.11 ELECTRICAL COMPONENTS AND ACCESSORIES

A. Components:

1. Control Relays:
  - a. Control relays shall be provided with two spare, unused contacts, one normally opened and the other normally closed.
  - b. All relays shall be plug-in interchangeable mounted on a circuit board and wired to numbered terminal strips.
  - c. Start/stop relay module shall provide either momentary or maintained switching action as appropriate for the motor being started.
2. Current Switches:
  - a. Current Sensing Switches (CS): CS shall be utilized for monitoring motor operation. Switch shall be adjustable so that a contact closure is made any time the motor is operating within a "normal" range (1.25-50 amps). Low motor amps resulting from low loading or belt failure shall indicate "OFF". Induced current from the motor power feed shall power CS. The CS shall provide visual indication (LED's) for output status and sensor power; shall have an adjustable trip set-point to  $\pm 1\%$  of its range from -15 to 60°C; shall be isolated to 600 VAC rms; shall be a self gripping split-core type with an optional drill mount bracket; output shall be N.O., solid state, 1.0 A at 30 VAC/DC with a minimum aperture of .52" x .68" for motor power feed. CS shall be a Hawkeye model #H-608 as supplied by Veris Industries, Inc. or equal.
  - b. Motor Status: The contractor shall provide and install a current sensing switch on any motor required to have motor status. The split-core current switch shall be clamped around one of the three phase motor conductors. The contractor shall adjust the switch per the manufacturer's recommendations to provide status only when the motor driven device (fan, pump, etc.) is operating normally.

B. Wiring and Conduit:

1. Control wiring and cabling shall be per National Electrical Code (NEC) requirements and equipment manufacturer's recommendation and requirements of the mechanical control systems.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Label every single control device and component including, but not limited to, space sensors, well sensors, AFS's, control panels, damper actuators, VAV box controllers, valves, outdoor air sensors, relays, pressure sensors, differential pressure transmitters, pressure switches, etc. Label must include plain English descriptor and BAS point ID that matches the ID on the OWS exactly.
- B. Verify that conditioned power supply is available to control units and operator workstation.
- C. Verify that duct-, pipe-, and equipment-mounted devices and wiring and pneumatic piping are installed before proceeding with installation.

#### **3.2 COMMISSIONING**

- A. This contractor shall make available a qualified technician that is familiar with the installation of this job for technical assistance to the commissioning engineer. No additional paperwork or reports will be required by this process. Where multiple operations in multiple locations are required to test equipment affected under this contract, the appropriate number of staff shall be required.

#### **3.3 INSTALLATION**

- A. Install equipment level and plumb.
- B. Install software in control units and OIS. Implement all features of programs to specified requirements and as appropriate to sequence of operation.
- C. Connect and configure equipment and software to achieve the sequence of operation specified.
- D. Verify location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation. Locate all 48 inches above the floor.
  - 1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.
- E. Install guards on thermostats in the following locations:
  - 1. Entrances
  - 2. Public areas
  - 3. Where indicated

#### **3.4 ELECTRICAL WIRING AND CONNECTION INSTALLATION**

- A. Control wiring in exposed areas and within walls shall be in conduit or EMT as specified in the Electrical Requirements - Division 26.
- B. Low voltage control wiring in plenum areas and ceiling cavities shall be plenum rated cable installed parallel or perpendicular to the building structure. Install control wire in bridle rings every 10' and change in direction. Label control wire as such at each bridle ring. **This item will be strictly enforced.**
- C. Space sensor wires that cannot be run within a wall cavity shall be run in one-piece steel surface raceway (Wiremold V500 or equal) and painted to match the existing finish. Fill and patch any cavities left by previous sensors. Paint to match existing finish.

### **3.5 CONNECTIONS**

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
  - 1. Install piping adjacent to machine to allow service and maintenance.
- B. Ground equipment.
  - 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

### **3.6 SENSORS, RELAYS, CONTROLS AND ASSOCIATED COMPONENTS**

- A. Location – Accessibility:
  - 1. Locate controls, relays, instruments, switches, valves, devices and accessories so they are readily accessible for adjustment, service and replacement or as indicated. Conceal tubing, sensing lines, cables and capillaries in all areas except equipment rooms and other unfinished spaces. Install and route tubing, sensing lines, cables, capillaries and conduits parallel and perpendicular to building steel in parallel banks with changes of direction made at 90 degree angles.
- B. Location – Sensing Air:
  - 1. Locate, size, and support temperature sensing elements in air streams to properly sense the representative temperature. In the case of controlling, transmitting and indicating elements, the sensing device shall be located, sized and of the type to sense the average condition. In case of safety elements, the sensing device shall be located and of the type to sense the extreme condition.
  - 2. Sensing elements in double wall casings and insulated ducts shall have the entire active portion within the air stream.
- C. Insulation:
  - 1. Where insulation is penetrated due to the installation of sensing elements or tubing, reseal the openings air and vapor tight. Where control devices are to be located on insulated surfaces, provide brackets to clear the finished surface of the insulation avoiding punctures of the vapor seal.

### **3.7 VIBRATION ISOLATION**

- A. Components:
  - 1. Provide vibration isolation for controllers and components, either by location or by mounting devices.
- B. Conduit and Tubing:
  - 1. Install tubing and conduit to preclude nullification of provisions for vibration isolation of equipment and ducting. Mount single tube runs in aircraft type clamps containing an elastomer insert. Mounting shall prevent contact with ducting and air handling unit housing, casing or enclosure. Multiple runs shall conform to the same isolation requirements but details of mounting shall be submitted for approval. Provide looped rubber hose connection when tubing crosses flexible duct and equipment connectors.

### **3.8 FASTENING TO BUILDING STRUCTURES**

- A. The methods of attaching or fastening equipment or equipment supports or hangers to the building structure shall be subject to approval by the AE. Submit shop drawings or samples for approval before proceeding with the work.
- B. Drilling, welding or the use of explosive driven fasteners on building structures shall require written prior approval by the AE for each type of application except where indicated.
- C. Equipment shall not be attached to or supported from the roof deck, from removable or knockout panels, or temporary walls or partitions.
- D. Electrical equipment mounted against exterior masonry walls shall be mounted at least 1 inch away from the wall surface.

### **3.9 FIELD QUALITY CONTROL**

- A. After the inspection has been completed, check systems for continuity.
- B. After completion of system installation, the Contractor shall test, adjust, and readjust as necessary, all control equipment in terms of design, function, systems balance, performance, and otherwise make ready for air handling systems acceptance tests.
- C. After systems acceptance and after the systems have operated in normal service for two weeks, check the adjustment on instruments and devices and correct items found to be out of order. When systems are in specified operating condition, and other pertinent specifications have been complied with, temperature control systems will be accepted for heating, ventilating and air conditioning systems. Readjustments necessary to accomplish the specified results shall be made during the warranty period upon request.
- D. Coordinate with system manufacturer's representative the time of the final system check.
- E. Provide equipment to check the calibration of instruments. Instruments not in calibration shall be recalibrated to function as required, or shall be replaced.
- F. Calibrate and adjust control devices, linkages, accessories, and components for stable and accurate operation to meet the design intent and to obtain optimum performance from the equipment controlled. Final adjustment, calibration and checking shall be performed while the respective controlled systems are in full operation. Cause every device to automatically function as intended to ensure its proper operation.
- G. After calibrations, adjustments, and checking have been completed and systems are operational, demonstrate to the administrative authorities having jurisdiction and to the AE the complete and correct functioning of all control systems and equipment. These demonstrations shall consist of operating the controls through their normal full ranges and sequences. Simulate abnormal conditions to demonstrate proper functioning of safety devices. Readjust settings to their correct design values, and after sufficient time, observe ability of controls to establish the desired conditions, noting abnormal deviations. Make necessary repairs, replacements or adjustments on items which fail to perform satisfactorily and repeat tests to demonstrate compliance with the design intent.

### **3.10 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain control systems and components.
  - 1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
  - 2. Provide operator training on data display, alarm and status descriptors, requesting data, executing commands, calibrating and adjusting devices, resetting default values, and requesting logs.



3. Review data in maintenance manuals.
4. Schedule training with Owner, through Architect, with at least seven days' advance notice.

**3.11 ON-SITE ASSISTANCE**

- A. Occupancy Adjustments: Within one year of date of Substantial Completion, provide up to three Project site visits, when requested by Owner, to adjust and calibrate components and to assist Owner's personnel in making program changes and in adjusting sensors and controls to suit actual conditions.

**3.12 OWNER'S INSTRUCTION**

- A. The MSCC shall Provide a training program encompassing equipment and systems for client's operating and maintenance personnel. Coordinate training schedule with the Owner.
- B. Training staff shall include Contractor's personnel supplemented by equipment manufacturer's engineering representative.
- C. Utilize corrected equipment and system shop drawings, manuals, demonstration apparatus and installed, functioning equipment.
- D. During system commissioning and when acceptable performance of the system hardware and software has been established, provide on-site operator and maintenance personnel instruction. Instruction shall be by acceptable competent Contractor Representatives familiar with the systems and computer software, hardware, and accessories.
- E. Provide 4 hours of "classroom" instruction to the client's personnel on the operation of DDC System equipment. Operator instruction shall include the overall operational program, equipment functions (both individually and as part of the total integrated system), commands, advisories, and appropriate operator intervention required in responding to the systems operation. Use the operating and maintenance manuals described above as texts during the instructional period. Instruction shall also include description of the chronological information flow from field sensors, contacts and devices to the DDC System. The overview of the system's communication network shall be to provide an understanding to the client's personnel of the interplay between initiating devices, data gathering locations, loop communications and their importance within the DDC System.

**END OF SECTION 23 0900**

## **SECTION 23 3100 – METAL DUCTS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Ductwork Construction and Application Schedule
  - 2. Ductwork materials, plenums, construction, fabrication and support
  - 3. Galvanized steel ductwork
  - 4. Round and flat oval ductwork
  - 5. Reinforcing and supports
  - 6. Double-walled panels, plenums, and duct at outside air intake plenums
  - 7. Bellmouth connections
  - 8. Duct sealants
  - 9. Duct cleaning and disinfecting
  - 10. Duct installation, sealing, inspection, and leakage testing

#### **1.3 PERFORMANCE REQUIREMENTS**

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible", 2005 and performance requirements and design criteria indicated in the "Ductwork Construction And Application Schedule" that follows in this Section.
- B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible", 2005.
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

#### **1.4 SUBMITTALS**

- A. Product Data: For each type of the following products:
  - 1. Project specific duct fabrication schedule including materials, methods of installation, and location of fitting types. Indicate the metal gage and reinforcement method intended for each pressure classification and size of duct.
  - 2. Construction details for double wall duct and panels, plenums, stacks, canopy hoods, etc.
  - 3. Double wall duct and panel fill material
  - 4. Hangers and supports
  - 5. Duct fittings (manufacturer supplied and contractor fabricated)
  - 6. Turning vanes
  - 7. Duct sealant
  - 8. Flexible duct
  - 9. Clothes dryer duct and fittings

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Duct layout indicating sizes, configuration and static-pressure classes.
3. Elevations indicating top and bottom height of ducts.
4. Dimensions of main duct runs from building grid lines.
5. Penetrations through fire-rated and other partitions.
6. Equipment installation based on equipment being used on Project.
7. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
8. Hangers and supports, including methods for duct and building attachment

**1.5 QUALITY ASSURANCE**

- A. Manufacturers and Products: The products and manufacturers specified in this Section establish the standard of quality for the Work. Subject to compliance with all requirements, provide specified products from the manufacturers named in Part 2.
- B. Reference Standards: Products in this section shall be built, tested, and installed in compliance with the following quality assurance standards; latest editions, unless noted otherwise.
- 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 A 666 – Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, And Flat Bar.
- E. ASTM B 209 & 209M – Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate.
- F. NFPA 90A – Standard for the Installation of Air Conditioning and Ventilating Systems.
- G. NFPA 90B – Standard for the Installation Of Warm Air Heating and Air Conditioning Systems.
- H. NFPA 91 – Standard for Exhaust Systems for Conveying of Materials
- I. NFPA 92A – Standard for Smoke Control Systems.
- J. NFPA 92B – Standard for Smoke Management Systems
- K. NFPA 96 – Standard for Ventilation Control of Cooking Operations
- L. NFPA 99 – Standard for Health Care Facilities
- M. SMACNA – All standards
- N. AWS - All applicable standards
- O. UL 181, 181A, & B – Factory-made Air Ducts and Connectors and Closure Systems
- P. UL 760 – Standard for Exhaust Hoods For Commercial Cooking Equipment
- Q. UL 723 – Standard for Surface Burning Characteristics of Building Materials
- R. Air Diffusion Council – Flexible Duct Performance and Installation Standards
- S. National Air Duct Cleaners Association (NADCA).

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. Provided duct and fittings of G90 galvanized steel unless otherwise indicated.
- B. Construct duct and fittings in compliance with SMACNA standards and recommendations and per the additional requirements indicated.
- C. Duct dimensions indicated on drawings are inside dimensions. The sheet metal dimensions shall be increased an equivalent amount to accommodate internal liner where liner is indicated.
- D. Drawings are diagrammatic and indicate the arrangement of the principal apparatus and ductwork and shall be followed as closely as possible. All the required offsets, rises, drops, fittings and accessories may not be indicated on the drawings, but shall be provided as required for a complete and fully functional system. Carefully investigate structure, finish conditions, and the work of other trades affecting sheet metal work, including work associated with testing, adjusting and balancing, in order to arrange all items accordingly. Provide best possible arrangement to provide maximum headroom and maintenance clearances.
- E. In addition to sheet metal ductwork specified herein, provide or install as furnished by other sections, accessories and devices including, but not limited to, smoke detectors, plenums, canopy hoods, control dampers, and blank-off panels at unused louver areas.
- F. Provide intake and exhaust/relief air plenums attached to louvers.
- G. Alternate Joining Methods: As an alternate to SMACNA joining methods, Contractor may propose proprietary joining systems with performance equivalent to SMACNA for Owner's review and approval.

DUCTWORK CONSTRUCTION AND APPLICATION SCHEDULE			
GENERAL SUPPLY/RETURN/TRANSFER/EXHAUST DUCTWORK			
DUCT	PRESSURE CLASS (IN. W.G.)	MATERIAL	NOTES
SUPPLY FROM AHU TO TAU	+6.4	G-90	---
SUPPLY DOWNSTREAM FROM TAU	+2	G-90	---
RETURN DOWNSTREAM FROM TAU AND IN SHAFTS TO RF	-3	G-90	
RETURN UPSTREAM FROM TAU	-2	G-90	
RETURN FROM RF TO AHU	+3	G-90	
RELIEF/EXHAUST FROM RF/EF	+3	G-90	---
SUPPLY DOWNSTREAM FROM FCU/HEAT PUMP/VRF UNIT	+2	G-90	---
RETURN UPSTREAM FROM FCU/HEAT PUMP/VRF UNIT	-2	G-90	---
TRANSFER DUCT	+2	G-90	---
LINEAR SUPPLY/RETURN GRILLE PLENUM	+2	G-90	---
EXHAUST ON ROOF	± 2	316L S.S. OR ALUM.	---
PLENUMS	± 6	SAME AS DUCTS SERVED	---
EXHAUST STACKS	+3	316L S.S.	1
ALL OTHER SUPPLY/RETURN/EXHAUST NOT SPECIFICALLY IDENTIFIED	± 2	N/A	G-90

DUCTWORK CONSTRUCTION AND APPLICATION SCHEDULE			
GENERAL SUPPLY/RETURN/TRANSFER/EXHAUST DUCTWORK			
DUCT	PRESSURE CLASS (IN. W.G.)	MATERIAL	NOTES
<u>ABBREVIATIONS</u> EF = EXHAUST FAN FCU = FAN COIL UNIT RF = RETURN FAN TAU = TERMINAL AIRFLOW UNIT		<u>NOTES</u> 1. MUST BE 100% LEAK PROOF WELD.	

## 2.2 DUCTWORK MATERIALS AND FABRICATION

### A. General Ductwork Fabrication Requirements

1. General: Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction with galvanized, sheet steel, according to SMACNA's 2005 "HVAC Duct Construction Standards--Metal and Flexible." Comply with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals
  - a. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure classification
  - b. Materials: Free from visual imperfections such as pitting, seam marks, roller marks, stains, and discolorations
2. Provide fittings, branches, inlets and outlets in such a manner that air turbulence is reduced to a minimum.
3. Turns
  - a. Use radius type elbows wherever possible. Where it is not possible to install a 1.5 times width to centerline radius elbow (full radius elbow), use lesser radii configurations, with 'radius-proportional' splitter vanes permanently installed within. No radius shall be less than 1.0 times width. Provide square elbows of equivalent pressure drop in rectangular ducts where radius elbows will not fit or where specifically noted on drawings. Elbows shall be installed with turning vanes in accordance with Related Section "HVAC Duct Accessories." Stamped elbows may be used up to and including a diameter of 12 in.
4. Transitions
  - a. Limit transition angles (for each side) to 15 degrees diverging and 30 degrees converging.
5. Take-Off Fittings
  - a. For take-offs carrying more than 25 percent of duct main, provide an increasing branch elbow with an inside radius equal to branch duct width. Size branch and main at elbow for equal velocity.
  - b. For take-offs carrying 25 percent or less of duct main, provide flanged increased area branch take-off (45 degree entry, "shoe" type) or 45 degree lateral wye takeoffs. Conical fittings shall be used for spiral, round, and oval ductwork.
  - c. For take-offs directly to side outlet for register or grille, provide an increased area tap. For take-offs directly to diffusers see appropriate SMACNA figures.
  - d. Acceptable take-off fitting manufacturers: Sheet Metal Connectors, Inc.; United Sheet Metal; McGill Airflow LLC; Foremost; Tangent; Flexmaster; SEMCO Inc.
6. Crossbreak or bead rectangular ductwork.
7. Rectangular duct longitudinal seams shall be Pittsburgh lock 3/8 in. minimum pocket.

8. Bolts and Fasteners
  - a. Carbon steel, zinc coated per ASTM A153 for G-90 and stainless steel for aluminum and stainless steel ducts.
9. Welding Materials
  - a. Refer to SMACNA "Guidelines for Welding Sheet Metal" for applicable requirements.
- B. Galvanized Steel Ductwork
  1. Minimum steel rectangular duct gage shall be as follows:
    - a. Ducts through 12 in. wide: 24 Gage
    - b. Ducts 13 in. through 30 in. wide: 22 Gage.
    - c. Ducts 31 in. through 84 in. wide: 20 Gage.
    - d. Ducts 84 in. and larger: 18 Gage
  2. Lock-forming quality ASTM A653, A924 mill galvanized steel sheet, 1.25 oz per sq. ft. zinc coating on each side in conformance with coating designation G-90. Mill-phosphatized finish for surfaces of ducts exposed to view.
- C. PVC-Coated Galvanized Steel Ductwork
  1. Minimum steel rectangular duct gage shall be as follows:
    - a. Ducts through 12 in. wide: 24 Gage
    - b. Ducts 13 in. through 30 in. wide: 22 Gage.
    - c. Ducts 31 in. through 84 in. wide: 20 Gage.
    - d. Ducts 84 in. and larger: 18 Gage
  2. UL 181, Class 1 Listing. Lock-forming quality ASTM A653, A924 mill galvanized steel sheet, 1.25 oz per sq. ft. zinc coating on each side in conformance with coating designation G-90. Factory-applied, 4 mil PVC coating on exposed surfaces of ducts and fittings (exterior of ducts and fittings for underground applications and interior of ducts and fittings for fume-handling applications) and with factory-applied, 2 mil PVC coating on reverse side of ducts and fittings.
- D. Galvanized Touch-Up Paint: Inorganic zinc-rich touch up paint containing a minimum of 65 percent metallic zinc by weight for damaged galvanized coating.
  1. Acceptable manufacturers/product: Carboline/Carbo-Zinc, Tnemec/Tneme-Zinc
- E. Aluminum Sheets: ASTM B 209, Alloy 3003, Temper H14, sheet form with standard, one-side bright finish for ducts exposed to view and with mill finish for concealed ducts.
- F. Round and Flat Oval Ductwork
  1. All round and oval duct shall be manufactured of spiral lock seams, with minimum gage per the appropriate SMACNA Tables and per manufacturers recommendations. Ductwork up to 12 in. diameter and 2 in. w.g. can be manufactured with longitudinal lock seams.
  2. Tees shall be conical. Laterals shall be straight. Taps through 10 in. diameter in size shall have a machine drawn entrance and fittings shall have longitudinal seams, continuously welded. Both sides of welds shall be primed with zinc chromate. Tap entrances shall be free of weld build-up.
  3. Elbows in diameters 2 in. through 10 in. shall be stamped or pleated. Elbows shall be 5 gore for 90 degrees and 3 gore for 45 degrees. Elbows shall have 1.5 times width to centerline radius (full radius elbow).
  4. Flanges, access doors and taps into spiral ducts shall be factory fabricated.

5. Field joints in diameters through 48 in. shall be made with 2 in. long slip-fit, sleeve coupling, or flanges. Ductwork 48 in. diameter and over, and for all sizes where disassembly or removal is required, shall be joined with flanges.

G. Reinforcing and Supports

1. Structural steel per ASTM A36; Mill galvanized per ASTM A653, Coating Designation G-90. Equivalent rolled steel structural support systems (such as TDF or TDC) may be used in lieu of mill rolled structural steel. Use double nuts and lock washers on threaded rod supports.
2. Tie-Rods
  - a. Maximum tie rod spacing shall be 42 in., unless specifically engineered in accordance with SMACNA Industrial Rectangular Duct Standard.
  - b. Minimum tie rod diameter shall be 1/2 in.
  - c. Tie Rods shall not be used in any plenum or ducts that require access.
  - d. Tie rods shall not be used in any PCD, cage wash, stainless steel, or ducts carrying lint.
  - e. Tie rods shall not be used in any return or exhaust ducts in health care facilities.

**2.3 DOUBLE-WALLED PANELS, PLENUMS AT OUTSIDE AIR INTAKE AND FIELD-BUILT SUPPLY AND RETURN AIR PLENUMS**

- A. Double-walled type panels, 2-1/2-in.-thick, constructed from smooth or embossed mill finish G-90 galvanized steel or aluminum facing sheets. Each panel shall contain an integral frame of G-90 galvanized steel or extruded aluminum bonded to the facing sheets to provide a moisture-tight seal at the panel perimeter. Panels shall be load bearing and capable of forming the plenum or duct without the installation of structural members. Join panels together with G-90 galvanized steel or extruded aluminum mullions and fasten with closed end rivets. Make connections to the duct or plenum using a support mullion that is an integral part of the panel and not bolted to or through the panel. Gasket all joining mullions with a double vinyl gasket or a double butyl gasket to provide a permanent air-tight seal. Design panel skins, core density, rib spacing, and mullion spacing to eliminate panel pulsation and to a maximum deflection of 1/200 of any span at design pressure, positive or negative. The overall "U" factor of the panels shall not exceed 0.14 BTU/ft<sup>2</sup>/°F.
- B. Removable panels shall be the same construction as described above, with double seals around periphery to guarantee tight closure.
- C. Access doors shall be constructed as follows.
  1. Doors shall be minimum 24 in. wide whenever possible, or widths as indicated on drawings. Provide doors that are the full height of the panel, maximum 5 ft. high.
  2. Each access door shall be equipped with continuous double gaskets and shall fit in the door frame in a manner to guarantee tight closure.
  3. Hinges and hardware shall be galvanized, stainless steel or aluminum. Outdoor unit hardware shall be stainless steel, or aluminum. Provide at least 2 handles per door, operable from either side.
  4. Access doors in positive pressure sections shall open inward, in negative pressure sections shall open outward.
  5. Where indicated, provide a glass window in the access door, minimum 6 in. by 6 in. size, located at a height convenient for viewing, sealed to prevent leakage, rated to operate safely against the duct/plenum pressure rating. Provide double pane insulating type glass at all locations connected to outdoors/exterior or exposed to air temperatures below 55F; single pane at other locations.
- D. The manufacturer shall have published literature available stating the coefficient of absorption and the sound transmission loss characteristics of the panels system per ASTM C 423 and the sound transmission loss properties per ASTM E 90 and E 413. Published acoustic data shall show the trademark or name of the manufacturer, shall have been verified by a recognized independent testing laboratory, and shall specify the coefficient of acoustic absorption and attenuation by octave band. Submit acoustic

performance data in graphic and tabular form as part of the shop drawings. Minimum panel performance for 2-1/2 inch thick panels shall be as follows:

Frequency	125	250	500	1000	2000	4000
Transmission Loss (dB)	14	22	28	35	43	48
Absorption Coefficient	0.3	0.7	0.95	0.95	0.95	0.85

- E. The duct and plenum systems, in addition to supporting indicated equipment, scheduled maximum operating pressure, and system test pressure, shall sustain a 35 lb. per sq. foot maintenance function load without permanent deformation or damage.
- F. Acceptable Manufacturers.
  - 1. McGill Airflow LLC.
  - 2. SEMCO Mfg Co.
  - 3. Vibro-Acoustics

## 2.4 BELLMOUTH CONNECTIONS

- A. Bellmouth fittings shall be constructed to match material requirements as indicated on drawings.
- B. Bellmouth shall have a minimum radius of 1 1/2 in. with 1/2 in. flange and 1/2 in. by 1/8 in. thick neoprene gasket.
- C. Acceptable Manufacturers.
  - 1. Buckley Associates
  - 2. McGill Airflow LLC
  - 3. SEMCO Mfg Co.

## 2.5 DUCT SEALANTS

- A. Solvent-based sealants may only be used if the outdoor air temperature will be below 40°F within 24 hours of applying.
- B. Sealant shall be non-asbestos type, and comply with UL and NFPA 90A.
- C. Sealant: Water or solvent based elastomeric compound, gun or brush grade, maximum 25 flame spread and 50 smoke developed (dry state) specifically for sealing ductwork. Use products as recommended by manufacturer for low, medium or high-pressure systems
  - 1. Acceptable Manufacturers.
    - a. Hardcast
    - b. McGill Airflow LLC
    - c. Polymer Adhesives
    - d. Ductmate
- D. Tape shall not be used.
- E. Gaskets and mastics used for flanged joints shall be compatible for the service of use and per the manufacturer's recommendations.



## **2.6 DUCTWORK CLEANING AND DISINFECTING**

- A. When ductwork is indicated on the drawings to be cleaned and disinfected, the minimum requirements for commercial HVAC system cleaning shall be as described in the National Air Duct Cleaners Association (NADCA) "General Specifications for the Cleaning of Commercial Heating, Ventilation and Air Conditioning Systems".
- B. Approved Cleaning Specialists.
  - 1. Sani-Vac Service
  - 2. Power Vac
  - 3. High Tech Vacuum
  - 4. Aero Filter Inc

## **PART 3 - EXECUTION**

### **3.1 GENERAL SHEET METAL DUCTWORK INSTALLATION**

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Ductwork shall be installed to true alignment, parallel or perpendicular to adjacent building walls, floors and ceilings, to present a neat and quality workmanlike appearance.
- D. Provide necessary offsets and transitions to avoid interference with the building construction, piping, or equipment. Locate ducts with sufficient space around equipment to allow operating and maintenance activities.
- E. Bullhead tees and straight tap connections are not acceptable.
- F. Provide straight runs of ductwork, upstream and downstream, at equipment, fans, coils, air terminal units, humidifiers and the like per manufacturer's recommendations and as indicated on drawings.
- G. Provide flexible connector where ductwork connects to fans, air handling units (unless internally isolated), other rotating equipment, and where indicated on drawings.
- H. Repair damaged galvanized surfaces with zinc rich paint.
- I. For ductwork mounted outdoors, install duct with slight lateral pitch to prevent water ponding on top of duct.
- J. Enclose dampers located behind architectural intake or exhaust louvers in a sheet metal collar and seal to building construction.
- K. Air volume control on parallel flow branches shall be accomplished with branch dampers. Splitter type dampers are not acceptable.
- L. Install special equipment items in ductwork systems including, but not limited to: control dampers, thermometers, airflow measuring devices and other related items, according to manufacturer's recommendations.

- M. Set plenum doors 6 in. to 12 in. above floor. Arrange door swings so that fan static pressure holds door in closed position.
- N. Store duct at least 4 in. above floor on wood pallets or similar devices. Protect duct from odors, dust, moisture, and other debris while stored on or off the jobsite, and when transporting to the jobsite, by tightly covering with plastic.
- O. Ductwork openings shall remain protected and covered until just prior to connection. Immediately after assembly, restore all protection to prevent odors, dust, moisture, and other debris from entering ductwork system. Remove any internal labels.
- P. Provide required penetrations and sleeves in building structure.
- Q. Blank-off panels shall be screwed to louver blades and caulked to provide a weather tight seal.

### **3.2 FLEXIBLE DUCTWORK INSTALLATION**

- A. Flexible duct runs shall not exceed 5 ft. long. Cut to length so that it is not compressed. Trim ends squarely. Sag shall not exceed 1/2 in. per linear foot when installed horizontally.
- B. Provide a minimum of 3 ft. of flexible non-metallic duct at connections to supply, return and exhaust diffusers/grilles mounted in horizontal ceilings, unless otherwise noted.
- C. Support at a maximum spacing of 2 ft. using 4 in. wide sheet metal protection saddles at each duct hanger. Flex duct directional changes shall not exceed 45 deg with centerline radius of bend no less than one-half times duct diameter.
- D. For connection to supply, return and exhaust diffusers/grilles located in horizontal ceilings, use pre-fabricated 90 degree plastic supports (such as the Flexflow Elbow by Thermaflex), or 90 degree sheet metal elbow fittings.
- E. Apply duct sealant to outside surface of collars and secure with metallic draw-band where flexible duct joins other duct or devices.
- F. Flexible duct shall not be used to connect terminal units to branch or main ducts.

### **3.3 PVC-COATED DUCT INSTALLATION**

- A. Install PVC-coated duct and fittings according to manufacturer's written instructions.
- B. Seal all joints and seams. Apply sealer to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.
- C. Secure couplings with sheet metal screws. Install screws at an interval of 12 inches, with a minimum of three screws in each coupling.
- D. Repair damage to PVC coating with manufacturer's recommended materials.

### **3.4 UNDERSLAB DUCT INSTALLATIONS**

- A. Verify undamaged conditions of duct before enclosure with fill or encasement.
- B. Install under slab ducts according to SMACNA's 2005 "HVAC Duct Construction Standards--Metal and Flexible" and as indicated.

- C. Protect ducts from damage by equipment used in placing concrete on or around ducts.
- D. Protect duct openings.

### **3.5 RANGE HOOD EXHAUST DUCT INSTALLATIONS**

- A. Install ducts to allow for thermal expansion of ductwork through 2,000 deg F temperature range.
- B. Install ducts without dips or traps that may collect residues unless traps have continuous or automatic residue removal.
- C. Install access openings at each change in direction and at 50 foot intervals; locate on sides of duct a minimum of 1-1/2 inches from bottom; and fit with grease-tight covers of same material as duct.
- D. Do not penetrate fire-rated assemblies.

### **3.6 SHOP APPLICATION OF LINER IN RECTANGULAR DUCTS**

- A. All duct liner shall be installed in accordance with the requirements of the NAIMA Fibrous Glass Duct Liner Standard or SMACNA HVAC Duct Construction Standard and the herein requirements.
- B. Duct liner shall be kept clean and dry during shipping, storage, job site installation, commissioning and system operation. All lined ductwork shall be protected from any moisture using secured plastic and stored on wood palates until installed. During installation, protect open ended ducts with plastic.
- C. The liner shall be cut and fitted to ensure all joints are neatly and tightly butted with no interruptions or gaps. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
- D. Provide a perforated inner metal liner over the duct liner in any system with high in duct velocities exceeding 5500 fpm.
- E. Do not apply liners in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and standard liner product dimensions make longitudinal joints necessary.
- F. All duct liner products shall be adhered to the sheet metal ductwork using an adhesive meeting the requirements of ASTM C916.
- G. Adhere a single layer (multiple layers of duct liner to achieve indicated thickness are prohibited) of indicated thickness of duct liner with a minimum of 90 percent coverage of adhesive on the metal surfaces. Apply adhesive to duct liner facing in direction of airflow not receiving metal nosing. Mechanical fasteners of the specified type and length shall be used, ensuring no greater than 10% compression of the liner thickness.
- H. In Addition to applying adhesive, secure duct liner to the sheet metal ductwork using weld secured mechanical fasteners. Butt transverse joints without gaps and coat joint with adhesive. Secure liner per SMACNA Standards with welded mechanical fasteners, 4 inches from corners and at intervals not exceeding 12 inches transversely around perimeter; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
- I. Butter all raw edges to coat duct cut-ins and/or minor installation damage.
- J. Secure transversely oriented liner edges facing the airstream with metal nosing that have either channel or "Z" profile or are integrally formed from duct wall. Fabricate edge facings at the following locations:
- K. Fan discharge.

- L. Intervals of lined duct preceding unlined duct.
- M. Upstream edges of transverse joints in ducts.

### **3.7 DUCTWORK HANGERS AND SUPPORTS**

- A. Generally, hang and support ductwork per the latest edition of SMACNA. Additionally, adhere to the more specific requirements found in this specification section and as indicated on the Project drawings.
- B. Hanging duct, equipment, or accessories with cables or wires is prohibited.
- C. Comply with Project drawing details regarding hangers, building attachments, fasteners, beam clamps and retaining clips, and as noted below.
- D. Provide vibration isolation as specified in the related Specification Section.
- E. Ductwork shall be supported and anchored to structure so that horizontal ducts are without sag or sway, vertical ducts without buckle, and so that all ducts are free from deformation, collapse or vibration.
- F. Support un-insulated rectangular ducts in sizes to 36 in. by non-perforated galvanized steel strap or by trapeze hangers. Support insulated rectangular ducts and ducts larger than 36 in. with trapeze hangers.
- G. Provide at least one support for each length of duct, with a maximum hanger spacing of 10 feet. Install supports on both ends of duct turns, branch fittings and transitions.
- H. Do not hang ductwork from piping, ducts, other trades' hangers, existing hangers, or equipment.
- I. Single band hangers are not acceptable on ducts greater than 24 in. diameter.
- J. Provide supports on each side of any duct mounted equipment or device, including fans, coils, dampers, etc, to permit removal of item without removal of adjacent duct sections.
- K. Provide supplemental steel required to support ductwork in shafts, mechanical rooms or on the floor where structural steel is not properly positioned.
- L. Beam clamps shall be double sided on ducts over 36 in. by 36 in. Use double sided or single sided beam clamps with retaining clips on all other sizes.
- M. Do not modify existing structural steel without approval of Project Manager and a structural engineer's review.
- N. Provide clamping systems that are compatible with the structural steel system of the building.
- O. Use angle iron "V" construction supports or similarly rigid construction for vertical ducting that requires lateral support.
- P. Ductwork mounted on roof or otherwise exposed to elements shall be supported with frames constructed of galvanized steel angles and channels, regardless of duct size. Supports shall not rest on top of roof, but shall be firmly attached to roof structure and properly flashed. Ducts that penetrate through the roof shall utilize curbs and shall be counter-flashed. All fasteners shall be galvanized.
- Q. Provide angle sway bracing and diagonal cross bracing to the structure to provide support against maximum lateral loads that may be imposed on the ductwork installed downstream of fan discharges and ductwork exposed to wind loads, and any other locations exposed to lateral loads.

### **3.8 DUCTWORK PAINTING**

- A. Where the interior of duct is visible through grilles, registers, diffusers or other air diffusion devices, paint the interior flat black. Coordinate work with Architectural Trade.
- B. For plenum returns, where equipment and structure above ceiling is visible through return air grilles, provide black sheet metal baffle with turned edges suspended from building construction. Size and position the baffle to prevent restriction of air flow. Where space above ceiling precludes use of a baffle, paint visible building surfaces flat black.

### **3.9 TEMPORARY USE**

- A. Develop a plan that assures ductwork is protected during temporary use. Obtain approval of the plan from the Owner's Representative.
- B. Maintain the protection plan until just prior to Owner turn-over.
- C. Successfully complete return/negative pressure duct leak testing prior to duct temporary use.
- D. Temporary filters shall be provided in return or negative pressure duct to protect ductwork and building contents when any fans are operated during construction. Filters shall have an equal or better performance rating than the air handling unit pre-filters specified for permanent use, but not less than MERV 8, in order to prevent construction dirt infiltration into duct systems. Install filters over grilles, diffusers, and all duct openings. Provide filters over supply grilles, diffusers and duct openings if construction dust and debris will enter when operated for temporary service (e.g. air system cycles off during periods when construction continues). Seal around temporary filters to prevent filter bypass.
- E. Continuously maintain all filters and replace when pressure drop exceeds 1 in. w.c., or at manufacturer's recommended change-out pressure drop, whichever is lower.
- F. Remove temporary filters and associated materials, and clean any adhesive residue from finished surfaces, at completion of temporary use.

### **3.10 DUCTWORK SEALING, INSPECTION AND LEAKAGE TESTING**

- A. Seal, inspect and test prior to insulating or concealing ductwork.
- B. Seal all ductwork, regardless of pressure class, to SMACNA Seal Class A (Seal all transverse joints, longitudinal seams, and duct wall penetrations):
  - 1. Openings for rotating shafts shall be sealed with bushings or other devices that seal off air leakage.
  - 2. Pressure sensitive tape shall not be used as the primary sealant unless it has been certified to comply with UL-181A or UL-181B by an independent testing laboratory and the tape is used in accordance with that certification.
  - 3. All connections shall be sealed, including but not limited to spin-ins, taps, other branch connections, access doors, access panels, and duct connections to equipment.
  - 4. Spiral lock seams do not require sealing.
- C. Perform measured leak testing on the following ductwork:
  - 1. 100% of ductwork that is intended to operate in excess of 3 inches water column
  - 2. 100% of ductwork located outdoors
  - 3. Representative sections totaling no less than 25% of the total installed duct area for each designated pressure class of 3 inches water column and below.
  - 4. 100% of welded ductwork

5. Maximum permissible leakage rate ( $L_{max}$  in cfm/100 ft<sup>2</sup> of duct surface area):
  - a.  $L_{max} = 4 \times P^{0.65}$ , where  $P$  = test pressure which shall be equal to the design duct pressure class rating in inches water column.
  - b. Welded Ductwork: Zero leakage.

D. Ductwork Leakage Testing Procedures:

1. Prior to fabrication and installation, develop and submit for approval a ductwork testing plan, indicating locations of temporary caps, surface area of ductwork test sections, test pressure, leakage class and allowable leakage in cubic feet per minute.
2. Notify the Owner's Representative at least 2 days prior to each test.
3. Provide all blank-off plates, flanges, and safing required to isolate each section of duct to be tested.
4. Provide necessary testing apparatus.
5. For all ducts, pressurize ductwork to the specified pressure class and inspect ductwork for visual and audible leaks, and leaks perceptible to a hand 2 in. from duct. Reseal all perceptible leaks until acceptable to Owner's Representative.
6. After completing visual and audible inspection, conduct measured ductwork leakage tests at the specified pressure class for the duct. Reseal and retest as required until successfully achieving the specified leakage class.
7. Positive pressure leakage testing is acceptable for negative pressure ductwork.
8. Submit leakage test report for approval, using SMACNA or other approved form.

**3.11 DUCTWORK CLEANING**

- A. Clean any newly installed ductwork that is visibly soiled.

**END OF SECTION 23 3100**

## **SECTION 23 3300 - AIR DUCT ACCESSORIES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Sheet metal accessories as shown in the Contract Documents and as required for complete and properly operating air distribution systems.
  - 2. Access doors in ductwork.
  - 3. Duct test holes.
  - 4. Duct air turning vanes
  - 5. Balance dampers
  - 6. Backdraft dampers
  - 7. Wire mesh screens
  - 8. Air flow regulators
- B. Section does not include automatic control dampers. See Related Section 23 0900 Mechanical Systems Controls.

#### **1.3 SUBMITTALS**

- A. Product Data: Submit performance data, rated capacities, furnished specialties, sound-power ratings, and accessories for each type of product.
- B. Duct Sound Attenuators: Include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.
- C. Damper manufacturer's installation instructions.
- D. Shop Drawings: Indicate the location, fire rating and pressure rating of all dampers on shop drawings and submittals.

#### **1.4 QUALITY ASSURANCE**

- A. Manufacturers and Products: The products and manufacturers specified in this Section establish the standard of quality for the Work. Subject to compliance with all requirements, provide specified products from the manufacturers named in Part 2.
- B. Reference Standards: Products in this section shall be built, tested, and installed in compliance with the following quality assurance standards; latest editions, unless noted otherwise.
- C. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems".
- D. SMACNA "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated.

- E. UL 555C "Standard for Fire Dampers".
- F. UL 555S "Standard for Smoke Dampers".

## **1.5 WARRANTY**

- A. Provide a complete parts and labor warranty for a minimum of one year from the date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 ACCESS DOORS IN DUCTWORK**

- A. Provide access doors in ductwork to permit access to the linkage side of automatic dampers, fire dampers, smoke dampers, combination fire/smoke dampers, upstream side of coils, filters, humidifiers, airflow measuring stations, other equipment or devices requiring access or other locations as indicated on Drawings for cleaning, maintenance, or inspection purposes.
- B. Hang access doors on heavy gauge continuous hinges and secure in the closed position by means of metal clinching type cam latches. Hinges shall move freely. Where space conditions preclude hinges, provide four heavy duty cam-lock type latches, in addition to a retainer chain.
- C. Access doors shall be of double wall insulated construction of not less than 20 gauge sheet metal, neoprene gasketed around the entire perimeter. Insulation between the metal panels shall be of the same thickness as the duct or panel adjacent to the access doors. Doors shall match duct material type, and at a minimum, the pressure class of the duct system in which they are installed.
- D. Minimum Size: 24 inches by 24 inches when permitted by duct size. For smaller ducts, provide largest size access door that can be accommodated by duct height or width.
- E. Acceptable Manufacturers.
  - 1. Air Balance, Inc
  - 2. Ruskin Company
  - 3. Ductmate Industries, Inc
  - 4. Nailor Industries, Inc
  - 5. American Warming & Ventilating

### **2.2 DUCT TEST HOLES**

- A. Permanent, factory fabricated duct test holes, with air-tight flanged fittings and screw cap. Provide extended neck fittings to clear insulation. Acceptable manufacturer and model:
  - 1. Ventlock Model 699 by Ventfabrics, Inc

### **2.3 DUCT AIR TURNING VANES**

- A. Provide factory manufactured turning vanes in each elbow where inside radius is less than the width of the duct, and in all square elbows located in duct construction of greater than 2 inches w.g.
- B. Turning vane assemblies shall be adequately supported and affixed to prevent rattling, breakaway, and shall not deform. Assemblies longer than 12 inches shall be double wall.
- C. Turning vanes in negative pressure ductwork with pressure rating above 2 inches shall be installed in accordance with SMACNA Industrial Duct Construction Standard.



- D. Turning vanes shall match the duct material construction.
- E. Use long radius elbows when the elbow free area is less than one square foot.
- F. Airfoil turning vanes are not permitted.
- G. Acceptable Manufactures:
  - 1. Aero Dyne
  - 2. Ductmate Industries, Inc.
  - 3. Sheet Metal Connectors, Inc.
  - 4. Duro-Dyne
  - 5. DynAir Inc

## **2.4 GENERAL DAMPER CONSTRUCTION REQUIREMENTS**

- A. Dampers shall be rated for the maximum close-off pressure at the installed location, but not less than the rating as indicated in the Damper Construction and Application Schedule.
- B. Dampers installed in galvanized ductwork shall be all galvanized construction including blades, shafts, bearings, linkages, etc. or as indicated in other sections.
- C. Dampers installed in stainless steel ductwork, polyvinyl coated ductwork (PCD), or located in any corrosive atmosphere shall be constructed of Type 304 or Type 316 stainless steel construction including blades, shafts, bearings, linkages, etc.
- D. Refer to the Damper Construction and Application Schedule on the Drawings for additional requirements.

## **2.5 BALANCE DAMPERS**

- A. For pressure dependent systems, as a minimum, provide balance dampers at each branch duct, at each outlet or inlet, and as indicated for supply air, return air, and exhaust air duct systems.
- B. For pressure independent systems, as a minimum, balance dampers shall be provided at each branch for each outlet downstream of each supply air Terminal Airflow Unit (TAU) or Laboratory Terminal Airflow Unit (LTAU) and at each branch inlet upstream of each return air or exhaust air TAU or LTAU, and as indicated.
- C. Comply with SMACNA requirements and provide continuous rod and bearings on each end of shaft regardless of pressure class.
- D. Use 3/8 inch continuous square rod and 18 gauge stiffened blade for duct sizes 18 inches wide by 18 inches high and smaller, or 12 inches diameter and smaller.
- E. Use 1/2 inch continuous square rod and 16 gauge stiffened blade for single blade dampers in ducts 19 inches to 48 inches wide by a maximum of 10 inches high; and in 12-inch to 16-inch round ducts.
- F. When multi-blade dampers are required, use a manufactured 16 gauge, stiffened, opposed blade damper in a 14 gauge hat channel steel frame with reinforced corners. All hardware shall be galvanized, except use brass trunnions and bronze, steel, or synthetic bearings.
- G. Quadrant shall be locking type.
- H. Quadrant end of damper rod shall be factory slotted to indicate blade position.

- I. Provide galvanized or stainless steel sheet metal "hat section" on ducts with exterior insulation so that quadrant will be exposed. Provide tight sealing nylon brushing at duct opening for damper shaft under hat section.
- J. Each square rod shall be installed so that quadrant will be accessible for adjusting.
- K. Provide 24-inch-by-24-inch access door through ceiling or wall construction for each balance damper that is not accessible.
- L. Acceptable Manufactures:
  - 1. Ruskin Company
  - 2. Young Regulator Company
  - 3. American Warming & Ventilating Co
  - 4. Vent Products Co., Inc
  - 5. Arrow United Industries
  - 6. Greenheck

## **2.6 WIRE MESH SCREENS**

- A. Screen assemblies shall be removable
- B. Mesh: 1/2 -inch square pattern, 1/16 inch galvanized wire, interwoven, welded at wire intersections and to the frame to prevent rattles.
- C. Frames: Minimum of 1 inch by 1 inch by 1/8 inch galvanized steel angles for duct sizes through 24 inches, 1-1/2 inch by 1-1/2 inch by 3/16 inch for duct sizes between 25 inches to 48 inches, and 2 inches by 2 inches by 3/16 inch for ducts larger than 48 inches continuous around perimeter of screen. Provide intermediate supports to limit screen deflection to 1/16 inch at maximum design airflow.

## **2.7 AIR FLOW REGULATORS**

- A. Constant airflow regulator consisting of a modulating orifice that automatically regulates airflows in ductwork to constant levels. The passive control element responds to duct pressure and requires no electric or pneumatic sensors or controls.
- B. Construction: UL94V-0 ABS plastic, UL 2043 safety classified and labeled for flame and smoke generation. A lip or flex-type ring seal gasket around the circumference ensures a tight, no leak fit in the ductwork.
- C. Performance: Air flow regulator shall control airflow accurately to within 10% of rated flow (15% for units 50 CFM or less) throughout the target operating pressure range of 0.2 to 0.8 in w.g. Each airflow regulator shall be factory tested and calibrated to the rated set point before shipping. On-site field adjustment of airflow set points can be made for supply air applications.
- D. Factory sizing/selection engineering requirement: Factory engineering shall review Contract Document HVAC plan drawings and shall appropriately select the correct pressure range for each air flow regulator at its proposed location within the ductwork system. Factory engineering shall provide a complete schedule of regulators specific to this project for A/E review and approval. Schedule shall indicate each regulator airflow set point, pressure range, and location within the system.
- E. Maintenance: Air flow regulator shall require no maintenance when used in conventional air flow systems.
- F. Warranty: Guaranteed for 5 years, from date of shipment, against all defects in material or workmanship.
- G. Acceptable Manufacturers:
  - 1. American Aldes CAR-II or equivalent

## **PART 3 - EXECUTION**

### **3.1 SHEET METAL ACCESSORIES INSTALLATION**

- A. Install sheet metal accessories in accordance with manufacturers' recommendations, Contract Drawings and approved submittals.
- B. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- C. Refer to other related sections for installation requirements, including joint connections and sealant requirements.
- D. Install duct accessories according to applicable details in SMACNA "HVAC Duct Construction Standards - Metal and Flexible".
- E. Install duct accessories of materials suited to duct materials. Use galvanized-steel accessories in galvanized-steel ducts, stainless-steel accessories in stainless steel ducts, use aluminum accessories in aluminum ducts.

### **3.2 DUCT ACCESS DOORS INSTALLATION**

- A. Locate access doors so they can be opened completely without interferences and to allow easy access by maintenance personnel.
- B. Fire, smoke, combination fire/smoke damper or similar automatic shutting device access doors shall be mounted downstream (after shutoff) to permit resetting and inspection.
- C. Doors shall seal tightly into frame.
- D. Label access doors to note equipment that is accessed through the door. Labels and lettering on labels shall be in accordance with the mechanical identification section. Provide 1-inch-high minimum letters.

### **3.3 DUCT AIR TURNING VANES INSTALLATION**

- A. Mount the outboard-most vane in the duct heel. Vanes shall be spaced across the entire corner diagonal, parallel to the airstream, adequately supported and affixed to prevent rattle and breakaway.

### **3.4 DUCT TEST HOLES INSTALLATION**

- A. Provide duct test holes where required for testing and balancing purposes and as shown on Drawings.

### **3.5 DAMPER INSTALLATION – GENERAL ( INCLUDING AUTOMATIC CONTROL DAMPERS FURNISHED UNDER RELATED SECTION)**

- A. Dampers shall be installed square and plumb to casing, duct, wall, etc. without racking. Align and adjust dampers to ensure proper opening and closing without binding or hesitation.
- B. Seal completely around frame.
- C. Install dampers designed for horizontal mounting in horizontal orientation, and dampers designed for vertical mounting in vertical orientation.
- D. Adequately reinforce multiple section dampers per manufacturer's recommendations.
- E. Install dampers so quadrants will be accessible for adjusting.

- F. Coordinate access through ceilings or walls to ensure each damper is accessible.
- G. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
- H. Set dampers to fully open position before testing, adjusting, and balancing.

### **3.6 WIRE MESH SCREEN INSTALLATION**

- A. Screen assemblies shall be firmly affixed and shall not vibrate.

### **3.7 FIELD QUALITY CONTROL**

- A. Tests and Inspections
  - 1. Operate dampers and operators to verify full range of movement.
  - 2. Inspect locations of access doors and verify proper labeling and access to equipment.
  - 3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
  - 4. Inspect turning vanes for proper and secure installation.

### **3.8 COMMISSIONING**

- A. Perform the commissioning activities as outlined in the Division 01 Section Commissioning and other requirements of the Contract Documents.

**END OF SECTION 23 3300**

## **SECTION 23 3400 - FANS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Ceiling-mounted ventilators.
  - 2. Centrifugal ventilators - roof downblast.
  - 3. In-line centrifugal fans.

#### **1.3 SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Static pressure, airflow (CFM), speed (RPM), system curve, outlet velocity and fan tag for each fan.
  - 2. Certified fan curves showing fan performance with the system operating points identified on curves. Surge, or "Do not operate" line, shall also be indicated on fan curve.
  - 3. Performance curves shall be published by the fan manufacturer and based on tests in accordance with AMCA 210. The curves shall be drawn with the fan flow rate plotted against fan total pressure and fan brake horsepower as per section 10.2.1 of AMCA 210.
  - 4. Bearing sizing and life calculations for each similar size and type of fan. Fan bearing calculations shall be based on fan maximum operating conditions including belt pull. Calculations shall be provided for both fan bearings and motor bearings.
  - 5. Sound power levels for each size and type of fan. Sound levels shall be provided for all 8 octave bands for discharge of fan, inlet to fan, and radiated noise through casing.
  - 6. Dimensional data for each size and type of fan, including operating and maintenance clearances.
  - 7. Details of vibration isolation bases including selections for vibration isolation springs.
  - 8. Details of fan discharge flexible duct connector.
  - 9. Details of motor and belt guards.
  - 10. Motor ratings, electrical characteristics, and motor accessories.
  - 11. Fan anti-corrosion coating data sheets.
  - 12. Construction details, material descriptions, dimensions of individual components and profiles, and finishes for fans.
  - 13. Material thickness and finishes, including color charts.
  - 14. Dampers, including housings, linkages, and operators.
  - 15. Prefabricated roof curbs.
  - 16. Fan speed controllers.

#### **1.4 QUALITY ASSURANCE**

- A. Manufacturers and Products: The products and manufacturers specified in this Section establish the standard of quality for the Work. Subject to compliance with all requirements, provide specified products from the manufacturers named in Part 2.
- B. Reference Standards: Products in this section shall be built, tested, and installed in compliance with the following quality assurance standards; latest editions, unless noted otherwise.
  - 1. AMCA Standard 99-0401, "Classification for Spark Resistant Construction".
  - 2. ANSI/AMCA Standard 99-2404, "Drive Arrangements for Centrifugal Fans".
  - 3. ANSI/AMCA Standard 99-2406, "Designation for Rotation and Discharge of Centrifugal Fans".

4. AMCA Standard 99-2408, "Operating Limits for Centrifugal Fans".
5. ANSI/AMCA Standard 210 ANSI/ASHRAE 51, "Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating"
6. ANSI/AMCA Standard 260 "Laboratory Methods of Testing Induced Flow Fans for Rating"
7. ANSI/AMCA Standard 300, "Reverberant Room Method for Sound Testing of Fans".
8. ANSI/AMCA Standard 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data"
9. ANSI/AMCA Standard 204, "Balance Quality and Vibration Levels for Fans".
10. UL-705, "Power Ventilators" (applies only for fans exposed to outdoor conditions).
11. American Bearing Manufacturers Association (ABMA) Standards.

## **1.5 SOURCE QUALITY CONTROL**

- A. Run test all fans 1 HP and larger at the factory before shipment. Testing shall be conducted at the maximum fan class speed.
- B. Statically and dynamically balance each fan per AMCA procedures. Perform electronic vibration analysis at the maximum fan class speed for all fans over 5 HP.
- C. Unless noted otherwise, the installed maximum allowable RMS velocity at maximum fan class speed measured at each bearing shall not exceed 0.09 inches/sec in vertical, horizontal, and axial directions.
- D. Fans may be field tested after installation by an independent third party. Any fan found to exceed specified vibration limits shall be corrected to perform within those limits without cost to the Owner.
- E. AMCA Certification for Fan Sound Performance Rating: Test, rate, and label in accordance with AMCA 311.
- F. AMCA Certification for Fan Aerodynamic Performance Ratings: Test, rate, and label in accordance with AMCA 211.
- G. AMCA Certification for Fan Energy Index (FEI): Test, rate, and label in accordance with AMCA 211.
- H. Operating Limits: Classify fans in accordance with AMCA 99, Section 14.

## **1.6 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  1. Belts: One set(s) for each belt-driven unit.

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

- A. Fan manufacturer shall provide protection to insure that the interior and exterior of each fan is completely protected from dirt or weather during shipping. Openings shall be covered with sealed sheet metal, plastic or other durable means to ensure unit cleanliness is maintained.
- B. Disassemble and reassemble units, as required for moving to final locations, according to manufacturer's written instructions.
- C. Lift and support units with manufacturer's designated lifting or supporting points.

## **1.8 COORDINATION**

- A. Coordinate size and location of structural-steel support members.

- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 "Roof Accessories."

## **1.9 WARRANTY**

- A. Provide a complete parts and labor warranty for a minimum of one year from the date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide fans by one of the following:
  - 1. Greenheck.
  - 2. Loren Cook Co.
  - 3. PennBarry.
  - 4. Twin City.

### **2.2 PERFORMANCE REQUIREMENTS**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of unit components.
- C. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- D. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

### **2.3 GENERAL CONSTRUCTION – ALL FANS**

- A. For belt driven fans, provide balanced variable sheaves for motors 7.5 HP and under and fixed sheaves for motors 10 HP and over. Size variable sheaves at midpoint of specified operating conditions to allow field adjustment up or down during balancing procedures. Where fixed speed sheaves are specified for a specific fan, provide one (1) additional sheave set, if required, for final balancing.
- B. Fan selection and ratings shall be based on tests made in accordance with AMCA 210.
- C. Fans shall be AMCA licensed and shall bear the AMCA seal for both sound and performance levels.
- D. Fan shall be minimum Class I construction with proper UL label.
- E. The specified fan RPM, outlet velocity, and tip speed are the maximum acceptable. The motor horsepower, CFM, and static pressure are the minimum acceptable.
- F. Unless noted otherwise by specific fan type or per schedule, fan housing shall be heavy gauge continuous welded corrosion resistant steel construction with fan scroll and bearings supported from structural steel framework.
- G. All fasteners shall be corrosion resistant type.
- H. Fan housing shall be of suitable thickness and bracing required for stable and rigid construction, with no deflection, and to prevent vibration and pulsation.

- I. Fans having duct-connected inlets shall be provided with a flanged inlet and/or outlet collar matching companion flange.
- J. Provide OSHA belt guards on all belt driven fans.
- K. For exterior mounted fans, a weatherproof housing shall be provided with ventilation grilles to cover motor and drive assembly.
- L. Provide special construction fans, such as spark-proof, explosion-proof, or specially coated fans as required by schedules or as specified herein.
- M. Provide birdscreen on fans exposed to the exterior environment.
- N. Provide adequate space for service of fan, motor and bearings.
- O. The fan shaft shall be solid high carbon steel, accurately turned, ground and polished, and ring gauged for accuracy.
- P. Recommended bearing manufacturer tolerances shall be met in the area of the shaft in contact with the bearings.
- Q. Shafts must be dial indicator inspected for straightness after the keys are cut.
- R. Fan shaft shall be coated with rust inhibitive coating.
- S. Fan wheel assembly or propeller assembly shall be statically and dynamically balanced prior to fan assembly.
- T. The entire rotating assembly shall be designed so the first critical speed is at least 25% over the maximum fan class speed.
- U. Fans shall have sharply rising pressure characteristics at the operating point specified and shall be quiet and stable in operation. Horsepower characteristics shall be self-limiting (non-overloading) and at peak value at the specified operating point.
- V. Fan Housing:
  - 1. Fans having wheel diameters 36 in. and larger shall have horizontally flanged split housings as required for installation.
  - 2. Fan housing and inlet shall be constructed to allow the fan wheel(s) to be removed through the inlet opening when the inlet cone is removed.
  - 3. Provide a quick opening inspection door with heavy duty latches.
  - 4. A 1/2 in. NPT tapped 3/4 in. diameter pipe coupling drain connection shall be welded to the fan scroll at the lowest point, equipped with a pipe plug.
  - 5. Class I and II fans shall be convertible to a minimum of 8 standard discharge arrangements.
  - 6. Provide a Fan cut-off to deliver good pressure distribution.
- W. Fan Inlet and Wheel Cone:
  - 1. Provide a precision die-spun or formed, and matched inlet and wheel cones for streamlined airflow into the wheel to ensure full loading of the blades.
  - 2. Inlet and wheel cones shall be hyperbolic. Radial side sheets are not acceptable.
  - 3. Inlet cone shall be heavy gauge, bolted to fan housing to allow for removal.
  - 4. Fans that are not duct-connected shall be provided with inlet/outlet screen(s). Screen(s) shall be standard manufacturer provided screen or galvanized maximum nominal 1 in. by 1 in. mesh fabricated 10 gauge steel.



5. Hubs shall be straight bored or use taper lock bushings, keyed and set screwed to shaft for positive attachment. Hubs shall be securely riveted or bolted to the backplate or center plate. Bushed hubs are not acceptable.
6. Double-width double-inlet fans shall be a single wheel of the common center plate design or 2 single-width single-inlet wheels back-to-back, each keyed and set screwed to a common shaft.
7. Fan blades shall be continuously welded to the inlet hub and the backplate.
8. Wheel center plate or backplate shall be heavy gauge steel construction with a minimum gauge as indicated in material construction schedule.

X. Fan Shaft Bearings:

1. Fan bearings shall be bolted on a rigid welded steel framework integral with the housing.
2. Bearings shall be designed and individually tested specifically for use in air handling applications.
3. Bearings shall be sized for a minimum L-10 life of 200,000 hours at the maximum fan class operating speed and horse power. Selection shall account for all operating conditions including belt pull. Bearings shall be selected in accordance with standards set forth by the American Bearing Manufacturers Association (ABMA).
4. Bearings shall be grease lubricated self-aligning ball or roller type. Provide tapered roller bearings for vertical applications.
5. Bearing housings shall be solid cast iron, pillow block or flange mount type. Provide split pillow block bearings where required by the application speed.
6. Stamped bearing housings are permitted on fans of 1/4 HP or less.
7. Bearings shall be of the type that can be re-lubricated, and shall be equipped with grease fittings.
8. Where fan bearings are not easily accessible or are installed in a hazardous exhaust airstream, provide clear plastic grease leads, properly secured to avoid damage or fatigue, routed to an accessible location.

Y. Fan Drive:

1. Fan drive shall be a multiple V-belt type sized for 1.65 times the fan motor horsepower. Sheaves shall be fixed or adjustable based on fan motor horsepower as specified herein before. Fan sheave shall have a tapered lock, split and keyed hub. Groove spacing on equipment and motor pulleys shall align. For fans 1/2 HP and larger, quantity of belts shall be such that if any one belt fails, remaining belts shall allow fan to continue functioning as designed. Multiple belts shall be provided as a matched set.
2. Motors shall meet requirements as specified in Motors section.
3. Motor shall be 1800 rpm maximum for belt driven or direct drive fans.
4. On OSHA approved type fan drive guard shall be provided with provision for RPM measurement at both motor and fan without removing the guard. The guard shall be made of 1/2 in., 16 gauge flattened expanded steel, wrapped around a 16 gauge channel frame suitably braced to prevent vibration. Guard shall be G-90 galvanized, or painted to match fan housing paint.
5. Fan belts shall be oil resistant 24,000-hour non-static belts.

Z. Provide thrust arrestors as required to limit movement of the fan upon start-up.

AA. Provide riveted, engraved aluminum nameplate containing pertinent, specific fan data, including manufacturer, model, serial number, and electrical data, etc.

**2.4 PAINTING**

- A. Each fan component shall be thoroughly cleaned, degreased and deburred.
- B. Prior to assembly, prime coat all non-galvanized ferrous metal parts with zinc rich primer (minimum 70 percent zinc), total dry film thickness of not less than 1.3 mils.
- C. For interior units, finish paint all non-galvanized ferrous metal parts with alkyd enamel paint.
  1. Low-luster interior enamel; total dry film thickness of not less than 2.6 mils

D. For exterior units, finish paint all non-galvanized ferrous metal parts with alkyd enamel paint.

1. Semi-gloss exterior enamel; total dry film thickness of not less than 2.6 mils.

E. Aluminum and stainless steel parts do not require painting.

F. Special coatings for corrosive exhaust systems are specified in the exhaust fan specifications.

## **2.5 IN-LINE CENTRIFUGAL FANS**

A. Description: In-line, belt-driven centrifugal fans consisting of housing, wheel, outlet guide vanes, fan shaft, bearings, motor and disconnect switch, drive assembly, mounting brackets, and accessories.

B. Housing: Split, spun aluminum with aluminum straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.

C. Direct-Driven Units: Motor encased in housing outside of airstream, factory wired to disconnect switch located on outside of fan housing.

D. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.

E. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.

F. Accessories:

1. Volume-Control Damper: Manually operated with quadrant lock, located in fan outlet.

2. Companion Flanges: For inlet and outlet duct connections.

3. Fan Guards: 1/2 inch by 1 inch mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.

4. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.

## **PART 3 - EXECUTION**

### **3.1 FAN INSTALLATION**

A. Receive and inspect fans for defects. All defective or damaged fans shall be replaced at no cost to the Owner.

B. Openings shall remain protected during storage. Immediately after installation and assembly, all factory protection shall be restored. Unit shall remain protected until just prior to final acceptance by Owner.

C. Use spreader bars on lifting cables when hoisting fans from lifting lugs to prevent cable damage to housing or components. Rig fans per fan manufacturer's recommendations.

D. Fans shall be installed as shown on drawings, in accordance with details, approved submittals and the fan Manufacturer's installation requirements and recommendations. Ensure fans are installed to allow easy accessibility for service or removal of fan components.

E. Provide and install supplemental steel, supports, isolators and hangers necessary to hang or mount fans. Coordinate final location and placement of intermediate steel and ductwork connections in field. Install suspended fans with supports attached to structural members.

F. Install any associated motors, drives, or other components that have been shipped loose. Fan shall be installed, made fully operation, and tested.

- G. Install power ventilators level and plumb.
- H. Equipment Mounting:
  - 1. Secure roof-mounted fans to roof curbs with zinc-plated hardware. See Division 07 "Roof Accessories" for installation of roof curbs.
  - 2. Ceiling Units: Suspend units from structure; use steel wire or metal straps.
  - 3. Comply with requirements for vibration isolation devices specified in Division 20 "Vibration & Seismic Controls for Mechanical."
- I. Install units with clearances for service and maintenance.
- J. Label units according to requirements specified in Division 20 "Mechanical Identification."
- K. Install flexible inlet and discharge couplings to prevent vibration transmission to ductwork.
- L. Inlet and discharge ductwork shall have a minimum straight run of two (2) fan diameters upstream and downstream of the fan.
- M. Just prior to final acceptance fan shall be thoroughly cleaned of all grease, dirt, and dust, etc. Apply touch-up paint or touch-up coating after final cleaning to repair any damage to the finish.
- N. Provide or coordinate the scope of work associated with the installation of fans as specified in the following sections:
  - 1. Roof curbs
  - 2. HVAC duct accessories
  - 3. Interconnecting wiring and conduit from power source to fan starter or VSD.
- O. Engage a factory-authorized service representative to perform startup service.
  - 1. Complete installation and startup checks in accordance with manufacturer's written instructions.
  - 2. Verify that shipping, blocking, and bracing are removed.
  - 3. Verify that unit is secure on mountings and supporting devices, and that connections to ducts and electrical components are complete.
  - 4. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
  - 5. Verify that cleaning and adjusting are complete.
  - 6. For direct-drive fans, verify proper motor rotation direction and verify fan wheel free rotation and smooth bearing operation.
  - 7. For belt-drive fans, disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
  - 8. Adjust belt tension.
  - 9. Inspect fan scroll for debris or water.
  - 10. Remove guards. Align and adjust belt tension, verify that fan wheel and motor rotate freely, and that bearing operation is smooth. Re-install belt guards.
  - 11. Adjust damper linkages for proper damper operation.
  - 12. Verify lubrication of bearings and other moving parts. Use proper bearing venting procedures, in particular at motor bearings. Use only grease type specifically recommended by fan mfr. Do not over-grease. Fill extended grease lines if not already filled, using mfr. recommended grease and proper venting procedures.
  - 13. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
  - 14. Verify proper motor and fan rotation.
  - 15. Disable automatic temperature-control operators, energize motor and confirm proper motor rotation and unit operation, adjust fan to indicated rpm, and measure and record motor voltage and amperage.

16. Shut unit down and reconnect automatic temperature-control operators.
17. Remove and replace malfunctioning units and retest as specified above.

P. Comply with requirements in Division 23 "Testing, Adjusting, and Balancing for HVAC."

Q. After completing system installation and testing, adjusting, and balancing and after completing startup service, clean fans internally to remove foreign material and construction dirt and dust.

R. Temporary Use of Fans

1. Contractor shall thoroughly clean unit of all grease, dirt, and dust, etc. and perform manufacturer's pre-start protocol and commissioning activities just prior to being placed into temporary service
2. During temporary service, perform all of manufacturer's required routine maintenance procedures. Continuously maintain a log of all such procedures. Store log at unit during temporary use period and include log as part of the final O&M manual.
3. Contractor shall thoroughly clean unit of all grease, dirt, and dust, etc., lubricate bearings, align and tighten belts and perform manufacturer's pre-start protocol and commissioning activities after unit has completed temporary service, and install a new, complete set of filters just prior to final acceptance by Owner.

### **3.2 DUCTWORK CONNECTIONS**

A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 "Air Duct Accessories."

### **3.3 ELECTRICAL CONNECTIONS**

A. Connect wiring according to Division 26 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment according to Division 26 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.

1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Division 26 "Identification for Electrical Systems."
2. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

### **3.4 CONTROL CONNECTIONS**

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring according to Division 26 "Control-Voltage Electrical Power Cables."

### **3.5 FIELD QUALITY CONTROL**

A. Each fan shall be field tested. Any deficiencies related to performance, manufacture or installation shall be corrected without cost to Owner.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

**3.6 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain centrifugal fans.

**END OF SECTION 23 3400**

## **SECTION 23 3713 – DIFFUSERS, REGISTERS, AND GRILLES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. This Section includes ceiling- and wall-mounted diffusers, registers, and grilles.

#### **1.3 DEFINITIONS**

- A. Diffuser: Circular, square, or rectangular air distribution outlet, generally located in the ceiling and comprised of deflecting members discharging supply air in various directions and planes and arranged to promote mixing of primary air with secondary room air.
- B. Grille: A louvered or perforated covering for an opening in an air passage, which can be located in a sidewall, ceiling, or floor.
- C. Register: A combination grille and damper assembly over an air opening.

#### **1.4 SUBMITTALS**

- A. Product Data: For each model indicated, include the following:
  - 1. Data Sheet: For each type of air outlet and inlet, and accessory furnished; indicate construction, finish, and mounting details.
  - 2. Performance Data: Include throw and drop, static-pressure drop, and noise ratings for each type of air outlet and inlet.
  - 3. Schedule of diffusers, registers, and grilles indicating drawing designation, room location, quantity, model number, size, and accessories furnished.
  - 4. Assembly Drawing: For each type of air outlet and inlet; indicate materials and methods of assembly of components.

#### **1.5 QUALITY ASSURANCE**

- A. Product Options: Drawings and schedules indicate specific requirements of diffusers, registers, and grilles and are based on the specific requirements of the systems indicated. Other manufacturers' products with equal performance characteristics may be considered. Refer to Division 1 Section "Substitutions."
- B. NFPA Compliance: Install diffusers, registers, and grilles according to NFPA 90A, "Standard for the Installation of Air-Conditioning and Ventilating Systems."

### **PART 2 - PRODUCTS**

#### **2.1 DIFFUSERS, REGISTERS AND GRILLES**

- A. Manufacturers:
  - 1. Krueger
  - 2. Price
  - 3. Titus

## **2.2 MANUFACTURED UNITS**

- A. General:
  - 1. Material: Steel or aluminum.
  - 2. Finish: Baked enamel or acrylic.
  - 3. Color: White or color as scheduled on Drawings.
  - 4. Frame: Shall be compatible with associated ceiling/wall type. Refer to architectural floor and reflected ceiling plans on Drawings.
- B. Diffusers, registers, and grilles as scheduled on Drawings.

## **2.3 SOURCE QUALITY CONTROL**

- A. Testing: Test performance according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

# **PART 3 - EXECUTION**

## **3.1 EXAMINATION**

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment. Do not proceed with installation until unsatisfactory conditions have been corrected.

## **3.2 INSTALLATION**

- A. Install diffusers, registers, and grilles level and plumb, according to manufacturer's written instructions, Coordination Drawings, original design, and referenced standards.
- B. Support devices independent of the ceiling construction when required for safe workmanlike construction.
- C. Paint visible duct, mounting clips, and accessories behind registers and grilles flat black.
- D. Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, locate units in the grid. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- E. Install diffusers, registers, and grilles with airtight connection to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.
- F. Adjust throw patterns to provide even airflow coverage throughout space or as indicated on Drawings.

## **3.3 ADJUSTING**

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

## **3.4 CLEANING**

- A. After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove burrs, dirt, and smudges. Replace diffusers, registers, and grilles that have damaged finishes.

**END OF SECTION 23 3713**

## **SECTION 23 7333 - INDOOR, INDIRECT, GAS-FIRED HEATING AND VENTILATING UNITS**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Indoor, indirect, gas-fired heating and ventilating units.

#### **1.2 SUBMITTALS**

- A. Product Data: Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories for each unit.
- B. Coordination Drawings: Floor plans and other details, or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.
- C. Sample Warranty: For manufacturer's warranty.
- D. Startup service reports.
- E. Operation and Maintenance Data: For indirect, gas-fired heating and ventilating units to include in emergency, operation, and maintenance manuals.

#### **1.3 INFORMATIONAL SUBMITTALS**

- A. Field quality-control reports.

#### **1.4 QUALITY ASSURANCE**

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of indoor, indirect, gas-fired heating and ventilating units and are based on the specific system indicated. Other manufacturers' systems with equal performance characteristics may be considered. Refer to Division 01 Section "Substitutions."
- B. AGA Certification: Gas-fired units shall be certified and labeled.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- D. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of units and components.
- E. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- F. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

#### **1.5 EXTRA MATERIALS**

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Filters: One set for each unit.
  - 2. Fan Belts: One set for each unit.



## **1.6 WARRANTY**

- A. Warranty: Manufacturer agrees to repair or replace components of indirect, gas-fired heating and ventilating units that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period for Entire Unit: Manufacturer's standard, but not less than one year from date of Substantial Completion.
  - 2. Warranty Period for Heat Exchangers: Manufacturer's standard, but not less than five years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 INDOOR, INDIRECT, GAS-FIRED HEATING AND VENTILATING UNITS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Applied Air; a Mestek Company
  - 2. Engineered Air
  - 3. Greenheck
  - 4. Hastings Industries; Division of Eric, Inc.
  - 5. Jackson & Church; Division of Donlee Technologies Inc.
  - 6. Modine
  - 7. Rapid Engineering, Inc.
- B. Unit Casings:
  - 1. General Fabrication Requirements for Casings:
    - a. Forming: Form walls, roofs, and floors with at least two breaks at each joint.
    - b. Casing Joints: Sheet metal screws or pop rivets, factory sealed with water-resistant sealant.
    - c. Heating and Ventilating Unit Mounting Frame: Formed galvanized-steel channel or structural channel supports, designed for low deflection, welded with integral lifting lugs.
  - 2. Configuration: Horizontal unit with horizontal discharge for suspended installation.
    - a. Discharge Section, Plenum: Plenum with two sides louvered.
  - 3. Single-Wall Construction
    - a. Material: Galvanized-steel with manufacturer's standard finish.
    - b. Floorplate: Galvanized steel, minimum 18 gauge thick.
    - c. Insulation and Adhesive:
      - 1) Materials: ASTM C1071, Type I or Type II glass-fiber blanket or board insulation, neoprene coated or foil faced.
      - 2) Insulation Thickness: 1 inch.
      - 3) Thermal Break: Provide continuity of insulation with no through-casing metal in casing walls, floors, or roofs of air-handling unit.
      - 4) Location and Application: Factory applied with adhesive and mechanical fasteners to the internal surface of complete unit.
    - a) Insulation Adhesive: Comply with ASTM C916, Type I.

4. Mechanical Fasteners: Galvanized steel suitable for adhesive, mechanical, or welding attachment to casing without damaging liner when applied as recommended by manufacturer and without causing Panels, Doors, and Windows:

a. Panels:

- 1) Fabrication: Formed and reinforced, with same materials and insulation thickness as casing.
- 2) Fasteners: Two or more camlock type for panel lift-out operation. Arrangement shall allow panels to be opened against airflow.
- 3) Gasket: Neoprene, applied around entire perimeters of panel frames.
- 4) Size: Large enough to allow unobstructed access for inspection and maintenance of unit's internal components.

b. Doors:

- 1) Fabrication: Formed and reinforced with same materials and insulation thickness as casing.
- 2) Hinges: A minimum of two ball-bearing hinges or stainless-steel piano hinge and two wedge-lever-type latches, operable from inside and outside. Arrange doors to be opened against airflow. Provide safety latch retainers on doors so that doors do not open uncontrollably.
- 3) Gasket: Neoprene, applied around entire perimeters of panel frames.
- 4) Size: Large enough to allow unobstructed access for inspection and maintenance of unit's internal components.

C. Fan, Drive, and Motor:

1. Fan and Drive Assemblies: Statically and dynamically balanced and designed for continuous operation at maximum-rated fan speed and motor horsepower.
2. Fans: Centrifugal, rated according to AMCA 210; galvanized steel; mounted on solid-steel shaft.
  - a. Shafts: With field-adjustable alignment.
  - b. Shaft Bearings: Heavy-duty, self-aligning, permanently lubricated ball bearings with an L50 rated life of 100,000 hours according to ABMA 9.
  - c. Housings: Formed- and reinforced-steel panels to form curved scroll housings with shaped cutoff and spun-metal inlet bell.
  - d. Mounting: For internal vibration isolation. Factory-mount fans with manufacturer's standard vibration isolation mounting devices having a minimum static deflection of 1 inch.
  - e. Shaft Lubrication Lines: Extended to a location outside the casing.
  - f. Flexible Connector: Factory fabricated with a fabric strip minimum 3-1/2 inches wide, attached to two strips of minimum 2-3/4-inch-wide by 0.028-inch-thick, galvanized-steel sheet.
    - 1) Flexible Connector Fabric: Glass fabric, double coated with neoprene. Fabrics, coatings, and adhesives shall comply with UL 181, Class 1.
3. Drive: Factory-mounted V-belt drive, with adjustable alignment and belt tensioning, and with 1.5 service factor based on fan motor.
  - a. Pulleys: Cast iron or cast steel with split, tapered bushing, dynamically balanced at the factory.
  - b. Belts: Oil resistant, non-sparking and nonstatic; in matched sets for multiple-belt drives.
  - c. Belt Guards: Comply with requirements specified by OSHA and fabricate according to SMACNA's "HVAC Duct Construction Standards"; 0.146-inch-thick, 3/4-inch diamond-mesh wire screen, welded to steel angle frame; prime coated.

4. Motors:
  - a. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Division 20 Section "Common Work Results for Mechanical."
  - b. Motor Sizes: Maximum sizes as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
  - c. Enclosure: Open, dripproof.
  - d. Efficiency: Premium efficient as defined in NEMA MG 1.
  - e. Motor Pulleys: Adjustable pitch for use with 5-hp motors and smaller; fixed pitch for use with motors larger than 5-hp. Select pulley size so pitch adjustment is at the middle of adjustment range at fan design conditions.
- D. Filters: Removable 2 inch thick, MERV 8, glass-fiber, disposable filters; located to filter air before fan.
- E. Dampers:
  1. Outdoor-Air Dampers: Low-leakage, double-skin, airfoil-blade, galvanized-steel dampers with compressible jamb seals and extruded-vinyl blade edge seals in opposed-blade arrangement with zinc-plated steel operating rods rotating in sintered bronze or nylon bearings mounted in a single galvanized-steel frame.
  2. Electronic Damper Operators:
    - a. Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
    - b. Electronic damper position indicator shall have visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.
    - c. Operator Motors:
      - 1) Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 20 Section "Common Work Results for Mechanical."
      - 2) Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
      - 3) Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
    - d. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft. (2.3 sq. m): Size for running and breakaway torque of 150 in. x lbf.
    - e. Size dampers for running torque calculated as follows:
      - 1) Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. of damper.
    - f. Coupling: V-bolt and V-shaped, toothed cradle.
    - g. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
    - h. Fail-Safe Operation: Mechanical, spring-return mechanism with external, manual gear release on nonspring-return actuators.
    - i. Power Requirements (Modulating): Maximum 10 VA at 24 V ac or 8 W at 24 V dc.
    - j. Temperature Rating: 40 to 104 deg F.
    - k. Run Time: 30 seconds.
- F. Indirect-Fired Gas Burner:
  1. Description: Factory assembled, piped, and wired; complying with ANSI Z21.47 and NFPA 54.
  2. CSA Approval: Designed and certified by and bearing label of CSA.

3. Burners: Aluminized steel with stainless steel inserts.
    - a. Rated minimum turndown ratio: 30 to 1.
    - b. Fuel: Natural gas.
    - c. Ignition: Electronically controlled electric spark with flame sensor.
    - d. Gas Control Valve: Modulating.
    - e. Gas Train: Regulated, redundant, 24-V ac gas valve assembly containing pilot solenoid valve, electronic-modulating temperature control valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff all in one body.
  4. Venting, Gravity: Gravity vented.
  5. Venting, Power: Power vented, with integral, motorized centrifugal fan interlocked with gas valve.
  6. Combustion-Air Intake: Separate combustion-air intake and vent terminal assembly.
  7. Heat Exchanger: Stainless steel.
  8. Heat-Exchanger Drain Pan: Stainless steel.
  9. Safety Controls:
    - a. Gas Manifold: Safety switches and controls complying with ANSI standards and FM Global.
    - b. Vent Flow Verification: Differential pressure switch to verify open vent.
    - c. High Limit: Thermal switch or fuse to stop burner.
    - d. Purge-period timer shall automatically delay burner ignition and bypass low-limit control.
    - e. Airflow Proving Switch: Differential pressure switch senses correct airflow before energizing pilot.
    - f. Automatic-Reset, High-Limit Control Device: Stops burner and closes main gas valve if high-limit temperature is exceeded.
    - g. Safety Lockout Switch: Locks out ignition sequence if burner fails to light after three tries. Controls are reset manually by turning the unit off and on.
    - h. Control Transformer: 24 V ac.
- G. Unit Control Panel:
1. Factory-wired, fuse-protected control transformer, connection for power supply and field-wired unit to remote control panel.
  2. Control Panel: Surface-mounted remote panel, with engraved plastic cover, and the following lights and switches:
    - a. On-off-auto fan switch.
    - b. Heat-vent-off switch.
    - c. Supply-fan operation indicating light.
    - d. Heating operation indicating light.
    - e. Thermostat.
    - f. Damper position potentiometer.
    - g. Dirty-filter indicating light operated by unit-mounted differential pressure switch.
    - h. Safety-lockout indicating light.
    - i. Enclosure: NEMA 250, Type 1.
- H. Controls:
1. Comply with requirements in Division 23 Section "Instrumentation and Control for HVAC" and Control Drawings.

## 2.2 SOURCE QUALITY CONTROL

- A. AMCA Certification for Fan Energy Index (FEI): Test, rate, and label in accordance with AMCA 211.
- B. Fan Operating Limits: Classify fans in accordance with AMCA 99, Section 14.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of indirect-fired heating and ventilating units.
- B. Examine roughing-in for piping, ducts, and electrical systems to verify actual locations of connections before equipment installation.
- C. Verify cleanliness of airflow path to include inner-casing surfaces, filters, coils, turning vanes, fan wheels, and other components.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION**

- A. Install units according to manufacturer's written instructions.
- B. Suspended Units: Suspend units from structural-steel support frame using threaded steel rods and spring hangers. Coordinate sizes and locations of structural-steel support members with actual equipment provided. Comply with requirements for vibration isolation devices specified in Division 20 Section "Vibration and Seismic Controls for Mechanical."]
- C. Install gas-fired units in accordance with NFPA 54.
- D. Install controls and equipment shipped by manufacturer for field installation with indirect, gas-fired heating and ventilating units.

#### **3.3 PIPING CONNECTIONS**

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
  - 1. Gas Piping: Comply with requirements in Division 20 Section "Plumbing and HVAC Piping." Connect gas piping with shutoff valve and union and with sufficient clearance for burner removal and service. Make final connections of gas piping to unit with corrugated, stainless steel tubing flexible connectors complying with ANSI LC 1/CSA 6.26 equipment connections.
- B. Drain: Comply with requirements in Division 20 Section "Plumbing and HVAC Piping." for traps and accessories on piping connections to condensate drain pans under condensing heat exchangers.
- C. Where installing piping adjacent to heating and ventilating units, allow space for service and maintenance.

#### **3.4 DUCTWORK CONNECTIONS**

- A. Connect supply ducts to indirect, gas-fired heating and ventilating units with flexible duct connectors. Comply with requirements in Division 23 Section "Air Duct Accessories" for flexible duct connectors.

#### **3.5 ELECTRICAL CONNECTIONS**

- A. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.

### **3.6 CONTROL CONNECTIONS**

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring according to Division 26 Section "Control-Voltage Electrical Power Cables."

### **3.7 STARTUP SERVICE**

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Verify that equipment is installed and connected according to manufacturer's written instructions.
- B. Complete installation and startup checks according to manufacturer's written instructions.
- C. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
- D. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

### **3.8 ADJUSTING**

- A. Adjust initial temperature set points.
- B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- C. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

### **3.9 CLEANING**

- A. After completing system installation and testing, adjusting, and balancing air-handling unit and air-distribution systems and after completing startup service, clean air-handling units internally to remove foreign material and construction dirt and dust. Clean fan wheels, cabinets, dampers, coils, and filter housings, and install new, clean filters.

### **3.10 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Units will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

### **3.11 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain Indoor, Indirect, Gas-Fired heating and Ventilating units.
  - 1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
  - 2. Review data in maintenance manuals. Refer to Division 01 Section "Closeout Procedures."

3. Review data in maintenance manuals. Refer to Division 01 Section "Operation and Maintenance Data."
4. Schedule training with Owner, through Architect, with at least seven days' advance notice.

**END OF SECTION 23 7333**

## **SECTION 23 8236 – ELECTRIC UNITARY HEATING EQUIPMENT**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Cabinet Unit Heaters
  - 2. Propeller Unit Heaters
  - 3. Radiant Ceiling Panels

#### **1.3 SUBMITTALS**

- A. Product Data: Include specialties and accessories for each unit type and configuration.
- B. Shop Drawings: Submit the following for each unit type and configuration:
  - 1. Plans, elevations, sections, and details.
  - 2. Details of anchorages and attachments to structure and to supported equipment.
  - 3. Power, signal, and control wiring diagrams. Differentiate between manufacturer-installed and field-installed wiring.
  - 4. Equipment schedules to include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.
- C. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items. Show the following:
  - 1. Ceiling suspension assembly members.
  - 2. Method of attaching hangers to building structure.
  - 3. Size and location of initial access modules for acoustical tile.
  - 4. Size and location of access panels in hard ceilings to provide access to concealed units.
  - 5. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
- D. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for units with factory-applied color finishes.
- E. Field Test Reports: Written reports of tests specified in Part 3 of this Section.
- F. Maintenance Data: For equipment to include in maintenance manuals specified in Division 1. Include the following:
  - 1. Maintenance schedules and repair parts lists for motors, coils, integral controls, and filters.

#### **1.4 QUALITY ASSURANCE**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.



## **1.5 COORDINATION**

- A. Coordinate layout and installation of equipment and suspension system components with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

## **1.6 EXTRA MATERIALS**

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Cabinet Unit Heater Filters: Furnish one spare filter[s] for each filter installed.

## **PART 2 - PRODUCTS**

### **2.1 CABINET UNIT HEATERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Berko
  - 2. Indeeco
  - 3. Markel
  - 4. Marley
  - 5. QMark
- B. Description: An assembly including filter, chassis, coil, fan, and motor in blow-through configuration with heating coil. Equipment shall be factory-assembled and tested under AHRI 440. Airflow: Down flow.
- C. Cabinet: For one or more of the following configurations:
  - 1. Surface, ceiling mounting.
    - a. Air Inlet: Front grille or bottom grille as indicated.
    - b. Air Outlet: Front or top grille as indicated.
  - 2. Semi-recessed, ceiling-mounting front grilles for air inlet and outlet.
- D. Materials:
  - 1. Chassis: Galvanized steel, with flanged edges.
  - 2. Coil Section Insulation: 1 inch duct liner complying with ASTM C 1071 and attached with adhesive complying with ASTM C 916.
    - a. Fire-Hazard Classification: Duct liner and adhesive shall have a maximum flame-spread rating of 25 and smoke-developed rating of 50 when tested according to ASTM E 84.
  - 3. Cabinet: Steel, with removable panels fastened with tamperproof fasteners.
  - 4. Cabinet Finish: Bonderize, phosphatize, and flow-coat with baked-on primer with manufacturer's standard paint, in color selected by Architect, applied to factory-assembled and -tested cabinet unit heater before shipping.

E. Coils:

1. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and hum, mounted in ceramic inserts in galvanized-steel housing; with fuses in terminal box for overcurrent protection and limit controls for high-temperature protection. Terminate elements in stainless steel machine-staked terminals secured with stainless steel hardware.

F. Fan:

1. Centrifugal, with forward-curved, double-width wheels and fan scrolls made of galvanized steel or thermoplastic material; directly connected to motor.

G. Fan Motors:

1. Permanently lubricated, electronically commutated (EC) motor with multispeed switch, thermal-overload protection and resilient mounts on motor board. Connect motor to chassis wiring with plug connection.

H. Accessories:

1. Aluminum wall boxes with integral eliminators and insect screen.
2. Control Access Door: Key operated.
3. Steel subbase, height as indicated.
4. Steel recessing flanges for recessing cabinet unit heaters into ceiling or wall.
5. Filters: 1 inch thick, glass-fiber media in fiberboard frame.
6. Dampers: Steel damper blade(s) with polyurethane stop across entire blade length and having factory-mounted electric operators for proportioning amounts of outside air and return air.

- I. Control devices and operational sequences are specified in Division 23 Section "Instrumentation and Control for HVAC" and Control Drawings.

- J. Electrical Connection: Factory-wired motors and controls for a single field connection.

## 2.2 PROPELLER UNIT HEATERS

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

1. Berko
2. Indeeco
3. Markel
4. Marley
5. Modine
6. QMark

- B. Description: An assembly including casing, coil, fan, and motor in horizontal discharge configuration with horizontal, adjustable louvers in blow-through configuration.

C. Materials:

1. Casing: Steel, with removable panels.
2. Cabinet Finish: Bonderize, phosphatize, and flow-coat with baked-on primer and manufacturer's standard paint applied to factory-assembled and -tested propeller unit heater before shipping.

D. Coils:

1. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in steel or corrosion-resistant metallic sheath with fins no closer than 0.16 inch. Element ends are to be enclosed in terminal box. Fin surface temperature is not to exceed 550 deg F at any point during normal operation.
  - a. Circuit Protection: One-time fuses in terminal box for overcurrent protection and limit controls for high-temperature protection of heaters.
  - b. Wiring Terminations: Stainless steel or corrosion-resistant material.

E. Fan:

1. Propeller with aluminum blades directly connected to motor.

F. Fan Motors:

1. Motors, 1/2 HP and Smaller: Permanent-split capacitor, multispeed motor with integral thermal-overload protection.
2. Motors, 3/4 HP and Larger: Totally enclosed with permanently lubricated ball bearings.

G. Accessories:

1. Horizontal Configuration: Louver fin diffuser.
2. Vertical Configuration: Louver cone diffuser.

H. Controls:

1. Control devices and operational sequences are specified in Division 23 Section "Instrumentation and Control for HVAC" and Control Drawings.

I. Source Quality Control:

1. Test propeller unit heater coils according to ASHRAE 33.

## 2.3 RADIANT HEATING PANELS

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

1. Berko
2. Indeeco
3. Markel
4. Marley
5. QMark

B. Description: Sheet-metal-enclosed panel with heating element suitable for recessed mounting. Comply with UL 2021.

1. Panel: Minimum 0.0276-inch-thick, galvanized sheet steel back panel riveted to minimum 0.0396-inch-thick, galvanized sheet steel front panel with fused-on crystalline surface.
2. Heating Element: Powdered graphite sandwiched between sheets of electric insulation.
3. Heating Element: Insulated resistive wires.
4. Electrical Connections: Nonheating, high-temperature, insulated-copper leads, factory connected to heating element.

5. Exposed-Side Panel Finish: Apply silk-screened finish to match appearance of Architect-selected acoustical ceiling tiles.
  6. Exposed-Side Panel Finish: Factory prime coated, ready for field painting.
  7. Exposed-Side Panel Finish: Baked-enamel finish in manufacturer's standard paint color as selected by Architect.
  8. Surface-Mounted Trim: Sheet metal with baked-enamel finish in manufacturer's standard paint color as selected by Architect.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Controls:
1. Control devices and operational sequences are specified in Division 23 Section "Instrumentation and Control for HVAC" and Control Drawings.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine areas to receive equipment for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in for electrical connections to verify actual locations before equipment installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 GENERAL INSTALLATION**

- A. Install equipment level and plumb.
- B. Install equipment to comply with NFPA 90A.
- C. Install wall-mounting thermostats and switch controls in electrical outlet boxes at heights to match lighting controls.

#### **3.3 CABINET UNIT HEATER INSTALLATION**

- A. Install cabinet unit heaters to comply with NFPA 90A.
- B. Suspend cabinet unit heaters, unit heaters from structure with rubber-in-shear vibration isolators (rubber hangers).
- C. Install new filters in each fan-coil unit within two weeks of Substantial Completion.
- D. Connect supply and return ducts to cabinet unit heaters with flexible duct connectors specified in Section 233300 "Air Duct Accessories."

#### **3.4 PROPELLER UNIT HEATER INSTALLATION**

- A. Install propeller unit heaters to comply with NFPA 90A.
- B. Suspend propeller unit heaters from structure with rubber-in-shear vibration isolators (rubber hangers).

### **3.5 RADIANT CEILING PANEL INSTALLATION**

- A. Support for Radiant-Heating Panels in or on Grid-Type Suspended Ceilings: Use grid as a support element.
  - 1. Install a minimum of four ceiling-support-system rods or wires for each panel. Locate not more than 6 inches from panel corners.
  - 2. Support Clips: Fasten to panel and to ceiling grid members at or near each panel corner with clips designed for the application.
  - 3. Panels of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support panels independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
- B. Verify locations of thermostats with Drawings and room details before installation.

### **3.6 CONNECTIONS**

- A. Ground equipment.
- B. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- C. Comply with safety requirements of UL 1995.

### **3.7 FIELD QUALITY CONTROL**

- A. Testing: Perform the following field quality-control testing and report results in writing:
  - 1. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 2. Test and adjust controls and safeties.
- B. Repair or replace malfunctioning units. Retest as specified above after repairs or replacements are made.

### **3.8 CLEANING**

- A. After installing units, inspect equipment for damage to finish. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
- B. After installing units, clean equipment internally according to manufacturer's written instructions.
- C. Install new filters in each cabinet unit heater within two weeks after Substantial Completion.

### **3.9 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain cabinet unit heaters.
  - 1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment.
  - 2. Review data in maintenance manuals.
  - 3. Schedule training with Owner, through Architect, with at least seven days' advance notice.

**END OF SECTION 23 8235**

## **SECTION 26 0500 – COMMON WORK RESULTS FOR ELECTRICAL**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to work of this Section.
- B. This Section shall apply to all Division 26 Sections.

#### **1.2 SUMMARY**

- A. This Section includes general administrative and procedural requirements for electrical installations. The following administrative and procedural requirements are included in this Section to expand the requirements specified in Division 01 Sections.
  - 1. Codes and standards
  - 2. Quality assurance
  - 3. Examination of drawings and premises
  - 4. Substitutions
  - 5. Alternates
  - 6. Permits, fees, and inspections
  - 7. Changes involving Electrical Work
  - 8. Submittals
  - 9. Project record documents
  - 10. Delivery, storage, and handling
  - 11. Warranty
  - 12. Scope of work specified in Division 26 sections
  - 13. Related work specified in other Divisions
- B. Part II – Products:
  - 1. This Section includes basic requirements for materials and installations for electrical work, including but not limited to:
    - a. Concrete
    - b. Access doors
    - c. Sealing of openings
    - d. Sleeves
    - e. Expansion fittings
    - f. Framed one-line diagram
- C. Part III – Execution:
  - 1. This section includes basic requirements for installations for electrical work.
    - a. Temporary services
    - b. Cutting and patching
    - c. Chases and recesses
    - d. Excavation and backfill
    - e. Equipment foundations and supports
    - f. Coordination with other trades
    - g. Assembly and connection of equipment
    - h. Field quality control

### **1.3 CODES AND STANDARDS**

- A. The electrical characteristics, physical properties, design, performance characteristics, methods of construction, all material, and the installation techniques shall be in accordance with the latest issue of the various, applicable Standard Specifications of the following recognized authorities:
1. ADA – Americans with Disabilities Act
  2. AEIC – Association of Edison Illuminating Companies
  3. ANSI – American National Standards Institute
  4. ASTM – ASTM International, formerly known as American Society for Testing and Materials
  5. BICSI – Building Industry Consulting Service International
  6. FCC – Federal Communications Commission
  7. ICEA – Insulated Cable Engineers Association
  8. IEC – International Electrotechnical Commission
  9. IEEE – Institute of Electrical and Electronics Engineers
  10. MBC – Michigan Building Code
  11. MIOSHA – Michigan Occupational Safety and Health Administration
  12. NEC – National Electrical Code
  13. NETA – InterNational Electrical Testing Association
  14. NEMA – National Electrical Manufacturers Association
  15. NFPA – National Fire Protection Association
  16. OSHA – Occupational Safety and Health Administration
  17. UL – UL, LLC, formerly known as Underwriters Laboratories, Inc.

### **1.4 QUALITY ASSURANCE**

- A. Furnish all labor, materials, equipment, technical supervision, and incidental services required to complete, test, and leave ready for operation the electrical systems as specified in the Division 26 Sections and as indicated on Drawings.
1. The Electrical Drawings indicate the general design and extent of the electrical system. Comply with the Drawings as closely as actual construction of the building and the work of other Trades permit.
- B. Perform all work in a first class and workmanlike manner in accordance with the latest accepted standards and practices for the Trades involved.
1. All equipment of the same or similar systems shall be by the same manufacturer.
- C. Regulatory Requirements:
1. Codes, Standards, Ordinances, and Regulations: Perform all work in accordance with applicable Federal, State, and local ordinances and regulations. Perform all work to comply with Codes and Standards identified in these Specifications.
    - a. Notify the Architect/Engineer before submitting a proposal should any changes in Drawings or Specifications be required to comply with the above codes, standards, ordinances, and regulations. After entering into a contract, make all changes required to comply with the above codes, standards, ordinances, and regulations without additional expense to the Owner.
    - b. Barrier-Free Regulations: All materials and installations shall comply with the requirements of the State of Michigan Barrier-Free Regulations and with the Americans with Disabilities Act (ADA).
- D. Rules of Local Utility Companies:
1. Perform work in accordance with the rules of local utility companies. Before submitting the Bid, check with each utility company supplying service to this Project, determine all equipment and charges which they will require, and include the cost in the Bid.

E. Field Measurements:

1. Drawings are not intended to be scaled for roughing-in or to serve as shop drawings. Take all field measurements required for fitting the installation to the building.

F. Sequencing and Scheduling: Sequence and schedule work in order to avoid interference with the work of other Trades. Be responsible for removing and relocating any work which in the opinion of the Owner's Representatives causes interference.

**1.5 EXAMINATION OF DRAWINGS AND PREMISES**

A. Before submitting the Bid, examine the Architectural, Mechanical, and other Trades' Drawings and Specifications.

1. Notify the Architect/Engineer should any discrepancies occur between the other Trades and the electrical work.
2. No additional charges will be allowed because of failure to make this examination or to include all materials and labor required for the electrical work specified in other Trades' documents.
3. The Architectural Drawings take precedence in all matters pertaining to the building structure, the Mechanical Drawings take precedence in all matters pertaining to the Mechanical Trades, and the Electrical Drawings take precedence in all matters pertaining to the Electrical Trades. However, where there are conflicts or differences between the Drawings for the various Trades, report such conflicts or differences to the Architect/Engineer who shall determine the course of action to be taken.

B. Before submitting the Bid, examine the premises to determine existing conditions for performing the electrical work.

1. Notify the Architect/Engineer should any discrepancies occur between the existing conditions and the electrical work.
2. No additional charges will be allowed because of failure to make this examination or to include all materials and labor required to complete the electrical work.

**1.6 SUBSTITUTIONS**

A. Base Bid shall be in accordance with materials and products specified. Any exceptions to this shall be approved in writing by the Architect/Engineer ten (10) days or more prior to bidding.

**1.7 ALTERNATES**

A. Mandatory Alternates:

1. The Contractor shall refer to Alternates listed in Division 01 and Proposals and shall submit price quotations for the alternates that apply to the electrical work.

B. Voluntary Alternates:

1. Voluntary alternates may be submitted for consideration with listed addition or deduction to the Bid but will not affect the awarding of the Contract.

**1.8 PERMITS, FEES, AND INSPECTIONS**

A. Obtain all permits, licenses, inspections, and tests required. At the completion of the work, obtain and send certificates of inspections and approvals to the Architect/Engineer.

1. Pay all fees and expenses for permits, licenses, tests, and inspections.
2. A copy of the final approved inspection certificates for electrical work specified in all Division 26 Sections shall be provided as a requirement prior to final payment.



## **1.9 CHANGES INVOLVING ELECTRICAL WORK**

- A. The design of the electrical systems is based on the mechanical and building equipment specified and scheduled on the Drawings.
  - 1. Where equipment changes are made that involve additional electrical work (increased motor horsepower or increased unit full load amperes, requirements for a disconnect switch scheduled to be part of the equipment, requirements for a starter scheduled to be part of the equipment, additional wiring of equipment, etc.) the Mechanical or respective Trades involved shall compensate the Electrical Trades for the cost of the additional work required.

## **1.10 SUBMITTALS**

- A. The following is in addition to the requirements for submittals in Division 01.
- B. Material List: Submit a complete list of all materials and equipment indicating their manufacturer for approval by the Architect/Engineer within 15 days after award of contract and prior to submittal of shop drawings.
- C. Construction Schedule: Submit a construction schedule including milestone dates and lead times for major electrical equipment.
- D. Provide equipment submittals in the form of letters of intent, product data or, shop drawings as specified for all materials provided on the project.
- E. Submittal Preparation: Place a permanent label or title block on each submittal for identification. Indicate the name of the entity that prepared each submittal on the label or title block.
  - 1. Provide a space approximately 4" x 5" on the label or beside the title block on shop drawings to record the review and approval markings and the action taken.
  - 2. Include the following information on the label for processing and recording action taken.
    - a. Project Name
    - b. Date
    - c. Name and address of Architect/Engineer
    - d. Name and address of Contractor
    - e. Name and address of Subcontractor
    - f. Name and address of Supplier
    - g. Name of Manufacturer
    - h. Number and title of appropriate Specification Section
    - i. Drawing number, identification mark, fixture type, panelboard number, specification section number, and detail references, or as noted on the Electrical Drawings.
- F. Equipment submittals shall be reviewed by the Electrical Contractor for completeness and accuracy and prior to submitting to the Architect/Engineer for review. Submittals shall be dated and signed by the Electrical Contractor. Note on the submittal any and all exceptions or changes to the Drawings and Specifications required by the submittal to meet the specified products.
- G. Partial submittals for equipment shall not be permitted. Where partial submittals are transmitted to the Architect/Engineer, they will be returned "Rejected".
- H. Where the equipment submittals consist of manufacturer's standard detail drawings or schedules and contain data for a variety of similar equipment, indicate the data pertinent to the equipment furnished for this project only. Standard detail drawings and schedules not clearly indicating which data is associated with this Project shall be returned "Rejected".
- I. Where accessories and/or options are specified and do not appear as part of manufacturer's standard detail drawings or schedules, state each accessory that is to be provided with the equipment on the standard detail drawings or schedules.

- J. The letter of intent shall state that the product is exactly as specified with no exceptions and that the product is being manufactured by one of the specified manufacturers. The letter of intent shall include the specification section number, the product description, and the name of the selected manufacturer. The aforementioned information shall be typed on the Electrical Contractor's letterhead.
- K. Lighting fixture submittals shall be submitted as one (1) package including all fixtures intended to be used for this Project.
- L. CADD files of the Electrical Drawings will be provided by the Architect/Engineer for this Contractor's use in preparing submittals. Refer to Division 01 for the forms and procedures for requesting electronic files/media.
- M. Layout Shop Drawings: Prepare layout shop drawings drawn to scale in electronic format and submit electronic copies in .PDF and .DWG formats to the Architect/Engineer for review. Refer to Division 01 for submittals and quantities.
  - 1. Layout shop drawings shall show building floor plans to scale and shall include lighting and power distribution systems, all details of electrical construction, routing of conduits, wiring, circuiting, and related information necessary for the installation and future maintenance of the electrical wiring systems.
- N. No apparatus or equipment shall be shipped from stock or fabricated until their equipment submittals have been reviewed and approved by the Architect/Engineer. By the review of submittals, the Architect/Engineer does not assume responsibility for actual dimensions or for the fit of completed work in position, nor does such review relieve Electrical Trades of full responsibility for the proper and correct execution of the work required.

#### **1.11 PROJECT RECORD DOCUMENTS**

- A. Submit final project record documents as described in Division 01.
- B. As-Built Drawings: At the completion of the work, submit to the Architect/Engineer the revised set of drawings in electronic file format indicating all changes from the bid documents using redlines, bubbles, or another approved method. The Drawings shall contain all title block information as originally issued by the Architect/Engineer with the addition of the Electrical Contractor's company name, address, telephone number, company's project number, date of issuance by the Electrical Contractor, and issued for "As-Built" in title.
- C. Operation and Maintenance Manuals: The manuals shall contain operating instructions, service instructions, parts lists, etc., which are shipped with electrical equipment. At the completion of the work, transmit these items to the Owner. If this information is not shipped with the equipment, obtain it from the manufacturer.
- D. Maintenance Materials: Retain all portable and detachable portions of the installation such as keys, tools, manuals, etc., until the completion of the work and then transmit them to the Owner and obtain itemized receipt. This receipt shall be provided as a requirement prior to final payment.
- E. Record Documents Manual: At the completion of the work, furnish and deliver to the Owner and Architect/Engineer two (2) electronic sets on USB flash drive of the record documents manual.
  - 1. One (1) copy of all shop drawings and product data
  - 2. One (1) copy of operation and maintenance manuals
  - 3. One (1) copy of as-built drawings

**1.12 DELIVERY, STORAGE, AND HANDLING**

- A. Storage and Protection: Provide adequate storage space for all electrical equipment, conduit, and materials delivered to the job site under a weather protected enclosure. Location of the space will be designated by the Owner's Field Representative. Equipment set in place in unprotected areas must be provided with temporary protection.
  - 1. Be responsible for the care and protection of electrical equipment until it has been fully tested and accepted.
  - 2. Protect materials with permanent factory finish from damage by covering.
  - 3. Protect conduit openings with temporary plugs or caps.

**1.13 WARRANTY**

- A. Warranty: Provide a one-year parts and labor warranty from date of substantial completion for all equipment and installation. Comply with requirements of Division 01.
  - 1. A copy of the warranty on the Electrical Contractor's letterhead shall be provided as a requirement prior to final payment.

**1.14 SCOPE OF WORK SPECIFIED IN DIVISION 26 SECTIONS**

- A. Furnish all labor, materials, equipment, technical supervision, and incidental services required to complete, test, and leave ready for operation the electrical systems as specified in the Division 26 Sections and as indicated on Drawings.
- B. Provide control wiring greater than 100 volts for temperature, pressure, and level control devices and for solenoid valves, control relays, MCC control wiring, and all power wiring required for equipment specified hereinafter.
- C. Provide empty raceway systems consisting of conduits, wireways, surface raceways, nylon pull strings, outlet boxes, pull boxes, cover plates, underfloor ducts, and cable trays as indicated for telephone wiring, data wiring, audio/video wiring, access controls and intrusion detection wiring, for work specified in all Division 27 Sections and for work specified in all Division 28 Sections.

**1.15 RELATED WORK SPECIFIED IN OTHER SECTIONS**

- A. Excavating, trenching, and backfilling for electrical – Division 31, except as specified in Division 26 Sections.
- B. Furnishing and mounting of all electric motors – Divisions 14, 21, 22 and 23.
- C. Furnishing, mounting, and wiring of all electro-mechanical temperature, pressure, level, and flow control devices, high and low temperature limit switches, door limit switches, and solenoid valves – Divisions 22, 23 and 25.
- D. Furnishing and wiring of low voltage thermostats – Division 23.
- E. Furnishing and installing low voltage instrumentation and control wiring – Divisions 21, 22 and 23, except where otherwise indicated.
- F. Furnishing and mounting of starters, disconnect switches, control wiring, and integral controls on package self-contained building service equipment – Divisions 14, 21, 22 and 23, except as otherwise indicated.
- G. Furnishing and installing field prime and finish painting – Division 09, except as specified in Division 26 Sections.
- H. Data LAN equipment and wiring – Division 27.

- I. Access Controls and Intrusion Detection equipment and wiring – Division 28

## **PART 2 - PRODUCTS**

### **2.1 CONCRETE**

- A. Provide concrete work required for the electrical installation. Concrete work shall include envelopes for underground conduits and ducts, housekeeping pads beneath equipment, and bases for outdoor lighting equipment. Concrete work shall be in conformance with Division 03.

### **2.2 ACCESS DOORS**

- A. Furnish access doors in conformance with Division 08 as required to make accessible all controls, motors, electrical boxes, and other equipment installed by the Electrical Trades or as required by Code.

### **2.3 SEALING OF OPENINGS**

- A. Seal openings around electrical materials (conduit, raceways, cable trays, panels, etc.) with fire and smoke stop systems where floors, fire rated walls, and smoke barriers are penetrated. Fiberglass is not acceptable. Fire and smoke stop systems shall be UL listed and shall have a fire rating equal to or greater than the penetrated barrier. Fire and smoke stop systems shall be in conformance with Division 07.

### **2.4 SLEEVES**

- A. Provide conduit sleeves where conduits pass through concrete floors, walls, beams, and ceilings.
- B. Sleeves shall be galvanized rigid steel conduit. Do not use aluminum conduit. Where specific sizes are not indicated on the Drawings, sleeves shall be sized to provide one-half (1/2) inch clearance around the outside surface of the item for which they were installed. They shall be cut flush with wall surfaces and shall extend one inch, or as directed, through floor. Sleeves shall be packed with approved non-combustible packing material and sealed with sealant to prevent passage of air, liquid, or fumes from one area to another. The filler and sealant materials used shall be rated at least equal in fire resistance to the construction material being penetrated. Floor sleeves shall be sealed between floor and sleeve with concrete grout.

### **2.5 EXPANSION FITTINGS**

- A. Provide expansion fittings in all conduits, cable trays, and feeder bus duct runs that cross building expansion joints, both in concrete slabs and where exposed, and provide bonding jumpers where required to maintain electrical continuity.

### **2.6 FRAMED ONE-LINE DIAGRAM**

- A. Provide a framed copy of the one-line diagram depicting the incoming source, the main electrical equipment, and the loads being served from the main electrical equipment as shown on the Electrical Drawings including all "as-built" conditions. The framed one-line diagram shall be mounted on the wall in the main electrical room. Frame shall include glass assembly to protect the drawing and shall accommodate a 30 inch by 42 inch drawing size. Entire drawing including title block information shall be clearly displayed. Drawings shall be updated to include any factory or field modifications and shall be a blackline drawing on a white background. Coordinate drawing requirements with the Architect/Engineer prior to installation.

## **PART 3 - EXECUTION**

### **3.1 TEMPORARY SERVICES**

- A. Provide temporary lighting, power, and telephone service as described in Division 01.

- B. The existing building will be occupied during construction. Maintain electrical services and provide necessary temporary connections and their removal at no additional expense. The existing service shall not be removed until the new services have been installed and made operational in order to minimize shutdown time during transfer of services. The Electrical Contractor shall be responsible for installing and maintaining a temporary service to the existing electrical equipment. Route temporary service in a manner that does not interfere with the convenience of the Owner.

### **3.2 CUTTING AND PATCHING**

- A. Refer to Division 01 for requirements for cutting, patching, and refinishing work necessary for the installation of electrical work.
- B. The drilling or punching of structural members, such as holes through beams or columns, shall not be done without the specific permission of the Architect/Engineer.
- C. Cooperate with the other Trades so that all cutting and repairing in any given area will be done simultaneously.

### **3.3 CHASES AND RECESSES**

- A. Provide sizes and locations of chases and recesses affecting the electrical work for provision by the General Trades.

### **3.4 EXCAVATION AND BACKFILL**

- A. Furnish excavating and backfilling to install electrical work. Refer to Electrical Drawings and Division 31 for methods and materials.

### **3.5 EQUIPMENT FOUNDATIONS AND SUPPORTS**

- A. Furnish foundations and supports for electrical equipment and materials as required by codes, as listed hereinafter, and shown or noted on the Drawings.
- B. Provide necessary inserts, rods, structural steel frames, brackets, platforms, etc., for equipment suspended from ceilings or walls, such as conduits, transformers, panels, etc.
- C. Inserts for equipment support shall be lead shield anchors for small work and expansion shields for large work. Wooden plugs will not be allowed. Do not use metal roof decking and cellular floors for supporting equipment.
- D. Provide and install concrete bases 4" above finished floor with leveling channels, where noted, for floor-mounted equipment such as unit substations, transformers, switchboards, distribution panels, motor control centers, etc.
- E. Enclosures for panelboards, motor starters, disconnect switches, and motor control centers shall be mounted on 1/2" spacers when mounted in a room below grade on exterior walls or 1/4" spacers when mounted in a room at or above grade on an exterior wall.

### **3.6 COORDINATION WITH OTHER TRADES**

- A. Install work in order to avoid interferences with the work of other Trades. The Electrical Contractor shall be responsible for removing and relocating any work which, in the opinion of the Owner's Representative, causes interferences.

- B. Should construction conditions prevent the installation of switches, conduit, outlet boxes, junction boxes, conductors, lighting fixtures, and/or other related equipment at locations shown on the Drawings, minor deviations may be permitted, shall be as directed by the Architect/Engineer and shall be made without additional cost to Owner.
- C. The Electrical Trades shall be responsible for all damage to other work caused by their work or through the neglect of their workers.
  - 1. All patching and repairing of any such damaged work shall be performed by the Trades which installed the work, but the cost shall be paid by the Electrical Trades.

### **3.7 ASSEMBLY AND CONNECTION OF EQUIPMENT**

- A. Assembly of Equipment:
  - 1. The Contract Drawings and Specifications indicate items to be purchased and installed which are noted by a manufacturer's name, catalog number and/or brief description.
  - 2. The catalog number may not designate all the accessory parts and appurtenances required for the particular use or function.
  - 3. Arrange with the manufacturer for the purchase of all items required for the complete installation and efficient operation.
- B. Equipment Connections:
  - 1. Connections to equipment, motors, elevator controllers, lighting fixtures, etc., shall be made in accordance with the shop drawings and rough-in measurements furnished by the manufacturers of the particular equipment furnished.
  - 2. Any and all additional connections not shown on the Drawings but called for by the equipment manufacturer's shop drawings or required for the successful operation of the particular equipment furnished shall be installed as part of this Contract at no additional charge to the Owner.

### **3.8 FIELD QUALITY CONTROL**

- A. Testing Ducts and Conduits: Ducts and conduits which are installed underground or concealed in concrete floor slab, foundations, etc., shall be cleared of foreign material and obstructions after installation and before conductor or pull wires are draw-in by wire brushing, swabbing, and employing an iron or hardwood mandrel which is 1/4" smaller in diameter than the internal diameter of the duct or conduit. Pulling wires shall be left in empty conduits.
- B. Tests and Inspection:
  - 1. When the systems are completed, operate equipment as directed by Architect/Engineer. Replace all faulty equipment. Make necessary adjustments before final acceptance.
  - 2. Perform all tests required by State, City, County and/or other agencies having jurisdiction.
  - 3. Provide all materials, equipment, etc., and labor required for tests.
  - 4. Perform cable and equipment testing as specified.
- C. Cleaning:
  - 1. Keep premises free from accumulation of waste materials and rubbish. At the completion of the work, remove all rubbish from and about the building, and leave the electrical systems clean and ready for use.
  - 2. Final clean-up shall include washing of fixture lenses, switchboards, substations, transformers, motor control centers, distribution panels, lighting panels, etc., to remove shipping and/or construction dust and debris. Fixture reflectors and/or lenses with water marks or cleaning streaks will not be accepted.
- D. Painting:

1. In general, no painting is required by Electrical Trades other than touch-up of factory-finished electrical equipment.
2. All factory finished electrical equipment shall be cleaned at the completion of the work. Equipment showing rust or mars shall be thoroughly cleaned and sanded, prime coated, and touched up with enamel of color to match original finish.

E. Laying Out Exterior Work:

1. All exterior manholes, handholes, utility poles, lighting poles, bollards, and similar equipment shall be staked by this contractor and approved by the Architect/Engineer prior to installation.

**END OF SECTION 26 0500**

## **SECTION 26 0513 - MEDIUM-VOLTAGE CABLES (1,001V - 15,000V))**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Conductors and cabling for buildings and electrical systems over 1000 volts.
  - 2. Wire and cable systems as required, and all materials and equipment, including wire, cable, connectors, lugs, splicing kits, terminating kits and identification, as indicated or specified.
- B. Related Sections including the following:
  - 1. Cable tests as specified in Section 26 0570.

#### **1.3 SUBMITTALS**

- A. General: Submit the following according to the Conditions of the Contract and Division 01 Specification Sections.
- B. Product Data:
  - 1. Conductors: Each type and size of wire and cable. Identify material, construction data, insulation thickness, jacket thickness, suitability for application intended, factory impulse test value and manufacturer's recommendations for items specified.
  - 2. Splice kits
  - 3. Termination kits
  - 4. Cable identification system
  - 5. Connectors
  - 6. Lugs
  - 7. Arc and fireproofing tape
- C. Samples: Submit samples on request of the Architect-Engineer.
- D. Submit test data for wire and cable upon request of the Architect-Engineer. Do not install wire and cable for which test data has been requested until test data is approved.

#### **1.4 QUALITY ASSURANCE**

- A. Wire, cable and components: Listed by Underwriters Laboratories as meeting National Electrical Code and NFPA 70 requirements, and be so labeled.
- B. Furnish wire and cable on which standard factory tests established by AEIC, ANSI, ASTM, ICEA and NEMA have been performed.
- C. Furnish cable tests as specified in Section 26 0570.



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

- A. Deliver all wire and cable to the site on reels, plainly marked for complete identification, including wire or cable size, number of conductors, type of wire or cable, length, weight, thickness and character of insulation and the name of the manufacturer.

## **PART 2 - PRODUCTS**

### **2.1 WIRE AND CABLE**

- A. General Requirements: Furnish wire and cable meeting the standard specifications established for such material and construction by ASTM, ANSI, AEIC, IPCEA AND NEMA, where applicable. Furnish stranded copper conductors unless otherwise specified and conductor sizes as indicated.
- B. Manufacturer: Provide products of one of the following:
  - 1. General Cable Corporation
  - 2. Kerite/Marmon Wire & Cable
  - 3. Okonite
  - 4. Southwire
  - 5. Aetna
  - 6. Prysmian
- C. 15 kV Cable for Power Distribution up to 13,800 Volts in Conduit and Underground Ducts: Single conductor, consisting of concentrically Class B round stranded annealed copper individual conductors covered with a semiconducting tape, insulated with a heat, moisture and ozone-resistant cross-linked polyethylene or ethylene propylene rubber compound rated 90 degC, 15,000 volts ungrounded (133% insulation level), having a copper shield over the insulation and a PVC or neoprene jacket over the shielding. Provide continuous phase identification of individual conductors in triplex assembly.

### **2.2 CONNECTORS FOR SPLICING COPPER CONDUCTORS**

- A. Connectors for Straight Splicing Conductors: Solderless compression 2-way type.
  - 1. Manufacturer: Provide products of one of the following:
    - a. Thomas & Betts 54500 Series
    - b. Burndy, model no. YS-L
- B. Connectors for 3-Way Splicing Conductors: Solderless compression type.
  - 1. Manufacturer: Provide products of one of the following:
    - a. Thomas & Betts 54700 Series
    - b. Burndy, model no. YS-T

### **2.3 LUGS FOR TERMINATING COPPER CONDUCTORS**

- A. Lugs for Terminating Conductors: Solderless compression type, one hole for sizes through No. 4/0 AWG, and two hole for larger sizes.
  - 1. Manufacturer: Provide products of one of the following:
    - a. Burndy, model no. YA-L
    - b. Thomas & Betts Series 54000

## **2.4 CABLE SPLICE AND TERMINATION KITS**

- A. Kits for Field Splicing and Terminating Cable: Of an appropriate design for the particular cables with which they will be used, and of a type recommended by the cable manufacturer. Include all material necessary for completion of the splice or termination in an individually packaged kit, with complete instructions for each step of the splicing or terminating procedure.

## **2.5 MISCELLANEOUS**

- A. Arc and Fire Proofing Tape.
1. Tape shall be flexible unsupported elastomer providing arc fault protection, flame resistant self-extinguishing to prevent flame propagation capable of withstanding 13,000° K, 60 Hz faults for 70 cycles, and 76 mils thick.
  2. Manufacturer: Provide products of one of the following:
    - a. Irvington, model no. 7700
    - b. 3M Scotch 77
- B. Banding Tape.
1. Tape shall be woven glass cloth designed for continuous operation in Class B (130 °C) applications and shall be 17 mils thick.
  2. Manufacturer: Provide products of one of the following:
    - a. Plymouth/Bishop Insulating Products "77 Plyglas"
    - b. 3M Scotch 27
- C. Wire Labels for Identification of Conductors.
1. Manufacturer: Provide products of one of the following:
    - a. Brady
    - b. Westline
- D. Lubricating Compound.
1. Manufacturer: Provide product of one of the following:
    - a. American Polymeter Corporation
    - b. Ideal 77 Yellow
    - c. Wire Lube
- E. Preformed Stress Relief Terminators.
1. Manufacturer: Provide products of one of the following:
    - a. Joslyn
    - b. G&W Electric Company
    - c. Thomas & Betts Corporation
    - d. 3M Electrics Product Division

## **2.6 PULLING EYES**

- A. Order all cables in lengths required by the installation. Mount on separate reels with factory-installed pulling eyes on each required length. Attach pulling eyes directly to conductors. Factory-seal cable ends to prevent the entrance of moisture.

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- A. Install wiring in raceway systems, as indicated and as specified except where exposed wiring is indicated or specified. Install wiring only in completed raceway systems and when systems are protected from the weather. Install conductors continuous, without splices, between equipments, where possible.
- B. Continuously lubricate all non-armored cables of the larger sizes at the pull-in point of conduit systems with a lubricating compound compatible with conductor insulation or jacket.
- C. Install conductors in such a manner that the bending radius of any wire or cable is not less than the minimum recommended by AEIC, ICEA or the manufacturer. In pulling cables, do not exceed the manufacturer's recommended values for maximum pulling tension. When cables are pulled by means of a powered winch, be particularly careful not to exceed cable tension limits; the Architect-Engineer may require the use of a dynamometer on all remaining pulls if in his opinion the tension limits are being exceeded.
- D. Connect all wiring to equipment such that phasing is A-B-C left to right, top to bottom and front to back, where possible, and permanently identify phasing on the structure or housing adjacent to the bus. Phase identification A-B-C is equivalent to transformer phase identification X1-X2-X3 and H1-H2-H3. Identify individual conductors as to phase connection A, B, C, by means of wire labels, at each splice and termination.

### **3.2 ARC AND FIRE PROOFING**

- A. Fire proof each cable at exposed locations in manholes, handholes and buildings as follows:
  - 1. Install not less than 4 layers of arc-proofing tape, two layers half-lapped, in one direction. Terminate fire proofing approximately 1/2 inch from the duct face to permit inspection of the cable at the duct entrance and to prevent the fire proofing from interfering with the expansion and contraction of the cable.
  - 2. In applying tape, snug the tape by twisting the tape with the hand. Where steep inclines are caused by changes in cable diameters, such as at splices, apply tape in a stairstep manner by increasing the lapping of the tape as required to maintain a minimum thickness of 4 layers. Increase lapping around cable bends to avoid decreasing the thickness below minimum on the outside of the cable bend.
  - 3. Band the arc-proofing tape with 1/2 inch wide pressure-sensitive fiberglass cloth banding tape, at intervals not exceeding 12 inches on centers. Construct bands of not less than six turns of banding tape so applied that not more than three turns are in contact with the elastomer backing of the arc-proofing tape.

### **3.3 IN UNDERGROUND DUCT SYSTEMS**

- A. Brush and swab the duct line before pulling cables. Use flexible cable feeders of an appropriate size to lead the cable from the reel into the duct mouth. In manholes and handholes, install cables on cable rack insulators. In passing cables through manholes and handholes, take care to avoid crossovers so that each cable is accessible when placed on racks; and where feasible, install each cable in the duct in the same relative position throughout the underground system, unless otherwise required or indicated. Install cable so that spare ducts are accessible for use in the future.

### **3.4 SPLICES AND TERMINATIONS**

- A. Splice and terminate conductors with connectors and lugs as specified for the specific size and type of conductor. Terminate shielded cables with stress cones. Continue shields through splices and ground shields at splices and at terminations. Do not splice cables except where cable lengths are limited by maximum reel capacity or anticipated pulling tension. Do not splice direct burial cable underground. Indent all compression type connectors and lugs with tools as recommended by the connector or lug manufacturer.
- B. Do not open cable prior to splicing or terminating unless unavoidable, and do not make splices or terminations if exposed to damp or inclement weather, except when prior approval has been obtained from the Architect-Engineer and a cable splicer's tent or other approved means of protection is employed. Train or rack cables into their final positions before cutting any cable. Cut cables to be spliced so that they butt squarely at the centerline of the splice. Once a cable is opened, proceed with the work immediately and continue uninterrupted until the splice or termination is completed, including any sealing or resealing required.
- C. Thoroughly clean wire ends before connectors or lugs are applied. Before installing a compression connector or lug on an aluminum conductor, apply an aluminum joint compound, to the exposed conductor and wire brush through the compound to remove the aluminum oxide film. Install the connector immediately after wire brushing the conductor.
- D. Whenever aluminum or copper lugs are terminated on aluminum bus, use a Belleville washer and two tin or cadmium plated washers, one on each side, in combination with aluminum joint compound on all contacting surfaces. Tighten bolts until Belleville washer is flat.
- E. Insulate splices and terminations with materials in packaged kits as specified. Follow instructions of the cable manufacturer for the work. Install rainshields for outdoor taped terminations. Install potheads, preformed stress relief terminators for outdoor terminations on poles or structures. Install armor terminators for armored cable terminations at equipment. Where splices are required in armored cables, use approved splicing sleeves and locate sleeves outside of and adjacent to the tray, not in the tray. Provide separate supports for same. Support all splices in non-armored cables in manholes and handholes adjacent to the splice, not on the splice. Terminate cable ground conductors on equipment ground bus.

### **3.5 CABLE IDENTIFICATION**

- A. Refer to Section 26 0553 "Identification for Electrical Systems" for conductor identification requirements.

### **3.6 FIELD QUALITY CONTROL**

- A. Perform testing on all conductors as indicated in Section 26 0570 "Electrical Testing and Power System Studies."

**END OF SECTION 26 0513**

## **SECTION 26 0519 – LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (0-1,000V)**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Conductors and cabling for building and structure electrical systems 600 volts and less.
  - 2. Wire and cable systems as required, and all material and equipment, including wire, cable, connectors, lugs, fittings, and identification, as indicated or specified.
- B. Related Sections including the following:
  - 1. Wiring for communications is specified in Division 27 and wiring for electronic safety and security is specified in Division 28.
  - 2. Tests on Cables as specified in Section 26 0570.

#### **1.3 SUBMITTALS**

- A. General: Submit the following according to the Conditions of the Contract and Division 01 Specification Sections.
- B. Letter of Intent: Submit a letter of intent stating compliance with drawings, specifications, and code:
  - 1. Wire and cable, except interlocked armor cable
  - 2. Connectors
  - 3. Lugs
  - 4. Terminal blocks
  - 5. Insulating tape
  - 6. Miscellaneous
- C. Samples: Submit samples on request of the Architect-Engineer.
- D. Submit test data for wire and cable upon request of the Architect-Engineer. Do not install wire and cable for which test data has been requested until test data is approved.

#### **1.4 QUALITY ASSURANCE**

- A. Wire, Cable and Components: Listed by Underwriters' Laboratories as meeting NFPA 70 National Electrical Code requirements and be so labeled.
- B. Furnish wire and cable on which standard factory tests established by AEIC, ANSI, ASTM, ICEA and NEMA have been performed.
- C. Furnish tests on cables as specified in Section 26 0570.

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

- A. Deliver all wire and cable to the site on reels or in coils, plainly marked for complete identification, including the wire or cable size, the number of conductors, type of wire or cable, length, weight, thickness and character of the insulation and the name of the manufacturer.

## **PART 2 - PRODUCTS**

### **2.1 WIRE AND CABLE (ALUMINUM WIRE WILL NOT BE ACCEPTED)**

- A. General Requirements: Furnish wire and cable per standard specifications established for such material and construction by ASTM, ANSI, ICEA and NEMA, where applicable. All conductors shall be copper unless otherwise specified. Minimum size of conductors shall be No. 12 AWG, except 120 volt control conductors which may be No. 14 AWG and 90 volt and less shall be as specified. Furnish conductor sizes as indicated. Conductors shall be stranded for sizes No. 14 AWG and larger. Conductors smaller than No. 14 AWG shall be as specified in the sections requiring use of such conductors.

1. Manufacturer: Provide products of one of the following:

- a. Cerrowire
- b. Encore Wire
- c. Prysmian Group
- d. Republic Wire
- e. Southwire

- B. Wire for General Interior Use: Single conductor, annealed copper, 600 volts.

- 1. No. 10 AWG and smaller: NEC Type THHN/THWN insulation rated 90 degC in dry locations and 75 degC in wet locations or NEC Type THHN/THWN-2 or XHHW-2 insulation rated 90 degC in dry and wet locations.
- 2. No. 8 AWG and larger: NEC Type THHN/THWN-2 or XHHW-2 insulation rated 90 degC in dry and wet locations.

- C. Wire for General Exterior Use: Single conductor, annealed copper, NEC Type XHHW-2 rated 90 degC in dry and wet locations, 600 volts.

- D. Wire for Underground Duct or Conduit: Single conductor, annealed copper, NEC Type XHHW-2 rated 90 degC in dry and wet locations, 600 volts.

- E. Cable types MC, MI, NM, NMC and NMS shall not be used unless specifically noted on the drawings or in the specifications.

### **2.2 CONNECTORS FOR SPLICING COPPER CONDUCTORS**

- A. Connectors for Straight Splicing (Butt Splice) Conductors Up To and Including No. 8 AWG: Uninsulated solderless compression 2-way type, copper, electro tin plated, rated 90 degC, 600 volts.

1. Manufacturer: Provide one of the following:

- a. ABB "Sta-Kon"
- b. Hubbell Burndy "Hylink"
- c. Panduit

- B. Connectors for Straight Splicing (Butt Splice) Conductors No. 6 AWG and Larger: Uninsulated solderless compression 2-way type, high conductivity copper, electro tin plated, rated 90 degC, 600 volts.

1. Manufacturer: Provide one of the following:
  - a. ABB "Color-Keyed"
  - b. Hubbell Burndy "Hylink"
- C. Connectors for Pigtail Splicing Conductors Up To and Including No. 8 AWG: Solderless type with a metallic insert connector within a plastic insulating cover having a temperature rating of 105 degC, 600 volts.
  1. Manufacturer: Provide one of the following:
    - a. 3M Scotchlok
    - b. Buchanan
    - c. Ideal
- D. Connectors for 3-Way Splicing Conductors No. 6 AWG and Larger: Uninsulated solderless compression 3-way type, high conductivity copper, electro tin plated, rated 90 degC, 600 volts.
  1. Manufacturer: Provide one of the following:
    - a. ABB Blackburn
    - b. Hubbell Burndy
- E. Connectors for termination of motor loads to branch circuits: Set screw type, multitap, clear insulation for termination inspection.
  1. Manufacturer: Provide one of the following:
    - a. ABB Blackburn
    - b. Hubbell Burndy "UNITAP"

### **2.3 LUGS FOR TERMINATING COPPER CONDUCTORS**

- A. Lugs for Terminating Power Conductors Up To and Including No. 8 AWG: Solderless type, manufacturer's standard, unless otherwise specified.
- B. Lugs for Terminating Power Conductors No. 6 AWG and Larger: Solderless compression type, one hole for No. 6 AWG through No. 4/0 AWG inclusive, and two hole for larger sizes, copper, electro tin plated, rated 90 degC, 600 volts.
  1. Manufacturer: Provide one of the following:
    - a. ABB "Color-Keyed"
    - b. Hubbell Burndy "Hylug"
- C. Lugs for Terminating Control and Switchboard Wiring: Solderless compression type with tinned ring tongue.
  1. Manufacturer: Provide one of the following:
    - a. ABB "Sta-Kon"
    - b. Hubbell Burndy "Hylug"

## **2.4 INSULATING TAPE**

### **A. General Use Tape:**

1. Tape shall be vinyl all weather designed for continuous operation in -18°C to 105°C applications and shall be 7 mils thick.
2. Manufacturer: Provide one of the following:
  - a. 3M Scotch "Super 33+ Vinyl Electrical Tape"

### **B. Arc and Fireproofing Tape:**

1. Tape shall be flexible unsupported elastomer providing arc fault protection, flame resistant self-extinguishing to prevent flame propagation, and 30 mils thick.
2. Manufacturer: Provide products of the following:
  - a. 3M Scotch "Fire-Retardant Electric Arc Proofing Tape 77"

## **2.5 MISCELLANEOUS**

### **A. Wire Labels for Identification of Conductors.**

1. Manufacturer: Provide products of one of the following:
  - a. ABB EZ CODE
  - b. Brady

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- A. Install all wiring in raceway systems unless otherwise specified. Install wiring only in completed raceway systems and when systems are protected from the weather. Install conductors continuous, without splices, between equipment, where possible. Where splices are required, make up splices in boxes; do not use fittings for same.
- B. Install phase and neutral conductors of each branch or feeder circuit in a single conduit except where paralleling circuits are indicated. Install paralleling circuits of identical makeup and length as the paralleled circuit, and terminate conductors at the same location, mechanically and electrically, at both ends, to ensure equal division of the total current between conductors.
- C. All 120 volt branch circuits exceeding 100 feet in length shall be minimum size No. 10 AWG.
- D. For interior branch circuits, provide a separate neutral conductor for each phase conductor for circuits supplying 120 volt convenience receptacles, fluorescent ballasts, LED drivers and high intensity discharge ballasts. Sharing neutrals between phase conductors shall not be permitted.
- E. All branch circuits for parking lot and roadway lighting shall be minimum size No. 8 AWG.
- F. Install conductors in such a manner that the bending radius of any wire or cable is not less than the minimum recommended by ICEA and/or the manufacturer. Do not exceed manufacturer's recommended values for maximum pulling tension applied to any wire or cable.



- G. Connect all power wiring to equipment such that phasing shall be A-B-C-N left to right, top to bottom and front to back, where possible, and permanently identify phasing on the structure or housing adjacent to bus. Phase identification A-B-C is equivalent to transformer phase identification X1-X2-X3 and H1-H2-H3.
- H. Connect phase wiring to all 3 phase receptacles to insure the same phase rotation in all receptacles with interchangeable plugs.
- I. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- J. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- K. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values.
- L. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
  - 1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.

### **3.2 COLOR CODING, CONDUCTOR AND CABLE IDENTIFICATION**

- A. Provide single conductor cables having black or solid color coded insulation for power feeders and subfeeders. Identify individual feeder and subfeeder conductors as to phase connection and voltage by means of wire labels and color coding at each pull box, junction box, manhole, handhole, vault, lighting fixture handhole, splice and termination.
- B. Refer to Section 26 0553 "Identification for Electrical Systems" for conductor and cable identification requirements.

### **3.3 IN UNDERGROUND DUCT SYSTEMS**

- A. Brush and swab the duct line before pulling cable. When installing cables of large sizes, use flexible cable feeders of an appropriate size to lead the cable from the reel into the duct mouth. In manholes and handholes, install power cables exposed on cable racks and control and special system wiring in rigid steel conduit systems. In passing cables through manholes and handholes, avoid crossovers so that each cable is accessible when placed on racks, and where feasible, install each cable in the duct in the same relative position throughout the underground system, unless otherwise required or indicated. Install cables so that spare ducts are accessible for use in the future.

### **3.4 SPLICES AND TERMINATIONS**

- A. Splice and terminate conductors with connectors and lugs as specified for the specific size and type of conductor. Do not splice armored cable except where cable lengths are limited by reel capacity. Do not splice direct burial cable underground. Indent all compression type connectors and lugs with tools as recommended by the connector or lug manufacturer.
- B. Thoroughly clean wire ends before connectors or lugs are applied. Before installing a compression connector or lug on an aluminum conductor, apply an aluminum joint compound to the exposed conductor and wire brush through the compound to remove the aluminum oxide film. Install the connector or lug immediately after wire brushing the conductor.

- C. Whenever aluminum or copper lugs are terminated on aluminum bus, use a Belleville washer and two tin or cadmium plated washers, one on each side in combination with aluminum joint compound on all contacting surfaces. Tighten bolts until Belleville washer is flat.
- D. Insulate all bare surfaces of conductors with a minimum of four layers (half lap in two directions) of electrical insulating tape. On larger splices and terminals, build up connection with electrical insulating putty before applying tape, to eliminate both sharp edges and voids.
- E. Terminate all armored cables at equipment with an approved type of armored cable terminator and terminate cable ground conductors on equipment ground bus. Where splices are required in armored cables, use metal pull box specified in Section 26 0533 and located outside of and adjacent to the tray, not in the tray.

### **3.5 FIELD QUALITY CONTROL**

- A. Perform tests on cables as specified in the Section 26 0570.

**END OF SECTION 26 0519**

## **SECTION 26 0526 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Ground Rods
  - 2. Grounding Busbars
  - 3. Grounding Conductors:
    - a. For General Use Above Grade: Insulated copper.
    - b. For General Use Below Grade: Bare copper.
    - c. In Conduit with Copper Phase Conductors: Insulated copper.
  - 4. Grounding Connections:
    - a. In Earth or Inaccessible Locations: Exothermic welded type.
    - b. To Structural Steel Used for Main Building Framing: Exothermic welded type.
    - c. To Non-Permanently Fixed Equipment: Lugs bolted to the equipment.
    - d. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
    - e. All Other Locations: Bolted connectors.
  - 5. Markers and Identifiers

#### **1.3 QUALITY ASSURANCE**

- A. Regulatory Requirements: Ground electrical system neutrals and non-current carrying parts of electrical equipment per the minimum requirements of NFPA 70 National Electrical Code, except where additional requirements are indicated or specified.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70 National Electrical Code by a Nationally Recognized Testing Laboratory (NRTL) acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- C. Comply with UL 467 for grounding and bonding materials and equipment.
- D. Furnish tests on grounding systems as specified in Section 26 0570.

#### **1.4 SUBMITTALS**

- A. General: Submit the following according to the Conditions of the Contract and Division 01 Specification Sections.
- B. Letter of Intent: Submit a letter of intent stating compliance with drawings, specifications, and code:
  - 1. Grounding conductors
  - 2. Grounding connectors
  - 3. Markers and identifiers

- C. Product Data: Submit complete product data on each item:

1. Ground rods
2. Grounding busbars

## **PART 2 - PRODUCTS**

### **2.1 GROUND RODS**

- A. Ground Rods: Copper-clad steel, 3/4 inch diameter, 10 foot length.

1. Manufacturer: Provide products of one of the following:
  - a. ABB Blackburn
  - b. nVent Erco

### **2.2 GROUNDING BUSBARS**

- A. Rectangular bar of annealed copper with predrilled holes suitable for installation of 2-hole lugs, wall mounted with standoff insulators, size as indicated.

1. Manufacturer: Provide products of one of the following:
  - a. Eaton
  - b. Hubbell Burndy
  - c. nVent Erco

### **2.3 GROUNDING CONDUCTORS**

- A. Bare Grounding Conductors: Stranded annealed copper.

- B. Insulated Copper Grounding Conductors: Single conductor, stranded annealed copper, NEC Type THHN/THWN insulation rated 90 degC in dry locations and 75 degC in wet locations or NEC Type THHN/THWN-2 or XHHW-2 insulation rated 90 degC in dry and wet locations, 600 volts, color-coded green. Conductor No. 10 AWG and smaller may be solid in lieu of stranded.

- C. Flexible Braid Grounding Strap: Copper tape, braided conductors terminated with copper ferrules, size as required for equivalent wire conductor.

1. Manufacturer: Provide products of one of the following:
  - a. ABB Blackburn
  - b. Hubbell Burndy
  - c. nVent Erco

- D. Manufacturer: Provide products of one of the following, unless otherwise noted:

1. Cerrowire
2. Encore Wire
3. Prysmian Group
4. Republic Wire
5. Southwire

## **2.4 GROUNDING CONNECTIONS**

- A. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
  - 1. Manufacturer: Provide products of one of the following:
    - a. ABB Blackburn
    - b. Hubbell Burndy
    - c. nVent Erico
- B. Mechanical-Type Bus-Bar Connectors: Cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
- C. Compression-Type Bus-Bar Connectors: Copper or copper alloy, with two wire terminals.
- D. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.
- E. Cable-to-Cable Connectors: Compression type, copper or copper alloy.
- F. Conduit Hubs: Mechanical type, terminal with threaded hub.
- G. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.
- H. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.
- I. Water Pipe Clamps:
  - 1. Mechanical type, two pieces with stainless steel bolts.
    - a. Material: Copper alloy.
    - b. Listed for direct burial.
  - 2. U-bolt type with malleable-iron clamp and copper ground connector rated for direct burial.
- J. Manufacturers: Provide products of the following, unless otherwise noted:
  - 1. ABB Thomas & Betts including Blackburn
  - 2. Emerson Appleton
  - 3. Emerson O-Z/Gedney
  - 4. Hubbell Anderson
  - 5. Hubbell Burndy
  - 6. nVent Erico
  - 7. Penn Union

## **2.5 MARKERS AND IDENTIFIERS**

- A. Underground Hazard Tape: Non-adhesive, vinyl or polyester, 3-inch wide, black letters on yellow background "CAUTION-BURIED GROUND WIRE".
  - 1. ABB Thomas & Betts
  - 2. Panduit
  - 3. Stranco Products

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install conductors of minimum size required by NFPA 70 National Electrical Code except where sizes exceeding the requirements are indicated.
- B. Install ground rods at locations indicated. Separate ground rods by at least 10 feet. Locate top of ground rod not less than 12 inches below finish grade.
- C. Ground structural steel building framing in the web of the column.
- D. Thoroughly clean all bonding surfaces of non-conducting materials. Where bolted connections are used, treat surfaces with a corrosion-inhibiting compound.
- E. Where insulated conductors are used, thoroughly tape all exposed splices and connections. Encapsulate below grade splices and connections so that bare conductors are not in contact with earth.
- F. Where metallic conduit is used for mechanical protection of a ground conductor, bond conductor to the conduit at each end.
- G. For electrical system neutral grounding, do not use conductor sizes smaller than No. 8 AWG.
- H. Ground the enclosures of all heavy duty equipment such as switchgear, substations, transformers, motor control centers, and motors above 50 horsepower with a separate grounding conductor connected to the nearest ground conductor or ground bus comprising a part of the electrical system grounding.
- I. Where non-metallic conduit is used, install a ground conductor in the conduit with the circuit conductors. The ground conductor may be a separate conductor, a conductor of a multi-conductor cable, or wires in the interstices of cabled circuit conductors. Size the ground conductors per NEC requirements except where noted otherwise.
- J. Lighting branch circuits in EMT or flexible conduit and lighting fixture cord and plug assemblies shall have an equipment grounding conductor.
- K. Provide an equipment grounding conductor, within the raceway along with phase conductors, for all feeders and branch circuits.
- L. Provide an equipment grounding conductor within all flexible conduits.
- M. An equipment grounding conductor shall be installed within the raceway along with the phase conductors for all electrical equipment and devices located in Health Care Facilities, Clinics and Medical Areas.
- N. The metallic enclosures and exposed noncurrent-carrying metal parts of all electrical equipment shall be grounded by connection with an equipment grounding conductor. This includes boxes, panels, lighting fixtures, ballasts and poles, receptacles, etc.
- O. Lighting poles and luminaries shall be grounded with a #6 bare, stranded copper cable exothermically welded to a ground rod adjacent to the pole. An equipment grounding conductor shall be installed with the phase conductors.
- P. In manholes, install grounding as indicated, and ground all steel and equipment. Minimum size bare copper conductor is #4/0. Exothermic weld all connections.
- Q. Install hazard warning tape 12 inches below grade at locations of all underground grounding cables.

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**END OF SECTION 26 0526**

## **SECTION 26 0529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Steel slotted support systems.
  - 2. Conduit and cable support devices.
  - 3. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
  - 4. Fabricated metal equipment support assemblies.

### **PART 2 - PRODUCTS**

#### **2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS**

- A. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- B. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.
- C. Structural Steel for Fabricated Supports and Restraints: ASTM A36/A36M steel plates, shapes, and bars; black and galvanized.
- D. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
  - 1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
  - 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
  - 3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
  - 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
  - 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M, Grade A325.
  - 6. Toggle Bolts: **[All] [Stainless]**-steel springhead type.
  - 7. Hanger Rods: Threaded steel.

#### **2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES**

- A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.



### **PART 3 - EXECUTION**

#### **3.1 APPLICATION**

- A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:
  - 1. NECA 1.
  - 2. NECA 101
  - 3. NECA 102.
  - 4. NECA 105.
  - 5. NECA 111.
- B. Comply with requirements in Section 07 8413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- C. Comply with requirements for raceways and boxes specified in Section 26 0533 "Raceways and Boxes for Electrical Systems."
- D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
  - 1. Secure raceways and cables to these supports with two-bolt conduit clamps.
- F. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

#### **3.2 SUPPORT INSTALLATION**

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT may be supported by openings through structure members, according to NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
  - 1. To Wood: Fasten with lag screws or through bolts.
  - 2. To New Concrete: Bolt to concrete inserts.
  - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
  - 4. To Existing Concrete: Expansion anchor fasteners.
  - 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
  - 6. To Light Steel: Sheet metal screws.

- 7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

### **3.3 INSTALLATION OF FABRICATED METAL SUPPORTS**

- A. Comply with installation requirements in Section 05 5000 "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

**END OF SECTION 26 0529**

## **SECTION 26 0533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Conduits, boxes, wireways, hand holes, and all associated fittings, as indicated or specified.

#### **1.3 SUBMITTALS**

- A. General: Submit the following according to the Conditions of the Contract and Division 01 Specification Sections.
- B. Letter of Intent: Submit a letter of intent stating compliance with drawings, specifications, and code:
  - 1. Conduits and fittings
  - 2. Boxes
  - 3. Miscellaneous items
- C. Product Data: Submit complete product data on each item:
  - 1. Wireways
  - 2. Hand holes

#### **1.4 QUALITY ASSURANCE**

- A. Work in Hazardous Areas shall be in accordance with Article 500 of the National Electrical Code.
- B. All products specified herein shall be listed by a Nationally Recognized Testing Laboratory (NRTL). Where indicated, products shall be listed by an NRTL to a UL standard. The following are not required to be listed.
  - 1. Pull and junction boxes, except when used in wet locations
  - 2. Sealants

### **PART 2 - PRODUCTS**

#### **2.1 METALLIC CONDUITS**

- A. Rigid Galvanized Steel (RGS) Conduit, Elbows and Couplings: Zinc-coated hot dip galvanized threaded steel per ANSI C80.1 and listed to UL 6. Each length of conduit shall be threaded on both ends.
  - 1. Manufacturer: Provide products of one of the following:
    - a. Atkore Allied Tube & Conduit
    - b. Nucor Tubular Products
    - c. Wheatland Tube

- B. Electrical Metallic Tubing (EMT): Zinc-coated steel per ANSI C80.3 and listed to UL 797.
  - 1. Manufacturer: Provide products of one of the following:
    - a. Atkore Allied Tube & Conduit
    - b. Nucor Tubular Products
    - c. Wheatland Tube
- C. Flexible Steel Conduit: Continuously interlocked, zinc-coated steel core, listed to UL 1.
  - 1. Manufacturer: Provide products of one of the following:
    - a. Anamet Electrical, Inc.
    - b. Atkore AFC Cable Systems
    - c. Electri-flex
    - d. Southwire
- D. Liquid-Tight Flexible Steel Conduit: Continuously interlocked, zinc-coated hot dip galvanized steel core, listed to UL 360, with a PVC jacket.
  - 1. Manufacturer: Provide products of one of the following:
    - a. Anamet Electrical, Inc
    - b. Atkore AFC Cable Systems
    - c. Electri-flex
    - d. Southwire

## **2.2 NON-METALLIC CONDUITS**

- A. PVC Conduit, Schedule 40 and Schedule 80: Constructed of polyvinyl chloride (PVC), rated for 90 degrees C wire, for underground (direct-buried and concrete-encased) and aboveground use, listed to UL 651, and conforming to NEMA TC 2 and NFPA 70 National Electrical Code Article 352.
  - 1. Manufacturer: Provide products of one of the following:
    - a. Atkore
    - b. Cantex
    - c. National Pipe & Plastics
    - d. Prime Conduit, Inc.

## **2.3 METALLIC CONDUIT FITTINGS**

- A. Fittings for RGS Conduit: Cast or malleable iron bodies, zinc or cadmium plated, with taper threads, screw attached cover plates, and gaskets when located in areas requiring gaskets as specified in Part 3.
  - 1. Manufacturer: Provide products of one of the following:
    - a. ABB
    - b. Eaton Crouse-Hinds
    - c. Emerson Appleton & O-Z/Gedney
    - d. Hubbell
    - e. Southwire Topaz

- B. Expansion Fittings for RGS Conduit: Cast or malleable iron bodies, zinc or cadmium plated, with threaded end caps for receiving fixed and movable conduits, metallic pressure packing and copper bonding jumper assembly, and providing for a minimum of 2 inches movement of the conduit in either direction.
1. Manufacturer: Provide products of one of the following:
    - a. ABB
    - b. Eaton Crouse-Hinds
    - c. Emerson Appleton & O-Z/Gedney
    - d. Hubbell
- C. Couplings and Connectors for EMT: Zinc-plated steel, compression or set screw type.
1. Manufacturer: Provide products of one of the following:
    - a. ABB
    - b. Eaton Crouse-Hinds
    - c. Hubbell
    - d. Southwire Topaz
- D. Three-Piece Coupling for RGS Conduit: Malleable iron with steel and malleable iron ring, zinc or cadmium plated, for use with RGS conduit to couple and effectively bond threaded ends of RGS conduit where neither length of conduit can be rotated.
1. Manufacturer: Provide products of the following:
    - a. ABB Erickson
    - b. Eaton Crouse-Hinds
    - c. Emerson O-Z/Gedney
    - d. Hubbell
- E. Expansion Fittings for EMT: Cast or malleable iron or steel bodies, zinc or cadmium plated, with compression end caps for receiving fixed and movable conduits, metallic pressure packing and copper bonding jumper assembly, and providing for a minimum of 2 inches movement of the conduit in either direction.
1. Manufacturer: Provide products of the following:
    - a. ABB
    - b. Eaton Crouse-Hinds
    - c. Emerson Appleton & O-Z/Gedney
    - d. Hubbell
- F. Fittings for Flexible Steel Conduit: Malleable iron or steel, zinc or cadmium plated, securing the conduit by clamping action around the periphery of the conduit. Do not furnish fittings that anchor the conduit by means of set screws.
1. Manufacturer: Provide products of one of the following:
    - a. ABB
    - b. Eaton Crouse-Hinds
    - c. Emerson Appleton & O-Z/Gedney
    - d. Hubbell

- G. Fittings for Liquid-Tight Flexible Steel Conduit: Malleable iron or steel, zinc or cadmium plated, securing the conduit by clamping action around the periphery of the conduit designed to maintain the liquid-tight feature of the installation. Do not furnish fittings that anchor the conduit by means of set screws.

1. Manufacturer: Provide products of one of the following:

- a. ABB
- b. Eaton Crouse-Hinds
- c. Emerson Appleton & O-Z/Gedney
- d. Hubbell

- H. Locknuts for RGS Conduit: Malleable iron or steel, zinc or cadmium plated.

- I. Bushings for 1 Inch and Smaller RGS Conduit: Insulating plastic type of non-burnable thermosetting phenolic, conforming to UL requirements. Do not furnish non-rigid plastic bushings.

- J. Bushings for 1-1/4 Inch and Larger RGS Conduit: Malleable iron or steel, zinc or cadmium plated, with insulating insert of thermosetting plastic as specified for smaller conduit bushings, molded and locked into the bushing ring.

## **2.4 NON-METALLIC CONDUIT FITTINGS**

- A. PVC Conduit and Tubing Fittings: Listed to UL 514B, conforming to NEMA TC 3, mate and match to conduit and tubing type and material complying with manufacturer's published product information.

1. Manufacturer: Provide products of one of the following:

- a. ABB Carlon
- b. Atkore
- c. Cantex
- d. National Pipe & Plastics
- e. Prime Conduit, Inc.

## **2.5 OUTLET BOXES**

- A. Steel Sheet Metal Boxes: Galvanized or sherardized stock not less than No. 14 gage, with knockout openings, single or multiple gang, with extensions, adapters, plaster rings, tile covers, fixture studs and cover plates. Furnish accessories with same gage and finish as specified for boxes, except where special finishes are specified for covers and device plates in Section 26 2726. Provide sizes per NEC requirements for wiring space, except where minimum sizes are specified under Part 3.

1. Manufacturer: Provide products of one of the following:

- a. ABB Steel City
- b. Eaton Crouse-Hinds
- c. Hubbell RACO

- B. Cast or Malleable Iron Boxes: Zinc or cadmium plated, or galvanized, single or multiple gang, with taper threaded hubs, adapters and cover plates. Furnish cast metal, galvanized or cadmium plated accessories, except where special device plates are specified in Section 26 2726. Furnish gaskets when located in areas requiring gaskets as specified in Part 3. Provide sizes per NEC requirements for wiring space, except where minimum sizes are specified under Part 3.

1. Manufacturer: Provide products of one of the following:

- a. ABB
- b. Eaton Crouse-Hinds
- c. Emerson Appleton & O-Z/Gedney
- d. Hubbell

## **2.6 PULL AND JUNCTION BOXES**

- A. Boxes Less than 5 Inches by 5 Inches: Conform to requirements specified for Outlet Boxes.
- B. Steel Sheet Metal Boxes: Code gage, full seam welded with bent-in flanges seam welded at corner joints, screw fastened cover of same gage as box, without knockout openings, NEMA type 1 in dry locations, NEMA type 3R in damp or wet locations or outdoors, listed for wet locations when used in such locations. Fasten cover with brass machine screws. Galvanize box and cover after fabrication. Provide sizes conforming to NEC requirements for wiring space, except where boxes of larger size are indicated. Furnish gaskets when located in areas requiring gaskets as specified in Part 3.
- C. Stainless Steel Sheet Metal Boxes: Type 316, code gage, full seam welded with bent-in flanges seam welded at corner joints, screw fastened cover of same gage as box, without knockout openings, NEMA type 4X, listed for wet locations. Fasten cover with stainless steel machine screws. Provide sizes conforming to NEC requirements for wiring space, except where boxes of larger size are indicated. Furnish gaskets when located in areas requiring gaskets as specified in Part 3.

## **2.7 WIREWAYS**

- A. Steel Wireway: Code gage, galvanized, full seam welded with bent-in flanges seam welded at corner joints, removable cover secured to box with zinc plated hardware including hinges and machine screws, with or without knockout openings, NEMA type 1 in dry locations, NEMA type 3R in damp or wet locations or outdoors, listed for wet locations when used in such locations, listed to UL 870 and conforming to NFPA 70 National Electrical Code Article 376. Provide sizes conforming to NEC requirements for wiring space, except where boxes of larger size are indicated. Furnish gaskets when required to meet NEMA type.

1. Manufacturer: Provide products of one of the following:

- a. Eaton
- b. Hubbell
- c. nVent Hoffman

## **2.8 HAND HOLES**

- A. Polymer Concrete Hand Holes: Size as indicated, polymer concrete box, polymer concrete cover with nonskid finish having a minimum coefficient of friction of 0.5 and secured to the box by stainless steel bolts, structural load capacity complying with ANSI/SCTE 77, designed for flush burial with open bottom, gray finish.

1. Cover Legend: Molded lettering.

- a. "ELECTRIC" – For power and lighting.
- b. "COMMUNICATIONS" – For telecommunications and security.

2. Manufacturers: Provide products of one of the following:

- a. Hubbell Quazite
- b. Oldcastle

## **2.9 MISCELLANEOUS**

- A. Silicone, Nonstaining Sealant:

1. ASTM C920, Type S, Grade NS, Class 50; Uses NT, A, G, M and O.
2. Non-Staining: No staining of substrates when tested according to ASTM C1248.
3. Cure Type: Single-component, neutral-curing.
4. Hardness Range: Comply with one of the following:
  - a. 15 to 35, Shore A, when tested in accordance with ASTM C661.
  - b. 25 to 35, Shore A, when tested in accordance with ASTM D2240.
5. Manufacturer: Provide products of one of the following:
  - a. Dow Corning Corporation; Dowsil 756 SMS Building Sealant
  - b. Momentive Performance Materials, Inc./GE; SCS9000 SilPruf NB
  - c. Pecora Corporation; 890NST
  - d. Sika Corporation; Sikasil WS-295 FPS
  - e. Tremco, Inc.; Spectrem 3

## **PART 3 - EXECUTION**

### **3.1 CONDUIT SYSTEMS**

- A. Use EMT as follows:

1. In dry locations not subject to physical damage; install compression connectors and couplings where the conduit is used as the sole equipment grounding conductor or when the conduit is installed in industrial type locations or locations subject to vibration, otherwise install set screw connectors and couplings.

- B. Use RGS conduit as follows:

1. In locations subject to physical damage including exposed conduit below 10'-0" above finished floor.
2. In outdoor locations.
3. In damp locations.
4. In wet locations.
5. As vertical riser routed above grade from below grade with RGS conduit elbow below grade.
6. As vertical riser routed through building floor slab with RGS conduit elbow in or below building floor slab.
7. For conduit elbows installed below grade as part of a PVC conduit system of 2 inch trade size or greater provided no part of the RGS conduit elbow is less than 18 inches below grade or the RGS conduit elbow is encased in minimum 2 inches of concrete.

- C. Use schedule 40 PVC conduit as follows:

1. Below grade.



- D. Use flexible steel conduit as follows:
1. In dry locations for final connection to recessed lighting fixtures and under-counter lighting fixtures, minimum 1/2 inch trade size; maximum six feet in length.
  2. In dry locations for final connection to distribution transformers in electrical rooms; maximum six feet in length.
- E. Use liquid-tight flexible steel conduit as follows:
1. For final connection to distribution transformers, except in electrical rooms, to motors, and to other equipment subject to vibration or movement; maximum six feet in length.
- F. Install conduit systems as indicated, as required by the NEC, and as specified. Install conduit sizes as indicated. Where conduit sizes are not indicated, install sizes per NEC requirements, except do not use conduit sizes smaller than 3/4 inch. The use of 1/2 inch conduit is permitted from receptacle outlet boxes and switch outlet boxes to the nearest junction box mounted in the ceiling space. Use 3/4 inch conduit minimum from the panelboards to the junction boxes and between junction boxes. Use 1/2 inch fixture stems optionally, unless otherwise indicated.
- G. Install concealed conduit in offices and other finished areas; install exposed conduit in all other areas, unless otherwise indicated or specified.
- H. Install all exposed and concealed conduit runs parallel or perpendicular to walls, structural members, or intersections of vertical planes and ceilings. Keep conduit at least six inches away from parallel runs of high temperature surfaces, such as steam or hot water pipes, and do not run conduit directly under cold water lines.
- I. Conduits routed below floor slabs shall have a minimum of three inches of sand cover and shall not be required to be run parallel to building walls.
- J. Group conduit for common support, where indicated and elsewhere as directed by the Architect-Engineer.
- K. Do not install crushed or deformed conduits and avoid trapped runs in damp or wet locations. Take care to prevent the entrance of water and the lodging of concrete, plaster, dirt or trash in conduit, boxes, fittings and equipment during the course of construction. Free conduit of obstructions or replace the conduits. Where conduit joints occur in concrete slabs, or in damp or wet locations, make joints watertight by applying an approved compound on the entire thread area before assembling. Draw up all conduit joints as tightly as possible. Cap exposed empty conduits which do not terminate in outlets, panels, cabinets, etc., with standard galvanized plumbers pipe caps. Plug empty conduits which terminate flush with floors or walls with flush coupling and brass plug.
- L. Install conduit sleeves for all exposed conduits and cables passing through walls, ceilings or floors, and fill the void between sleeve and conduit with sealant flush with the end of the sleeve to seal the opening.
1. For conduit sleeves passing through fire rated walls, floors or ceilings, comply with requirements of Division 07 Firestop Systems.
- M. Terminate conduit stubbed up through concrete floors for connections to free standing equipment with a coupling flush with finish floor, and extend rigid conduit to equipment, except that where required, use flexible conduit from a point 6 inches above the floor.
- N. Make changes in direction of runs with symmetrical bends, fittings or pull boxes. Do not use bends around outside corners; use fittings for same. Install elbows, bends and offsets having a minimum radius of curvature of 24 inches for 2 inch and 2-1/2 inch conduit, and 36 inches for 3 inch and larger conduit. Except where conduit runs are shown in exact detail, install pull points at not greater than 200 foot intervals in straight runs. Where bends are included between pull points, reduce this maximum permissible 200 foot separation between pull points by 50 feet for each 90 degree bend and 25 feet for each 45 degree bend.

Figure deductions for all other angle bends on a similar basis. When bends are made in the field, make bends with an approved hickey or conduit bending machine. Make bends in 1-1/4 inch and larger conduits with standard conduit ells where possible.

- O. Provide conduit nipples with two independent sets of threads. Do not use running threads on any part of the conduit system. Where conditions require joining two fixed conduits into a continuous run, use a conduit union, in place of running threads and coupling.
- P. Install expansion fittings in exposed conduit runs of excessive length, where conduits cross building expansion joints, and where indicated.
- Q. Install double locknuts and bushings on all rigid conduit terminations into threadless openings. Increase length of conduit threads at terminations sufficiently to permit the bushing to be fully seated against the end of the conduit.
- R. Use one hole malleable iron galvanized pipe straps for support of single conduits, or clevis type hangers. Support groups of conduits on trapeze hangers. Use threaded rod or pipe for hanger support. Do not use perforated strap or wire for conduit or hanger support. Use beam clamps or malleable iron or wrought steel with hook rods to grip the beam flange for conduit or hanger support; do not use C-clamp type fittings. Support exposed conduit at least every 8 feet if smaller than 2 inch, and every 10 feet if 2 inch and larger unless otherwise noted.
- S. Install nylon pull string in empty conduits.

### **3.2 OUTLET, SWITCH, PULL AND JUNCTION BOXES**

- A. Outlet Boxes for Use with RGS Conduit in Non-Hazardous Areas: Steel sheet metal outlet boxes for flush or concealed work in dry locations; cast or malleable iron outlet boxes elsewhere.
- B. Outlet Boxes for Use with EMT and Flexible Steel Conduit: Steel sheet metal outlet boxes.
- C. Outlet Boxes for Use in Hazardous Areas: Approved for use in such areas.
- D. Pull and Junction Boxes for Use in Non-Hazardous Areas Indoors: Steel sheet metal.
- E. Pull and Junction Boxes for Use in Non-Hazardous Areas Outdoors: Steel sheet metal.
- F. Pull and Junction Boxes for Use in Hazardous Area: Approved for use in such areas.
- G. Flush Mounted Boxes: For single gang outlets and two gang outlets, use boxes not less than 4 inches square and 2-1/8 inches deep with single gang and two gang plaster reducing ring. For multiple outlets, use gang type boxes not less than 2-1/4 inches deep. Plaster rings shall not be less than 3/4 inches deep. For ceiling outlets in concrete slabs, use boxes not less than 3 inches deep.
- H. Gaskets: Provide cover gaskets for boxes in damp or wet locations and in utility or industrial areas.
- I. Install boxes in the wiring or raceway systems as required for pulling of wires, making connections, and mounting of devices and fixtures.
- J. Install extension rings, adapters, raised covers and plaster rings on flush mounted boxes as required. Equip flush mounted boxes in masonry block or tile walls with tile covers.
- K. Install separate concealed boxes for semi-flush or recessed fixtures when required by the fixture terminal operating temperature. Make boxes readily accessible on removal of the fixture or provide ceiling access panels as approved by the Architect-Engineer.

- L. Locate outlets in offices and other finished areas with due regard for the finish and interior architectural treatment so that outlets are centered with respect to panels, joints or moldings, and so that plaster rings, frames and tile covers are properly located with respect to the finished surface.
- M. The mounting height of recessed junction or outlet boxes in block or brick walls may be adjusted to the nearest horizontal coursing as long as the specified mounting height is not exceeded. The cover plate shall conceal the grout line.
- N. Install outlets for wall switches controlling lighting on the latch side of door where possible.
- O. Support boxes independent of conduit and secure rigidly in place. Install boxes used for fixture support such that they are capable of carrying 100 pounds.
- P. In concrete, anchor boxes securely to reinforcing steel and to forms to prevent shifting when concrete is placed.
- Q. Above suspended ceilings, support boxes to the building steel or structural floor above and independent of the ceiling pads; flush mounted boxes for suspended ceilings, fasten boxes to the ceiling support system by bar hanger or other approved support; flush boxes in drywall ceilings, fasten boxes to ceiling support system by bar hanger or other approved support system.

### **3.3 WIREWAYS**

- A. Install NEMA type 1 wireways in dry locations indoors and NEMA type 3R wireways in damp or wet locations or outdoors.
- B. Install wireways at locations indicated. Where wireways are located on surfaces susceptible to moisture on exterior masonry or concrete walls, do not install wireway in contact with such surfaces; support wireways with not less than 1/4 inch air separation from the surface.
- C. Provide supports at a maximum of 5 foot intervals.
- D. Where pendant supports are indicated or required, provide 1/2 inch diameter threaded rods with beam clamps as specified for conduit supports. Provide lateral bracing at not greater than 10 foot intervals.

### **3.4 HAND HOLES**

- A. Install polymer concrete hand holes with an ANSI/SCTE 77 Tier 8 rating in sidewalks and other areas not subject to vehicular traffic but with possible non-deliberate vehicular traffic up to 8,000 pounds. Install hand holes in locations to avoid deliberate and non-deliberate vehicular traffic.
- B. Install polymer concrete hand holes with an ANSI/SCTE 77 Tier 22 rating in driveways, parking lots, and off-roadway applications subject to occasional non-deliberate heavy vehicular traffic up to 22,500 pounds. Install hand holes in locations to avoid deliberate vehicular traffic.
- C. Install concrete hand holes with an AASHTO H20 rating in roadway applications subject to deliberate heavy vehicular traffic up to 32,000 pounds per axle.

**END OF SECTION 26 0533**

## **SECTION 26 0553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Equipment identification nameplates
  - 2. Raceway identification
  - 3. Power and control cable identification
  - 4. Floor marking tape
  - 5. Underground-line warning tape
  - 6. Warning labels and signs
  - 7. Miscellaneous identification products

#### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each electrical identification product indicated.
- B. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.
- C. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

#### **1.4 QUALITY ASSURANCE**

- A. Comply with ANSI A13.1 [and IEEE C2].
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

#### **1.5 COORDINATION**

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

## **PART 2 - PRODUCTS**

### **2.1 EQUIPMENT IDENTIFICATION NAMEPLATES**

- A. Engraved, Plastic Laminate or Laminated Acrylic: Punched or drilled for screw mounting. Black engraved letters on a white face. Minimum letter height shall be 1/4 inch.

### **2.2 RACEWAY IDENTIFICATION**

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
- B. Colors for Raceways Carrying Circuits as specified voltages:
  - 1. Black letters on a yellow field for 250V or less.
  - 2. Black letters on a red field for over 250V and less than 600V.
  - 3. Black letters on an orange field for circuits over 600V.
  - 4. Legend for Systems below 600V: Indicate voltage.
  - 5. Legend for systems over 600V: "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3 inch high letters on 20 inch centers.
- C. Self-Adhesive Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- D. Snap-Around Labels for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- E. Tape and Stencil for Raceways Carrying Circuits More Than 600 V: 4 inch black stripes on 10 inch centers diagonally over orange background that extends full length of raceway or duct and is 12 inches wide. Stop stripes at legends.
- F. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.

### **2.3 POWER AND CONTROL CABLE IDENTIFICATION**

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- D. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- E. Write-On Tags: Polyester tag, 0.015 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
  - 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
  - 2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

## **2.4 FLOOR MARKING TAPE**

- A. 2 inch wide, 5 mil pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

## **2.5 UNDERGROUND-LINE WARNING TAPE**

- A. Tape:
  - 1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
  - 2. Printing on tape shall be permanent and shall not be damaged by burial operations.
  - 3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.
- B. Color and Printing:
  - 1. Comply with ANSI Z535.1 through ANSI Z535.5.
  - 2. Power Conduits and Cables Red-Colored Tapes with these legends: ELECTRIC LINE FOR SYSTEMS LESS THAN 600V, HIGH VOLTAGE FOR SYSTEMS ABOVE 600V.
  - 3. Communications Conduits and Cables Orange-Colored Tapes with the appropriate legends: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.
- C. Tag:
  - 1. Multilayer laminate consisting of high-density polyethylene scrim coated with pigmented polyolefin, bright-colored, continuous-printed on one side with the inscription of the utility compounded for direct-burial service.
  - 2. Thickness: 12 mils.
  - 3. Weight: 36.1 lb/1000 sq. ft.
  - 4. 3 Inch Tensile According to ASTM D 882: 400 lbf, and 11,500 psi.

## **2.6 WARNING LABELS AND SIGNS**

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.
- C. Baked-Enamel Warning Signs:
  - 1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
  - 2. 1/4 inch grommets in corners for mounting.
  - 3. Nominal size, 7 by 10 inches.
- D. Warning label and sign shall include, but are not limited to, the following legends:
  - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
  - 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

## **2.7 MISCELLANEOUS IDENTIFICATION PRODUCTS**

- A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- F. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50 foot maximum intervals in straight runs, and at 25 foot maximum intervals in congested areas.
- G. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.
- H. Painted Identification: Comply with requirements in Division 09 painting Sections for surface preparation and paint application.

#### **3.2 EQUIPMENT IDENTIFICATION NAMEPLATES**

- A. Equipment Identification Nameplates: On each unit of equipment, install unique designation label that is consistent with one line diagram tag nameplates, wiring diagrams, schedules, and the Operation and Maintenance Manual
  - 1. Labeling Instructions:
    - a. Indoor and Outdoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/4 inch high letters on 1-1/2 inch high label.
    - b. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
    - c. Fasten nameplates with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
  - 2. Equipment to Be Labeled:
    - a. Main Distribution panelboards
    - b. Feeder breakers
    - c. Panelboards: Both panelboard identification label and typewritten directory of circuits.
    - d. Enclosures and electrical cabinets
    - e. Access doors and panels for concealed electrical items
    - f. Emergency system boxes and enclosures
    - g. Push-button stations

### 3.3 RACEWAYS AND CONDUCTOR IDENTIFICATION SCHEDULE

- A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits 100 amperes or more and 120 volts or more to ground:
- Self-adhesive vinyl tape applied in bands. Install labels at 30 foot maximum intervals.
- B. Accessible Raceways, Cables, Junction Box Cover Plates and Pull Box Covers:
- Self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
    - Emergency power
    - Power
    - UPS
- C. Conductor Identification, 600 V or Less:
- Identify individual phase conductors, neutral conductor and ground conductor of branch power and lighting circuits as to phase and system voltage by means of color coding in conformance with Sections 200-6 and 210-5 of the NEC.
  - Use the following identification scheme unless there are existing schemes being utilized by the Owner:
- | Phase |        |        | Neutral      |                  | Equipment Grounding Conductor | System       |
|-------|--------|--------|--------------|------------------|-------------------------------|--------------|
| A     | B      | C      | Normal Power | Emergency Power  |                               |              |
| X     | Y      | Z      | N            | N                | GRD.                          | Any Voltage  |
| Black | Red    | Blue   | White        | White/Red tracer | Green                         | 120/208 Volt |
| Brown | Orange | Yellow | Gray         | Gray/Red tracer  | Green/Yellow Tracer           | 277/480 Volt |
- Where color schemes deviate from above, submit color schemes for approval of the Architect-Engineer prior to implementation. Provide conductor color coding by means of colored insulating materials or by means of colored wire labels attached to individual conductors in all outlet, pull or junction boxes and at all terminations.
  - Install color coding scheme labels at each switchboard, panelboard, distribution panel, power panel and motor control center.
  - Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- D. Identify cable groups and conduit at entering and leaving locations in manholes, handholes and at terminations.
- E. Tags shall be 1/8 inch thick lead die-stamped tags with punched ears. Fasten tags around the cable group or conduit with No. 12 AWG copper wire.
- F. Identify cables in cable tray at intervals of 40 feet, at each side of walls, and at terminations and splices by means of strip aluminum with raised letters.
- G. Identify cables entering or exiting conduits, passing through pull boxes, at each pullbox and at each termination location.



- H. Designate source and load, or feeder or cable identification on tags. Submit identification for the approval of the Architect-Engineer.
- I. Conductor Identification, More than 600 V:
  - 1. Identify cables and conductors in primary switches, vacuum breakers, 15 kV incoming line sections, building entry points, vaults, pull and junction boxes, manholes, and handholes.
  - 2. Identify cables in cable tray at intervals of 40 feet, at each side of walls, and at terminations and splices by means of strip aluminum with raised letters.
  - 3. Designate source and load, or feeder or cable identification on tags. Submit identification for the approval of the Architect-Engineer.
  - 4. Tags shall be 1/8 inch thick lead die-stamped tags with punched ears. Fasten tags around the cable with No. 12 AWG copper wire.
  - 5. Tags shall be made of polypropylene, injection molded characters integral with locking grids. Color additives and UV stabilizers shall be molded throughout the tags. Both the background and the characters have a minimum thickness of 0.040 inch.
  - 6. Tags shall be horizontal orientation with a polyethylene tag holder. Tag holder shall have a 0.060 inch thickness punches with six slots for mounting.
  - 7. Tags shall be 1 inch high character Everlast by Tech Products, Inc. (800-221-1311).
  - 8. Information on tags shall be as noted and shown on drawing. Tags shall be approved by Engineering Services Department prior to installation.
- J. Auxiliary Systems Conductor Identification:
  - 1. Identify field-installed alarm, control, and signal connections.
  - 2. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
  - 3. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
  - 4. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- K. Underground Lines:
  - 1. Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
  - 2. Limit use of underground-line warning tape to direct-buried cables.
  - 3. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- L. Workspace Indication:
  - 1. Install floor marking tape to show working clearances in the direction of access to live parts.
  - 2. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- M. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.
  - 1. Comply with 29 CFR 1910.145.
  - 2. Identify system voltage with black letters on an orange background.
  - 3. Apply to exterior of door, cover, or other access.
  - 4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
    - a. Power transfer switches.
    - b. Controls with external control power connections.

N. Operating Instruction Signs:

1. Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

O. Install instructional sign using adhesive-film-type labels.

**END OF SECTION 26 0553**

## **SECTION 26 0570 – ELECTRICAL TESTING AND POWER SYSTEM STUDIES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. General Scope:
1. Perform inspections and tests as herein specified.
  2. Furnish and install generic arc flash hazard labels on all electrical equipment indicated herein.
  3. It is the intent of these tests to assure that all electrical equipment, both contractor and owner supplied, is operational and within industry and manufacturer's tolerances and is installed in accordance with design specifications.
  4. The tests and inspections shall determine suitability for energization.
- B. Applicable Codes, Standards and References:
1. All inspections and tests shall be in accordance with the following applicable codes and standards except as provided otherwise herein.
    - a. American National Standards Institute - ANSI
      - 1) ANSI/IEEE C2: National Electrical Safety Code
      - 2) ANSI/ASSP Z244.1: The Control of Hazardous Energy Lockout, Tagout and Alternative Methods
    - b. ASTM International, formerly known as American Society for Testing and Materials - ASTM
    - c. Association of Edison Illuminating Companies - AEIC
    - d. Electrical Apparatus Service Association - EASA
    - e. Institute of Electrical and Electronics Engineers - IEEE
    - f. Insulated Cable Engineers Association - ICEA
    - g. InterNational Electrical Testing Association - NETA
      - 1) ANSI/NETA ATS: Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems
      - 2) ANSI/NETA ECS: Standard for Electrical Commissioning Specifications for Electrical Power Equipment and Systems
    - h. National Electrical Manufacturers Association - NEMA
    - i. National Electrical Code - NEC
    - j. National Fire Protection Association - NFPA
      - 1) NFPA 70B: Recommended Practice for Electrical Equipment Maintenance
      - 2) NFPA 70E: Standard for Electrical Safety in the Workplace
      - 3) NFPA 70: National Electrical Code
      - 4) NFPA 101: Life Safety Code
      - 5) NFPA 110: Standard for Emergency and Standby Power Systems
      - 6) NFPA 111: Standard on Stored Electrical Energy Emergency and Standby Power Systems
      - 7) NFPA 780: Standard for the Installation of Lightning Protection Systems
    - k. Occupational Safety and Health Administration - OSHA

- 1) OSHA Part 1910; Subpart S
  - 2) OSHA Part 1926; Subpart E, Subpart K, and Subpart V
- I. UL, LLC, formerly known as Underwriters Laboratories, Inc. - UL
  - m. State and Local Codes and Ordinances
2. All inspections and tests shall utilize the following references:
  - a. Project Design Specifications.
  - b. Project Design Drawings.
  - c. Project Short Circuit, Arc Flash Hazard and Coordination Study.
  - d. Manufacturer's instruction manuals applicable to each particular apparatus.
- C. Division of Responsibility:
  1. The Electrical Contractor shall notify the Engineer prior to commencement of any testing.
  2. Any system, material or workmanship which is found defective on the basis of acceptance tests shall be reported.
  3. The Electrical Contractor shall maintain a written record of all tests and upon completion of project, assemble and certify a final test report.
- D. Electrical Tests: Furnish all labor, materials, test equipment, and technical supervision to perform and record the electrical tests as specified, and perform and record all electrical tests as required, including tests on:
  1. Switchgear, Switchboard, and Panelboard Assemblies
  2. Cables, Low-Voltage, 1000-Volt Maximum
  3. Cables, Medium- and High-Voltage
  4. Grounding Systems
  5. Surge Protective Devices, Low-Voltage
- E. Furnish and install generic arc flash hazard labels on the following new electrical equipment:
  - a. Distribution panels/power panels
  - b. Panelboards
  - c. Safety switches
  - d. Motor starters
- F. Preliminary Inspections and Tests:
  1. Visual inspections of electrical equipment, wire checks of factory wiring and any other preliminary work required to prevent delays during performance of electrical acceptance tests.
- G. Electrical Acceptance Tests:
  1. Those inspections and tests required to show that the workmanship, methods, inspections, and materials used in erection and installation of the electrical equipment conforms to accepted engineering practices, IEEE Standards, IPCEA-NEMA Standards, the National Electrical Code, manufacturer's instructions, and Division 26 Sections, and to determine that the equipment involved may be energized for operational tests.
- H. Operating Tests:
  1. Those tests performed on all electrical equipment installed under Division 26 Sections, and under other Sections, to show that the electrical equipment will perform the functions for which it was designed.

### **1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS**

- A. Refer to Section 26 0500 "Common Work Results for Electrical".
- B. Operating tests on mechanical and electrical equipment installed under other Sections to prove capability of such equipment to perform as specified in the Section covering specific equipment.
- C. Repair or replacement of equipment installed under other Sections and not meeting acceptance tests specified in this Section and therefore not acceptable.
- D. Uncoupling of motors installed under other Sections where reverse rotation could damage equipment during acceptance tests for proper rotation.

### **1.4 PERFORMANCE REQUIREMENTS**

- A. Final acceptance of electrical equipment will not only depend on equipment integrity as determined by the electrical acceptance test, but will also depend on complete operational tests, whether performed under this or other Sections.

### **1.5 SUBMITTALS**

- A. Test Reports:
  - 1. The test report shall include the following:
    - a. Project Name: Obtain from project manual.
    - b. A/E Firm: Integrated Design Solutions, LLC
    - c. A/E Address: 1441 W. Long Lake Road, Suite 200, Troy, MI 48098
    - d. A/E Project Number: Obtain from project manual.
    - e. Name of testing organization.
    - f. Address of testing organization.
    - g. Name of individual performing tests.
    - h. Description of tests.
    - i. Test data.
    - j. Analysis and recommendations.
    - k. Description of equipment tested and its number/name.
    - l. Humidity, temperature, and other conditions that may affect the results of the tests and/or calibrations.
    - m. Date of inspections, tests, maintenance, and/or calibrations.
    - n. Identification of the testing technician.
    - o. Indication of inspections, tests, maintenance, and/or calibrations to be performed and recorded.
    - p. Indication of expected results when calibrations are to be performed.
    - q. Indication of "as-found" and "as-left" results, as applicable.
    - r. Sufficient spaces to allow all results and comments to be indicated.
  - 2. Submit test reports, including complete data on actual readings taken and corrected values, to the Architect/Engineer for approval after each test period. Have all test reports signed by the authorized witnesses present at tests prior to submission. Do not energize any equipment or material for operating tests until test data has been approved.
- B. Submit five (5) hard copies and one (1) electronic copy on a USB flash drive of final approved test reports to the Owner at the completion of the work under this Section. Also submit one (1) electronic copy on a USB flash drive to the Architect/Engineer.
- C. Submit five (5) sample arc flash hazard labels to the Architect/Engineer.

## **1.6 PROJECT/SITE CONDITIONS**

### **A. Environmental Requirements:**

1. Do not perform insulation-resistance or dielectric withstand tests during times of high relative humidity.
2. Do not perform tests on outdoor equipment during inclement weather. Do not perform tests on direct burial bare ground conductors or on ground rods within a 48 hour period following rainfall.

### **B. Safety Precautions:**

1. All parties involved shall be cognizant of applicable safety procedures. This document does not include any procedures, including specific safety procedures. It shall be understood and clear that an overwhelming majority of the tests and inspections recommended in these specifications are potentially hazardous. Individuals performing these tests shall be trained and capable of conducting these tests in a safe manner and with complete knowledge of the hazards involved. Safety practices shall include, but are not limited to, the following requirements:
  - a. All applicable provisions of the Occupational Safety and Health Act, particularly OSHA 29 CFR 1910.
  - b. Accident Prevention Manual for Industrial Operations, National Safety Council.
  - c. Applicable state and local safety operating procedures.
  - d. Owner's safety practices.
  - e. NFPA 70E, Standard for Electrical Safety in the Workplace.
2. A safety lead person shall be identified prior to commencement of work.
3. A safety briefing shall be conducted prior to the commencement of work.
4. All tests shall be performed with the apparatus de-energized and grounded except where otherwise specifically required to be ungrounded or energized for certain tests.
5. The testing organization shall have a designated safety representative on the project to supervise operations with respect to safety.
6. During cable tests, station a person at each point where cable has exposed connections. Supply each person with a two-way communication device.

### **C. Suitability of Test Equipment:**

1. All test equipment shall meet the calibration requirements found in these specifications and shall be in good mechanical and electrical condition.
2. Field test metering used to check power system meter calibration shall be more accurate than the instrument being tested.
3. Accuracy of metering in test equipment shall be appropriate for the test being performed.
4. Waveshape and frequency of test equipment output waveforms shall be appropriate for the test and the tested equipment.

### **D. Test Instrument Calibration:**

1. The testing organization shall have a calibration program which assures that all applicable test instruments are maintained within rated accuracy for each test instrument calibrated.
2. The firm providing calibration service shall maintain up-to-date instrument calibration instructions and procedures for each test instrument calibrated.
3. The accuracy shall be directly traceable to the National Institute of Standards and Technology (NIST).
4. Instruments shall be calibrated in accordance with the following frequency schedule:
  - a. Field instruments: Analog, 6 months maximum. Digital, 12 months maximum.
  - b. Laboratory instruments: 12 months maximum.
  - c. Leased specialty equipment: 12 months maximum.

5. Dated calibration labels shall be visible on all test equipment.
6. Records, which show date and results of instruments calibrated or tested, must be kept up to date.
7. Calibrating standard shall be of better accuracy than that of the instrument tested.

#### **1.7 SEQUENCE AND SCHEDULING**

- A. Perform all acceptance and operating tests in the presence of the Architect/Engineer.
- B. Schedule sequence of tests so that equipment can be energized immediately after completion of the applicable tests and approval of test reports. Notify the Architect/Engineer of time of test at least 48 hours prior to testing.
- C. Notify vendors and manufacturers of electrical equipment of the time of tests and extend reasonable cooperation to them or their representatives to permit them to witness tests should they so request. Obtain list of manufacturers of Owner furnished equipment from the Architect/Engineer.

### **PART 2 - PRODUCTS (NOT APPLICABLE)**

### **PART 3 - EXECUTION**

#### **3.1 PREPARATION**

- A. Perform preliminary inspections and tests immediately prior to performing acceptance tests. Fuses and fusing devices, such as cable limiters, shall be omitted from cable tests and tests involving cables.

#### **3.2 DIELECTRIC WITHSTAND TESTS**

- A. Perform dielectric withstand tests where indicated in this specification.
- B. Do not perform more than one dielectric withstand test on any conductor or equipment bus unless specifically authorized by the Architect/Engineer.
- C. When insulation-resistance tests are specified, perform an insulation-resistance test before and after the dielectric withstand test.
- D. Either direct current or very low frequency alternating current may be used when dielectric withstand tests are specified for new conductors and equipment. Very low frequency alternating current shall be used where dielectric withstand tests are specified for existing conductors and equipment.

#### **3.3 INSULATION-RESISTANCE TESTS**

- A. Perform insulation-resistance tests where indicated in this specification.
- B. Insulation resistance readings specified are the minimum readings desired at an ambient temperature of 60 degF (15.56 degC) and at a low relative humidity. When insulation resistance readings are taken at other than 60 degF, convert readings to equivalent values at 60 degF.
- C. When insulation resistance readings fall below the specified minimum values at 60 degF, devise some means of applying heat for the purpose of drying out the equipment subject to the approval of the Architect/Engineer. If drying is to be done by applying an electric potential to a piece of equipment, do not exceed the continuous voltage or current ratings of the equipment being dried, either directly or by induction.

### 3.4 TABLES

Table 100.1 (Reference ANSI/NETA ATS)  
Insulation Test Values  
Electrical Apparatus and Systems Other Than Rotating Machinery

Nominal Rating of Equipment in Volts	Minimum Test Voltage, DC	Recommended Minimum Insulation Resistance in Megohms
250	500	25
600	1,000	100
1,000	1,000	100
2,500	1,000	500
5,000	2,500	1,500
8,000	2,500	2,500
15,000	2,500	5,000
25,000	5,000	10,000
34,500	5,000	100,000
46,000 and above	5,000	100,000

Notes:

1. In the absence of consensus standards dealing with insulation-resistance tests, the NETA Standards Review Council suggests the above representative values.
2. See ANSI/NETA ATS, Table 100.14 for temperature correction factors.
3. Test results are dependent on the temperature of the insulating material and the humidity of the surrounding environment at the time of the test.
4. Insulation-resistance test data may be used to establish a trending pattern. Deviations from the baseline information permit evaluation of the insulation.
5. For rotating machinery insulation-resistance test values see Table 100.11.
6. For medium-voltage cables, the values shown are typical. Conductor and insulation geometry, temperature, and overall cable length need to be taken into account per manufacturers published data for definitive minimum insulation resistance criteria.

### 3.5 TESTS ON SWITCHGEAR, SWITCHBOARD, AND PANELBOARD ASSEMBLIES

#### A. Scope of Work

1. Perform the following inspections and tests on all new low-voltage panelboards rated up to 600 Volts:
  - a. Perform all visual and mechanical inspections, except as noted.
  - b. Perform insulation-resistance tests on each bus section as described in electrical tests.

#### B. Connections

1. Prior to performing any tests on main bus, isolate bus to be tested by racking out all vacuum and power circuit breakers, opening all insulated-case and molded-case circuit breakers, short and ground current transformer secondaries, remove potential transformer primary fuses, and ground housing.

#### C. Visual and Mechanical Inspection

1. Compare equipment nameplate data with drawings and specifications.
2. Inspect physical and mechanical condition.
3. Inspect anchorage, alignment, grounding, and required area clearances.
4. Verify the unit is clean and all shipping bracing, loose parts, and documentation shipped inside cubicles have been removed.



5. Verify that fuse and circuit breaker sizes and types correspond to drawings.
6. Verify that current and voltage transformer ratios correspond to drawings.
7. Verify that wiring connections are tight and that wiring is secure to prevent damage during routine operation of moving parts.
8. Inspect bolted electrical connections for high resistance using one or more of the following methods:
  - a. Use of a low-resistance ohmmeter in accordance with "Electrical Tests" paragraph.
  - b. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or ANSI/NETA ATS, Table 100.12.
9. Inspect insulators for evidence of physical damage or contaminated surfaces.
10. Exercise all active components.
11. Inspect mechanical indicating devices for correct operation.
12. Verify that filters are in place and vents are clear.
13. Perform visual and mechanical inspection of instrument transformers in accordance with "Tests on Instrument Transformers" sections.
14. Inspect control power transformers.
  - a. Inspect for physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.
  - b. Verify that primary and secondary fuse or circuit breaker ratings match drawings.

**D. Electrical Tests**

1. Perform resistance measurements through bolted electrical connections with a low-resistance ohmmeter, if applicable, in accordance with "Visual and Mechanical Inspection" paragraph.
2. Perform insulation-resistance tests on each bus section, phase-to-phase and phase-to-ground, for one minute in accordance with Table 100.1.
3. Perform a dielectric withstand voltage test on each bus section, each phase-to-ground with phases not under test grounded, in accordance with manufacturer's published data. If manufacturer has no recommendation for this test, it shall be in accordance with ANSI/NETA ATS, Table 100.2. The test voltage shall be applied for one minute.
4. Perform electrical tests on instrument transformers in accordance with "Test on Instrument Transformers" section.
5. Perform ground-resistance tests in accordance with "Tests on Grounding Systems" section.
6. Test metering devices in accordance with "Tests on Metering Devices" sections.
7. Control Power Transformers
  - a. Perform insulation-resistance tests. Perform measurements from winding-to-winding and each winding-to-ground. Test voltages shall be in accordance with Table 100.1 unless otherwise specified by the manufacturer.
  - b. Perform a turns-ratio test on all tap positions.
  - c. Perform secondary wiring integrity test. Disconnect transformer at secondary terminals and connect secondary wiring to a rated secondary voltage source. Verify correct potential at all devices.
  - d. Verify correct secondary voltage by energizing the primary winding with system voltage. Measure secondary voltage with the secondary wiring disconnected.
  - e. Verify correct function of control transfer relays located in the switchgear with multiple control power sources.
8. Voltage Transformers
  - a. Perform secondary wiring integrity test. Verify correct potential at all devices.
  - b. Verify secondary voltages by energizing the primary winding with system voltage.
9. Perform system function tests in accordance with ANSI/NETA ECS.
10. Verify operation of cubicle switchgear/switchboard space heaters.

11. Perform phasing checks on double-ended or dual-source switchgear to insure correct bus phasing from each source.
  12. Perform electrical tests of surge arresters in accordance with "Tests on Surge Arresters" sections.
- E. Test Values – Visual and Mechanical
1. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
  2. Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use ANSI/NETA ATS, Table 100.12.
  3. Results of the thermographic survey shall be in accordance with "Thermographic Survey" section.
- F. Test Values – Electrical
1. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
  2. Insulation-resistance values of bus insulation shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1. Values of insulation resistance less than this table or manufacturer's recommendations should be investigated. Dielectric withstand voltage tests shall not proceed until insulation-resistance levels are raised above minimum values.
  3. If no evidence of distress or insulation failure is observed by the end of the total time of voltage application during the dielectric withstand test, the test specimen is considered to have passed the test.
  4. Results of electrical tests on instrument transformers shall be in accordance with "Tests on Insulation Transformers" section.
  5. Results of ground-resistance tests shall be in accordance with "Tests on Grounding Systems" section.
  6. Accuracy of metering devices shall be in accordance with "Tests on Metering Devices" section.
  7. Control Power Transformers
    - a. Insulation-resistance values of control power transformers shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1. Values of insulation resistance less than this table or manufacturer's recommendations should be investigated.
    - b. Turns-ratio test results shall not deviate by more than one-half percent from either the adjacent coils or the calculated ratio.
    - c. Secondary wiring shall be in accordance with design drawings and specifications.
    - d. Secondary voltage shall be in accordance with design specifications.
    - e. Control transfer relays shall perform as designed.
  8. Voltage transformers
    - a. Secondary wiring shall be in accordance with design drawings and specifications.
    - b. Secondary voltage shall be in accordance with design specifications
  9. Results of system function tests shall be in accordance with ANSI/NETA ECS.
  10. Phasing checks shall prove the switchgear or switchboard phasing is correct and in accordance with the system design.
  11. Results of electrical tests on surge arresters shall be in accordance with "Tests on Surge Arresters" sections.
- G. Acceptance: The equipment must pass all inspections and tests.
- H. Records: Make complete and accurate records of each inspection and test.

### **3.6 TESTS ON CABLES, LOW-VOLTAGE, 1000-VOLT MAXIMUM**

#### **A. Scope of Work**

1. Perform the following inspections and tests on all new low-voltage cables rated up to 1000 Volts:
  - a. Perform all visual and mechanical inspections on all feeders and branch circuits, except as noted.
  - b. For branch circuits rated 50 amps and less, perform all visual and mechanical inspections at the source end of the cable or conductor but do not perform visual and mechanical inspections at the load end of the cable or conductor.
  - c. Perform all electrical tests on feeders and branch circuits rated 200 amps and above.
  - d. Perform continuity tests on all feeders.
  - e. Perform uniform resistance testing of all parallel conductors.

#### **B. Connections**

1. Isolate cable prior to testing by opening disconnecting means at each end of cable except disconnect and fan out cable where directly connected without disconnecting means.

#### **C. Visual and Mechanical Inspection**

1. Compare cable data with drawings and specifications.
2. Inspect exposed sections of cable for physical damage and correct connection in accordance with the single-line diagram.
3. Inspect bolted electrical connections for high resistance using one or more of the following methods:
  - a. Use of a low-resistance ohmmeter in accordance with "Electrical Tests" paragraph.
  - b. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or ANSI/NETA ATS, Table 100.12.
  - c. Perform thermographic survey in accordance with "Thermographic Survey" section.
4. Inspect compression-applied connectors for correct cable match and indentation.
5. Inspect for correct identification and arrangements.
6. Inspect cable jacket insulation and condition.

#### **D. Electrical Tests**

1. Perform resistance measurements through bolted connections with low-resistance ohmmeter, if applicable, in accordance with "Visual and Mechanical Inspection" paragraph.
2. Perform insulation-resistance test on each conductor with respect to ground and adjacent conductors. Applied potential shall be 500 volts dc for 300-volt rated cable and 1000 volts dc for 600-volt rated cable. Test duration shall be one minute.
3. Perform continuity tests to insure correct cable connection.
4. Verify uniform resistance of parallel conductors.

#### **E. Test Values – Visual and Mechanical**

1. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
2. Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use ANSI/NETA ATS, Table 100.12.

F. Test Values – Electrical

1. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
2. Insulation-resistance values shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1. Values of insulation resistance less than this table or manufacturer's recommendations shall be investigated.
3. Cable shall exhibit continuity.
4. Deviations in resistance between parallel conductors shall be investigated.

G. Acceptance: The equipment must pass all inspections and tests.

H. Records: Make complete and accurate records of each inspection and test.

**3.7 TESTS ON GROUNDING SYSTEMS**

A. Scope of Work

1. Perform the following inspections and tests on all new grounding systems:
  - a. Perform all visual and mechanical inspections, except as noted.
  - b. Perform all electrical tests, except as noted.

B. Visual and Mechanical Inspection

1. Verify ground system is in compliance with drawings, specifications, and NFPA 70 National Electrical Code Article 250.
2. Inspect physical and mechanical condition.
3. Inspect bolted electrical connections for high resistance using one or more of the following methods:
  - a. Use of low-resistance ohmmeter in accordance with "Electrical Tests" paragraph.
  - b. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or ANSI/NETA ATS, Table 100.12.
4. Inspect anchorage.

C. Electrical Tests

1. Perform resistance measurements through bolted connections with a low-resistance ohmmeter, if applicable, in accordance with "Visual and Mechanical Inspection" paragraph.
2. Perform fall-of-potential or alternative test in accordance with ANSI/IEEE 81 on the main grounding electrode or system.
3. Perform ground continuity test on equipment ground bars in switchgear, switchboards, and panelboards.
4. Perform ground continuity test on ground bars installed in electrical rooms, telecommunications rooms, and specialty areas such as laboratories.
5. Perform point-to-point tests to determine the resistance between the main grounding system and all major electrical equipment frames, system neutral, and derived neutral points.

D. Test Values – Visual and Mechanical

1. Grounding system electrical and mechanical connections shall be free of corrosion.
2. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
3. Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use ANSI/NETA ATS, Table 100.12.

E. Test Values – Electrical

1. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
2. The resistance between the main grounding electrode system and ground shall be no greater than five ohms, except two ohms or less for data centers and hospitals. (Reference ANSI/IEEE Standard 142)
3. Grounding from ground bars to main grounding electrode system shall be continuous.
4. Point-to-point resistance values shall not exceed 0.5 ohm.

F. Acceptance: The equipment must pass all inspections and tests.

G. Records: Make complete and accurate records of each inspection and test.

**3.8 TESTS ON SURGE PROTECTIVE DEVICES, LOW-VOLTAGE**

A. Scope of Work

1. Perform the following inspections and tests on all new surge protective devices rated 600 Volts or less:
  - a. Perform all visual and mechanical inspections, except as noted.

B. Visual and Mechanical Inspection

1. Compare equipment nameplate data with drawings and specifications.
2. Inspect physical and mechanical condition.
3. Inspect anchorage, alignment, grounding, and clearances.
4. Verify the devices are clean.
5. Verify that electrical wiring installation complies with manufacturer's written installation requirements.

C. Acceptance: The equipment must pass all inspections and tests.

D. Records: Make complete and accurate records of each inspection and test.

**END OF SECTION 26 0570**

## **SECTION 26 0923 – LIGHTING CONTROL DEVICES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to Work of this Section.
- B. Related Sections
  - 1. Section 26 0943 "Performance Network Lighting Controls" for digitally addressable devices.
  - 2. Section 26 2726 "Wiring Devices" for line voltage toggle switches, faceplates and device colors.
  - 3. Section 26 0553 "Identification of Electrical Systems"

#### **1.2 SUMMARY**

- A. This Section includes the following:
  - 1. The objective of this section is to ensure the proper installation of the following lighting control devices not specified in other sections:
    - a. Wall switch sensors
    - b. Photoelectric Controllers
  - 2. Contractor's work to include all labor, materials, tools, appliances, control hardware, sensors, wire, junction boxes and equipment necessary for and incidental to the delivery and installation of devices specified herein
  - 3. The occupancy sensor-based lighting control devices shall accommodate all conditions of space utilization and all irregular work hours and habits.
  - 4. The location and quantities of sensors shown on the Drawings are diagrammatic and indicate only the rooms which are to be provided with sensors. Provide additional sensors as required to properly and completely cover the respective room.

#### **1.3 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Provide wiring and installation details for all devices specified herein.
  - 1. Lighting plans indicating location, orientation, and coverage area of each sensor and each emergency lighting controls devices. The locations and quantities of sensors and transfer devices indicated on the Drawings are diagrammatic and indicate only the rooms which are to be provided with sensors and emergency lighting. Provide layout shop drawings indicating all emergency lighting controls devices and all sensors including any additional sensors required to cover the respective areas properly and completely. Include locations of emergency lighting controls devices.
  - 2. Interconnection diagrams showing field-installed wiring.
  - 3. Coordinate these shop drawings with interfacing systems specified in other sections.
- C. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

#### **1.4 WARRANTY**

- A. Contractor shall warrant all equipment furnished in accordance with this specification to be undamaged, free of defects in materials and workmanship, and in conformance with the specifications. The suppliers obligation shall include repair or replacement, and testing without charge to the owner, all or any parts of equipment which are found to be damaged, defective or non-conforming and returned to the supplier. The warranty shall commence upon the owner's acceptance of the project. Warranty shall be for a minimum period of one (1) year.

## **1.5 QUALITY ASSURANCE**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Products supplied shall be from a single manufacturer that has been continuously involved in the manufacturing of occupancy sensors for a minimum of five (5) years. Mixing of manufacturers shall not be allowed.
- C. All components shall be U.L. listed and meet all state and local applicable code requirements.
- D. Wall switch products shall be capable of withstanding the effects of inrush current. Submittals shall clearly indicate the method used.
- E. It shall be the contractor's responsibility to make all proper adjustments to assure owner's satisfaction with the occupancy sensor system.
- F. It shall be the manufacturer's responsibility to verify all proper adjustments and train owner's personnel to ensure owner's satisfaction with the occupancy system. A minimum of four (4) hours at the jobsite building shall be included for training.

## **1.6 COORDINATION**

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.
- B. Contractor shall coordinate all work described in this section with all other applicable plans and specifications, including but not limited to wiring, conduit, fixtures, HVAC systems and building management systems.

## **PART 2 - PRODUCTS**

### **2.1 WALL SWITCH SENSOR**

- A. Device shall be provided with momentary contact pushbutton(s) in configuration shown on plan (1 zone, 2 zone, etc). with integral occupancy sensor and shall be provided with (1) auxiliary contact for HVAC control. Auxiliary contact may be a remote power pack located nearby in an accessible ceiling space if not provided as integral. Auxiliary contact shall be automatically controlled by occupancy sensor and shall not be controlled by additional "fan button".
- B. Switching mechanism shall be latching air gap relay, compatible with electronic power supplies, and inductive loads. Triac and other harmonic generating devices shall not be allowed. Zero Crossing Circuitry shall be used to increase the relay life, protect from the effects of inrush current, and increase the sensor's longevity.
- C. Device shall utilize dual-technology sensing technologies to detect both small and large motion. Small motion detection coverage pattern shall be a minimum of 625 sf and large motion coverage shall be a minimum of 2025 sf. PIR coverage shall be provided wall-to-wall with a 180 degree field of view.

- D. Device shall be capable of being wired in multi-way configurations without loss of functionality.
- E. Sensor shall utilize signal technology to provide immunity to RFI and EMI.
- F. Device shall be capable of being wired in multi-way configurations without loss of functionality.
- G. Sensor shall operate at either 120 VAC or 277 VAC and shall be capable of switching 0 to 800 watt load or 1/4 hp @ 120 volts, 60 Hz; 0 to 1200 watt load of 1/4 hp @ 277 volts, 60 Hz.
- H. Device shall be provided with integral daylight harvesting sensor and programmed as indicated on drawings. Daylight harvesting sensor shall be disabled if not indicated for use on drawings.
- I. Device shall have an operating range of 32 degrees F to 140 degrees F, and up to 90% humidity (non-condensing).
- J. The sensor shall utilize terminal style wiring. Sensor shall provide automatic equipment grounding to a metal junction box, and provide grounding to a metal cover plate.
- K. Sensor shall have 100% off switch with no leakage current to load in OFF mode. In the event there is an open circuit in the AC line such as a ballast or lamp failure, the sensor shall automatically switch to OFF mode.
- L. Manufacturer: Provide the following:
  - 1. Sensor Switch WSX Series
  - 2. Greengate
  - 3. Leviton
  - 4. Watt Stopper WS-200
  - 5. Lutron
  - 6. Sensorworx

## **2.2 PHOTOELECTRIC CONTROLLERS**

- A. Weatherproof for outdoor mounting, operating on 105-130 volt, 60 hertz power and having a single pole, single throw contact rated a minimum of 1800 watts incandescent lighting. Provide unit having preset adjustable turn-on and turn-off points from 1.0 to 12 footcandles and equipped with a time delay feature to prevent switching of lights due to transient lighting changes. Equip controller with a 1/2 inch pipe thread connection.
  - 1. Manufacturer: Provide one of the following:
    - a. Intermatic
    - b. Paragon
    - c. Tork

## **2.3 CONDUCTORS AND CABLES**

- A. Power Wiring to Supply Side of Remote-Control Power Sources: No. 12 AWG (minimum), complying with Division 26 Sections.
- B. Power Wiring to Supply Side of Emergency Emergency lighting controls devices No. 12 AWG (minimum), complying with Division 26 Sections.
- C. Control wiring between sensors and control units shall be Class II, 18-24 AWG, stranded U.L. Classified, PVC insulated and TEFLON jacketed cable suitable for use in plenums.



- D. Control wiring for dimming to LED fixtures #14 AWG minimum 600V complying with Division 26 sections.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Locate and aim sensors in the correct location required for complete and proper volumetric coverage within the range of coverage(s) of controlled areas per the manufacturer's recommendations. Rooms shall have one hundred (100) percent coverage to completely cover the controlled area to accommodate all occupancy habits of single or multiple occupants at any location within the room(s). The locations and quantities of sensors shown on the Drawings are diagrammatic and indicate only the room which are to be provided with sensors. The contractor shall provide additional sensors if required to properly and completely cover the respective room.
- B. Proper judgment shall be exercised in executing the installation so as to ensure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structural components. The contractor shall also provide, at the owner's facility, the training necessary to familiarize the owner's personnel with the operation, use, adjustment, and problem solving diagnosis of the occupancy sensing devices and systems.
- C. Mount equipment at locations indicated.
- D. Install devices in outlet boxes as specified in Section 26 0533 "Raceways and Boxes for Electrical Systems" unless otherwise specified in this Section. Mount devices at uniform heights above the floor for various areas as indicated.
- E. Install plates on flush mounted devices with all four edges in continuous contact with finished wall surfaces without the use of plaster mats or similar devices. Do not use plaster or similar fillings. Install plates vertically, unless otherwise noted, with an alignment tolerance of 1/16 inch.

#### **3.2 WIRING INSTALLATION**

- A. Wiring Method: Comply with Division 26 Sections. All wiring shall be installed in conduit. Minimum conduit size shall be ¾ inch.
- B. Wiring Within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.
- E. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

#### **3.3 IDENTIFICATION**

- A. Identify components and power and control wiring according to Division 26 Sections.
- B. All emergency power systems junction box covers, conduit couplings and panels shall be painted orange.

### **3.4 FIELD QUALITY CONTROL**

- A. Perform the following field tests and inspections and prepare test reports:
  - 1. After installing sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
  - 2. Operational Test: Verify actuation of each sensor and adjust time delays.
- B. Remove and replace lighting control devices where test results indicate that they do not comply with specified requirements.
- C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

### **3.5 FACTORY COMMISSIONING**

- A. Upon completion of the installation, the system shall be completely commissioned by the manufacturer's factory authorized technician who will verify all adjustment and sensor placement to ensure a trouble-free occupancy-based lighting control system. This service shall be provided with the base bid contract.
- B. The electrical contractor shall provide both the manufacturer and the electrical engineer with ten (10) working days written notice of the scheduled commissioning date.

### **3.6 ADJUSTING**

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two (2) visits to site outside normal occupancy hours (4 hour minimum duration each) for this purpose.

### **3.7 TRAINING**

- A. The Contractor shall provide a training session for the Owner's Representative for one (1) four (4) hour period (minimum) at a jobsite location determined by the Owner.
- B. The training session shall be conducted by a manufacturer's qualified representative. The training program shall consist of instruction on the operation, adjustment, and maintenance of the lighting control devices.

**END OF SECTION 26 0923**

## **SECTION 26 0943 – PERFORMANCE BASED NETWORKED LIGHTING CONTROLS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to Work of this Section.
- B. Related Sections
  - 1. Section 26 0923 "Lighting Control Devices" for line voltage and non-digitally addressable devices
  - 2. Section 26 2726 "Wiring Devices" for line voltage toggle switches, device face plates and device colors
  - 3. Section 26 5119 "LED Interior Lighting"
  - 4. Section 26 5619 "LED Exterior Lighting"

#### **1.2 DESCRIPTION OF SYSTEM**

- A. These Specifications, together with the related Drawings and General Conditions of the Contract, comprise the requirements for the lighting control system.
- B. Summary:
  - 1. The system shall function in each of two configurations as indicated on drawings.
    - a. Rooms and spaces with locally networked digitally addressable devices with complete system functionality, not connected to a centralized system controller. All control functions are stored locally within the devices associated to each space. This configuration shall be capable of future connection to a building-wide system through the addition of network distribution components.
    - b. Rooms and spaces with centrally networked digitally addressable devices connected to a centralized system controller through a network of distribution components. In this configuration, all device programming shall be stored locally within devices, but shall be accessible and adjustable remotely with manufacturer's software as indicated.
  - 2. The lighting control system shall provide automatic time-based, automatic sensor-based (both occupancy and daylight), and manual lighting control.
  - 3. The system shall be capable of controlling lighting in accordance with protocols listed on the lighting fixture schedule. Control required may include, but not be limited to, on/off phase dimming, 0-10V dimming, DMX, color changing and tunable white applications.
  - 4. The system architecture shall be capable of enabling stand-alone groups (rooms) of devices to function in some default capacity if network connectivity to the network system is lost.
  - 5. The system shall not require any centrally hardwired switching equipment for normal operation.
  - 6. The networked lighting control system shall meet all of the characteristics and performance requirements specified herein and as shown on applicable drawings.
  - 7. The contractor shall furnish, install and verify proper operation of all equipment necessary for proper operation of the system as specified herein and as shown on applicable drawings.
- C. The lighting control system shall be comprised of the following components:
  - 1. System Software Interfaces
    - a. Management and Visualization Interface
    - b. Historical Database and Analytics Interface
    - c. Personal Control Applications
    - d. Smartphone Programming Interface for wired devices

2. System Backbone and Integration Equipment

- a. System Controller
- b. OpenADR Interface

3. Wired Networked Devices

- a. Control Stations: Wall Switches, Dimmers, Scene Controllers and Touchscreens
- b. Auxiliary Input/Output Devices
- c. Occupancy and Photocell Sensors
- d. Power Packs and Secondary Packs
- e. Networked Luminaires
- f. Relay and Dimming Panel

D. Abbreviations/Definitions:

- 1. Networked Luminaire: Any lighting fixture or group of lighting fixtures connected to the lighting controls system through a remote or integral digitally addressable power pack or relay control device.

**1.3 SUBMITTALS**

A. General: Submit the following according to the Conditions of the Contract and Division 01 Specification Sections.

B. Product data in the form of manufacturer's product specification sheets containing, but not limited to the following. Indicate product data specific to the project.

- 1. General physical device description including colors and dimensions.
- 2. Installation instructions.
- 3. Electrical specifications.
- 4. Typical wiring details and risers showing connections to the system.
- 5. Sequence of operations.
- 6. Required listings.

C. Bill of Materials necessary to complete the project installation

D. Shop Drawings: Detail assemblies of standard components, custom assembled for specific application on this Project.

- 1. Outline Drawings: Indicate dimensions, weights, arrangement of components, and clearance and access requirements.
- 2. Front elevations of all control panels and control stations including the customized legends on each device.
- 3. Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components. Indicate data communication paths and identify networks, data buses, data gateways, concentrators, and other devices to be used. Describe characteristics of network and other data communication lines. Indicate control zone to correspond to plan drawings and specification sequence of operation.
- 4. Wiring Diagrams: Power, signal, and control wiring. Coordinate nomenclature and presentation with a block diagram.
- 5. Riser diagrams depicting all devices and wiring.
- 6. Modifications to existing floor plans depicting any circuiting revisions or device locations (occupancy sensors, daylight sensors, etc.).
- 7. Modifications to panelboard schedules to maintain proper circuit loading and phase balancing.
- 8. Plan drawings indicating locations and interconnections of all components. Components to be included, but not limited to, are:

- a. Sensors
  - b. Control stations
  - c. Power/relay packs
  - d. Network infrastructure/backbone components
  - e. System processing units (head end)
  - f. Cable/interconnections
  - g. Relay control panels
9. Complete operational sequences of each project space reflecting sequences indicated on drawings and in specifications.
- E. Coordination Drawings: Submit evidence that lighting controls are compatible with connected monitoring and control devices and systems specified in other Sections.
  1. Show interconnecting signal and control wiring and interfacing devices that prove compatibility of inputs and outputs.
  2. For networked controls, list network protocols and provide statements from manufacturers that input and output devices meet interoperability requirements of the network protocol.
- F. Samples: Provide a sample of a typical control station for review during the shop drawing review process. The sample shall be an actual factory mock-up of the proposed control station including all required faceplates, pushbuttons, dimmer controls and engraving per the project specifications.
- G. Operation and Maintenance Data:
  1. Hardware and software operation manuals.
  2. Updated shop drawings showing final installed locations of equipment to function as system as-builts.

#### **1.4 QUALITY ASSURANCE**

- A. Source Limitations: Obtain dimming controls from a single source with total responsibility for compatibility of lighting control system components specified in this Section.
- B. The networked lighting control system shall meet all of the characteristics and performance requirements specified herein.
- C. The contractor shall furnish, install and verify proper operation of all equipment necessary for proper operation of the system as specified herein and as shown on applicable drawings.

#### **1.5 COORDINATION**

- A. Coordinate lighting controls with Sections specifying distribution components that are monitored or controlled by power monitoring, power control equipment, and audio/video systems.
- B. Schedule and attend coordination meeting between Project Engineer, Startup Agent and Owner prior to system startup.

#### **1.6 WARRANTY**

- A. Special Warranty: Repair or replace components of lighting controls that fail in materials or workmanship within warranty periods specified below.
  1. Warranty Period: Cost to repair, reprogram or replace any parts for five (5) years from the date of Substantial Completion, including all labor and materials to return the system to its original working order.
  2. During the warranty period, provide 24 hours/day 7 days per week telephone technical assistance.
  3. During the warranty period, provide 24 hour on-site response time by manufacturer's factory certified technician.

4. Failures include, but are not limited to, the following:
  - a. Software: Failure of input/output to execute switching or dimming commands.
  - b. Failure of modular relays to operate under manual or software commands.
  - c. Damage of electronic components due to transient voltage surges.
  - d. Failure to switch relays to "on" status and to switch dimmer modules to full light output in power failure mode.
  - e. Failure or damage to pushbutton stations due to human use/abuse.
  - f. Failure of any component under normal wear and tear.
5. Manufacturer shall provide and install critical/security software and/or firmware upgrades for all lighting control systems and components during the warranty period. Upgrades shall be coordinated with owner prior to avoid un-timely down time.

#### **1.7 SPARE PARTS**

- A. Furnish spare parts described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  1. Control Stations: Provide one (1) spare of each type installed.
  2. Sensors: Provide one (1) spare of each type installed.
  3. Power/Relay Packs: Provide two (2) spares of each type installed.

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

- A. Package for delivery to best protect finish surfaces while using the least amount of single-use packaging as possible. If possible, package and ship product using reusable blankets and fabrics or reusable cardboard and crate systems.
- B. Protect materials against weather and contact with damp or wet surfaces from time of delivery through time of installation. Store materials indoors under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes.
- C. When storing prior to installation, raise off floor on pallets, stack flat with protective material between to eliminate chance of creating nicks, scratches, and other imperfections and damage to finish surfaces, wrap weather-tight, and provide for air circulation within and around stacks and under temporary coverings.
- D. Do not allow materials to become damp. Maintain temperatures at 60°F or higher, and humidity between 20% and 60% prior to, during and after installation.

#### **1.9 CODES AND STANDARDS**

- A. UL 916 Energy Management Equipment
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a nationally recognized testing laboratory (NRTL) acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with 47 CFR 15, Subparts A and B, for Class A digital devices.
- D. UL 924 and 1008 Emergency Lighting
- E. ASHRAE 90.1-2013 as adopted by Michigan Energy Code 2015.
- F. DLC - Design Lights Consortium

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

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

1. Acuity Brands, nLight network control system

### **2.2 SYSTEM PERFORMANCE REQUIREMENTS**

- A. System Architecture

1. System shall have an architecture that is based upon three main concepts: (a) networkable intelligent lighting control devices, (b) standalone lighting control zones using distributed intelligence, (c) optional system backbone for remote, time based and global operation between control zones.
  - a. Intelligent lighting control devices shall have individually addressable network communication capability and consist of one or more basic lighting control components: occupancy sensor, photocell sensor, relay, dimming output, contact closure input, analog 0-10V input, and manual wall station capable of indicating switching, dimming, and/or scene control. Combining one or more of these components into a single device enclosure shall be permissible so as to minimize overall device count of system.
  - b. Lighting control zones consisting of one or more networked luminaires and intelligent lighting control devices and shall be capable of providing automatic control from sensors (occupancy and/or photocell) and manual control from local wallstations without requiring connection to a higher level system backbone; this capability is referred to as "distributed intelligence."
  - c. System must be capable of interfacing directly with networked luminaires such that either low voltage network cabling or wireless RF communication is used to interconnect networked luminaires with control components such as sensors, switches and system backbone (see Control Zone Characteristics sections for each type of network connection, wired or wireless).
2. The system shall be capable of providing individually addressable switching and dimming control of the following: networked luminaires, control zones to include multiple switch legs or circuits, and relay and dimming outputs from centralized panels to provide design flexibility appropriate with sequence of operations required in each project area or typical space type. A single platform shall be used for both indoor and outdoor lighting controls as indicated on drawings.
3. Lighting control zones shall be capable of being networked with a higher level system backbone to provide time based control, remote control from inputs and/or systems external to the control zone, and remote configuration and monitoring through a software.
4. All system devices shall support remote firmware update, such that physical access to each device is not necessary, for purposes of upgrading functionality at a later date.
5. System shall be capable of "out of box" sequence of operation for each control zone. Standard sequence is:
  - a. All switches control all fixtures in a zone
  - b. All occupancy sensors automatically control all fixtures in the control zone with a default timeout of 15 minutes.

- B. Wired Networked Control Zone Characteristics

1. Following proper installation and provision of power, all networked devices connected together with low voltage network cable shall automatically form a functional lighting control zone without requiring any type of programming, regardless of the programming mechanism (e.g., software application, handheld remote, pushbutton). The "out of box" default sequence of operation is intended to provide typical sequence of operation so as to minimize the system startup and programming requirements and to also have functional lighting control operation prior to system startup and programming.
2. System shall be able to automatically discover all connected devices without requiring any provisioning of system or zone addresses.

3. The following types of wired networked control devices shall be provided for egress and/or emergency light fixtures:

- a. Low-Voltage power sensing: These devices shall automatically provide 100% light level upon detection of loss of power sensed via the low voltage network cable connection.
- b. UL924 Listed Line-Voltage power sensing: These devices shall be listed as emergency automatic load control relays under the UL924 standard, and shall automatically close the load control relay(s), open the 0-10V control relay (when lighting has dimming control), and provide 100% light output upon detection of loss of power sensed via line voltage connections.
- c. Emergency egress devices shall be provided and UL listed by the lighting control manufacturer.

C. System Integration Capabilities

1. The system shall interface with third party building management systems (BMS) to support two-way communication using the industry standard BACnet/IP or BACnet/MSTP protocols.

## 2.3 SYSTEM SOFTWARE INTERFACES

A. Management Interface

1. System shall provide a web-based management interface that provides remote system control, live status monitoring, and configuration capabilities of lighting control settings and schedules.
2. Management interface must be compatible with industry-standard web browser clients, including, but not limited to, Microsoft Edge®, Apple Safari®, Google Chrome® and Mozilla Firefox®.
3. All system software updates must be available for automatic download and installation via the internet.

B. Historical Database and Analytics Interface

1. System shall provide a browser-based trending and monitoring interface that stores historical data for all occupancy/daylight sensors and lighting loads. Additionally, the system shall optionally upload that data to a cloud based server.

C. Visualization Interfaces

1. System shall provide an optional web-based visualization interface that displays a graphical floorplan. System data, to include status of occupancy sensors, daylight sensors and light output shall be overlaid to the floorplan to provide a graphical status page.

D. Portable Programming Interface for Standalone Control Zones

1. Portable handheld application interface for standalone control zones shall be provided for systems that allows configuration of lighting control settings.
2. Programming capabilities through the application shall include, but not be limited to, the following:
  - a. Switch/occupancy sensor/photocell sensor group configuration
  - b. Manual/automatic on modes
  - c. Turn-on dim level
  - d. Occupancy sensor time delays
  - e. Dual technology occupancy sensors sensitivity
  - f. Photocell sensor calibration adjustment and auto-setpoint
  - g. Trim level settings

## 2.4 SYSTEM BACKBONE AND SYSTEM INTEGRATION EQUIPMENT

A. System Controller



1. System Controller shall be a multi-tasking, real-time digital control processor consisting of modular hardware with plug-in enclosed processors, communication controllers, and power supplies.
2. System Controller shall perform the following functions:
  - a. Facilitation of global network communication between different areas and control zones.
  - b. Time-based control of downstream wired and wireless network devices.
  - c. Linking into an Ethernet network.
  - d. Integration with Building Management Systems (BMS) and Heating, Ventilation and Air Conditioning (HVAC) equipment.
  - e. Connection to various software interfaces, including management interface, historical database and analytics interface, visualization interface, and personal control applications.
3. System Controller shall not require a dedicated PC or a dedicated cloud connection.
4. Device shall automatically detect all networked devices connected to it, including those connected to wired and wireless communication bridges.
5. Device shall have a standard and astronomical internal time clock.
6. Shall be capable of connecting to the customers Local Area Network (LAN) via IEEE 802.11.x Wireless and IEEE 802.3 Wired connection.
7. System Controller shall support BACnet/IP and BACnet/MSTP protocols to directly interface with BMS and HVAC equipment without the need for additional protocol translation gateways.
  - a. BACnet/MSTP shall support a minimum of 50 additional BACnet MS/TP controllers in addition to the Expansion I/O modules.
  - b. BACnet/MSTP shall support 9600 to 115200 baud.
  - c. System Controller shall be BACnet Testing Laboratory (BTL listed) using Device Profile BACnet Building Controller (B-BC) with outlined enhanced features.
  - d. System controller must support BACnet/IP Broadcast Management Device (BBMD) and Foreign Device Registration (FDR).

**B. OpenADR Interface**

1. System shall provide an interface to OpenADR protocol Demand Response Automation Servers (DRAS) typically provided by local electrical utility.
2. OpenADR interface shall meet all of the requirements of Open ADR 2.0a Virtual End Nodes (VEN), including:
  - a. Programmable with the account information of the end-user's electrical utility DRAS account credentials.

**2.5 WIRED NETWORKED DEVICES**

**A. Wired Networked Wall Switches, Dimmers, Scene Controllers**

1. Wall switches & dimmers shall support the following device options:
  - a. Number of control zones: 1, 2 or 4
  - b. Control Types Supported: On/Off or On/Off/Dimming
2. Scene controllers shall support the following device options:
  - a. Number of scenes: 1, 2 or 4
  - b. Control Types Supported:
    - 1) On/Off or On/Off/Dimming
    - 2) Preset Level Scene Type
    - 3) Reprogramming of other devices within daisy-chained zone so as to implement user selected lighting scene

- 4) Selecting a lighting profile to be run by the system's upstream controller so as to implement a selected lighting profile across multiple zones

B. Wired Networked Auxiliary Input / Output (I/O) Devices

1. Auxiliary Input/Output Devices shall be specified as an input or output device with the following options:
  - a. Contact closure input
    - 1) Input shall be programmable to support maintained or momentary inputs that can activate local or global scenes and profiles, ramp light level up or down, or toggle lights on/off.
  - b. 0-10V analog input
    - 1) Input shall be programmable to function as a daylight sensor.
  - c. RS-232/RS-485 digital input
    - 1) Input supports activation of up to 4 local or global scenes and profiles, and on/off/dimming control of up to 16 local control zones.
  - d. 0-10V dimming control output, capable of sinking a minimum of 20mA of current
    - 1) Output shall be programmable to support all standard sequence of operations supported by system.
  - e. Phase dimmable module
    - 1) 0-10V input and phase dimmable output capable of dimming LV and ELV loads.
  - f. DMX controller
    - 1) Input shall be control input signals from any networked device to recall presets and trigger scenes.
    - 2) Secondary input shall allow direct control of DMX enabled lighting equipment by any DMX enabled control signal (i.e. lighting console, DMX touchscreen, etc.).

C. Wired Networked Occupancy Sensors and Photocell Sensors

1. Sensors shall utilize passive infrared (PIR) or dual technology (PIR/ultrasonic or PIR/microphonics or PIR/microwave) to detect both major and minor motion as defined by NEMA WD-7 standard.
2. Sensing technologies that are acoustically passive, meaning they do not transmit sounds waves of any frequency do not require additional commissioning. Ultrasonic or Microwave based sensing technologies may require commissioning due to the active nature of their technology, if factory required.
3. Sensor programming parameter shall be available and configurable remotely from the software and locally via the device.
4. Sensor mounting type shall match project design requirements as shown on plans.
  - a. Sensors shall have optional features for photocell/daylight override, dimming control, and low temperature/high humidity operation.
5. The system shall support the following types of photocell-based control:

- a. On/Off: The control zone is automatically turned off if the photocell reading exceeds the defined setpoint and automatically turned on if the photocell reading is below the defined setpoint. A time delay or adaptive setpoint adjustable behavior may be used to prevent the system from exhibiting nuisance on/off switching.
    - b. Continuous Dimming: The control zone automatically adjusts its dimming output in response to photocell readings, such that a minimum light level consisting of both electric light and daylight sources is maintained at the task. The photocell response shall be configurable to adjust the photocell setpoint and dimming rates.
  6. All ceiling mounted occupancy sensors shall be provided with an auxiliary isolated relay for use by HVAC controls contractor.
- D. Wired Networked Wall Switch Sensors
1. Wall switch sensors shall support the following device options:
    - a. User Input Control Types Supported: On/Off or On/Off/Dimming
    - b. Occupancy Sensing Technology, PIR only or Dual Technology (PIR/ultrasonic or PIR/microphonics or PIR/microwave)
    - c. Daylight Sensing Option: Inhibit photocell sensor
- E. Wired Networked Embedded Sensors
1. Embedded sensors shall support the following device options:
    - a. Occupancy Sensing technology: PIR only or Dual Technology, PIR only or Dual Technology (PIR/ultrasonic or PIR/microphonics or PIR/microwave)
    - b. Daylight Sensing Option: Occupancy only, Daylight only, or combination Occupancy/Daylight sensor
- F. Distributed System Power, Switching and Dimming Controls
1. Devices shall incorporate one load control relay, one optional isolated auxiliary relay, optional 0-10 VDC dimming output, and contribute low voltage Class 2 power to the rest of the system.
  2. Device programming parameters shall be available and configurable remotely from the software and locally via the device push-button.
  3. Device shall be plenum rated.
  4. Devices shall be UL Listed for load and load type as specified on the plans.
- G. Wired Networked Luminaires
1. Networked luminaire shall have a factory installed mechanically integrated control device and carry a UL Listing as required.
  2. Networked LED luminaire shall provide low voltage power to other networked control devices.
  3. System shall be able to maintain constant lumen output over the specified life of the LED luminaire (also called lumen compensation) by automatically varying the dimming control signal to account for lumen depreciation.
  4. System shall be able to provide control of network luminaire intensity, in addition to correlated color temperature of specific LED luminaires.
  5. Controls manufacturer is responsible for primary troubleshooting and tech support of complete fixture.
- H. Wired Networked Relay and Dimming Panel
1. Relay and dimming panel(s) shall be capable of providing the required amount of relay capacity, as required per panel schedules shown on drawings, with an equal number of individual 0-10V dimming outputs.

2. Standard relays used shall have the following required properties:
  - a. Configurable in the field to operate with normally closed or normally open behavior.
  - b. Provides visual status of current state and manual override control of each relay.
  - c. Be individually programmable
3. 0-10 dimming outputs shall support a minimum of 100mA sink current per output.
4. Panel shall be UL924 listed for control of emergency lighting circuits.
5. Panel shall provide a contact closure input that acts as a panel override to activate the normally configured state of all relays (i.e., normally open or normally closed) in the panel.

## **2.6 CONDUCTORS AND CABLES**

- A. Provide systems communications cabling as required by systems manufacturer.
- B. Power Wiring to Supply Side of Lighting Controls Equipment: Not smaller than No. 12 AWG, complying with Division 26 Sections.
- C. Non-category control wiring between devices shall be Class II, 18-24 AWG, stranded U.L. Classified, PVC insulated or TEFLON jacketed cable suitable for use in plenums, where applicable.
- D. Minimum acceptable wire gauge from the circuit control hardware relays shall be #14 AWG.
- E. Category type communications cables shall be plenum rated, pre-terminated **green** in color and shall be furnished. Provided by the lighting control system manufacturer.

## **2.7 UNIT EMERGENCY AUTOMATIC LOAD CONTROL RELAY (ALCR)**

- A. The ALCR shall be UL 924 listed and consist of a voltage sensor and automatic load control relay. The ALCR shall automatically switch and, where indicated, dim emergency lighting fixtures with normal lighting; upon loss of normal power or signal from the fire alarm system, emergency lights shall provide 100% light output. The ALCR shall be designed for fail-safe operation. The ALCR shall be rated for LED loads, suitable for connection to 20 amp normal-power and 20-amp emergency-power circuits and rated 120 or 277 volts as required. The ALCR shall control lighting in conjunction with occupancy sensors, photocells, time clocks and other control devices and shall be warranted for five (5) years.
- B. Where light fixtures are controlled with dimming controllers, the ACLR shall be compatible with the dimming method.
- C. Where the ALCR serves lighting in a space provided with manual controls to allow transient occupants to adjust the lighting (instructional areas, offices, meeting areas, etc.), the unit shall not utilize a time delay to perform a self-test.
- D. Locate the ALCR above the lighting control station or switch at the main point of entry to the space.
- E. The ALCR shall have a low voltage input for connection to a fire alarm system dry contact.
- F. Refer to the drawings for additional requirements.
- G. Manufacturer: Provide the following:
  1. Bodine; BLCD16DIM for dimming and non-dimming.
  2. Functional Devices; ESRN for dimming and ESRN-1 for non-dimming.
  3. LVS Controls; EPC-2-D for dimming and EPC-2 for non-dimming.
  4. Nine 24, Inc.

## **2.8 UNIT EMERGENCY BRANCH CIRCUIT EMERGENCY LIGHTING TRANSFER SWITCH (BCELTS)**

- A. The BCELTS shall be UL 1008 listed and consist of voltage sensors and automatic transfer switch. The BCELTS shall automatically transfer lighting fixtures between normal and emergency power circuits depending on availability of source. The BCELTS shall be designed for fail-safe operation. The BCELTS shall be rated for LED loads, suitable for connection to 20 amp normal-power and 20-amp emergency-power circuits, rated 120 or 277 volts as required. The BCELTS shall control lighting in conjunction with occupancy sensors, photocells, time clocks and other control devices and shall be warranted for five (5) years.
- B. Where light fixtures are controlled with dimming controllers, the BCELTS shall be compatible with the dimming method.
- C. Where BCELTS serve lighting in a space provided with manual controls to allow transient occupants to adjust the lighting (instructional areas, offices, meeting areas, etc.), the unit shall not utilize a time delay to perform a self-test.
- D. Locate the BCELTS above the lighting control station or switch at the main point of entry to the space.
- E. Where indicated on drawings, the BCELTS shall have a low voltage input for connection to a fire alarm system dry contact.
- F. Refer to the drawings for additional requirements.
- G. Manufacturer: Provide the following:
  - 1. Bodine; GTD20A (note: does not include low voltage fire alarm input and is not approved for Michigan Bureau of Fire Services projects)
  - 2. LVS Controls; EPC-D-F-ATS
  - 3. ETC

## **2.9 LIGHTING CONTROL SEQUENCE OF OPERATION**

- A. Refer to Drawings for room specific sequence of operation.
- B. Power Interruption and Fire Alarm Event
  - 1. Power interruption will automatically over-ride the current setting and bring all emergency egress lighting to 100% output.
  - 2. Fire alarm event anywhere in building shall bring all lighting to 100%.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Locate and aim sensors in the correct location required for complete and proper volumetric coverage within the range of coverage(s) of controlled areas per the manufacturer's recommendations. Rooms shall have one hundred (100) percent coverage to completely cover the controlled area to accommodate all occupancy habits of single or multiple occupants at any location within the room(s). The locations and quantities of sensors shown on the Drawings are diagrammatic and indicate only the rooms which are to be provided with sensors. The contractor shall provide additional sensors if required to properly and completely cover the respective room.
- B. Proper judgment shall be exercised in executing the installation so as to ensure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structural components.

- C. Install devices in outlet boxes as specified in Section 26 0533 "Raceways and Boxes for Electrical Systems" unless otherwise specified in this Section. Mount devices at uniform heights above the floor for various areas as indicated.
- D. Install plates on flush mounted devices with all four edges in continuous contact with finished wall surfaces without the use of plaster mats or similar devices. Do not use plaster or similar fillings. Install plates vertically, unless otherwise noted, with an alignment tolerance of 1/16 inch.
- E. Prior to installation, schedule and attend a pre-construction meeting with manufacturer's representative and engineer to review all installation and pre-startup procedures.
- F. Test all low-voltage cable associated to the lighting controls system and confirm all parameters meet manufacturer's requirements. Parameters include, but are not limited to insertion loss, connection points, terminations and lengths.
- G. Coordinate with the owner's representative to secure all required network connections to the owner's IT network infrastructure.
  - 1. Provide to the owner's representative all network infrastructure requirements of the networked lighting control system.
  - 2. Provide, to the manufacturer's representative, all necessary contacts pertaining to the owner's IT infrastructure, to ensure that the system is properly connected and started up.
- H. Install all equipment at locations indicated, and secure to ceilings, walls, floors or structural members as required.
- I. Provide special cable as indicated or specified by manufacturer.
- J. Install all line voltage and communications wiring in conduit systems as indicated and as specified in Section 26 0533, unless otherwise noted.
- K. Provide final wiring and connections per the manufacturer's wiring diagrams.
- L. Provide a dedicated power feed to each power supply. Provide 120V branch circuit(s) dedicated for lighting controls equipment as required by manufacturer.
- M. Communication hubs shall be installed in electrical closets, telecommunications closets, or above lay-in ceilings at doorways at strategic locations. Gang equipment where possible to minimize 120 volt wiring and to centralize their location for maintenance. They shall not be installed in spaces with open ceiling construction.
- N. System controllers shall be installed in telecommunications closets or electrical rooms.
- O. System Programming: The system shall be turned over to the Owner programmed and ready for immediate operation. It shall be the responsibility of the contractor to coordinate with the Owner and supply the necessary "as-installed" information and schedule requirements for system programming in a timely manner.
- P. Where multiple single gang devices are shown adjacent on plan, install in one (1) multi-gang device box (i.e. wall switch control stations).

### **3.2 EMERGENCY ALCR AND BCELTS INSTALLATION**

- A. Install caution labels indicating two power sources at the ALCR/BCELTS and at each load or fixture supplied by the device.
- B. Do not install ALCR/BCELTS behind the wall switch.

- C. Extend independent emergency raceway and wiring to emergency fixtures.
- D. Locate the ALCR/BCELTs above the lighting control station or switch at the main point of entry to the space or within the source electrical closet.
- E. Label ALCR/BCELTs with source and load. Refer to 26 0553 "Identification for Electrical Systems".
- F. Refer to drawings for additional requirements.

### **3.3 QUALITY CONTROL**

- A. Adjusting: After completion of system wiring, connect, test, adjust, and readjust as necessary, all equipment in terms of design function and performance.

### **3.4 START UP SERVICES**

- A. A factory authorized technician shall assist the contractor with all installation inquiries.
- B. Provide a factory authorized technician to perform on-site start-up services including verifying the installation, programming the sequence of operations and commissioning the system. Before requesting start-up services, the installing contractor shall verify that:
  - 1. The control system has been fully installed in accordance with manufacturer's installation instructions.
  - 2. Low voltage wiring for overrides and sensors is completed.
  - 3. Proper notification of the impending start-up has been provided to the Owner's representative.

### **3.5 TRAINING**

- A. A factory authorized technician shall provide training for Owner's Personnel on the operation and maintenance of the lighting control system. The training shall be project specific and executed in one (1) training session of duration as required.
  - 1. Training session requirements.
    - a. Overview of system automatic operations including time clock, occupancy sensor and photocell.
    - b. Walk-through of each major space type indicating general control features of wall stations.
    - c. Review of the project-specific sequences for each space type.
    - d. Overview of basic system architecture.
    - e. Review of project as-builts indicating equipment locations and primary connection points.
    - f. Basic trouble-shooting processes.
    - g. Overview of system software interface, functions and feature with demonstration of customizable system settings including occupancy sensor time adjustments, time clock setting adjustments and profiles creations for special event, etc.
    - h. Question and Answer Session

### **3.6 COMMISSIONING**

- A. Visit each space and validate that the quantity, type of fixtures, voltage and wattage are documented in the administrative/trending software package.
- B. Program each zone to validate that lighting levels in the spaces are uniform and that the lighting levels remain uniform with daylight harvesting in operation.
- C. Validate that each photocell, occupancy sensor and pushbutton operate as specified and required. Document each device with its IP address and the room and group of fixtures it controls.

- D. Test each space for operation during scheduled "on" hours and then for scheduled "off" hours to assure controls operate as intended. Document spaces and times when the spaces were tested.
- E. Simulate a power outage to validate all emergency lighting operates as required.

**3.7 PRODUCT SUPPORT AND SERVICES**

- A. Factory telephone support shall be available at no cost to the Owner during the warranty period and extended warranty period. Factory assistance shall consist of assistance in solving programming or other application issues pertaining to the control equipment. The factory shall provide a toll-free number for technical support.

**END OF SECTION 26 0943**



## **SECTION 26 2416 - PANELBOARDS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Distribution systems including circuit breaker power distribution panelboards, circuit breaker lighting service panelboards and circuit breaker general services panelboards, as indicated or specified.
- B. Provide equipment supports and identification as specified.

#### **1.3 SUBMITTALS**

- A. General: Submit the following according to Conditions of the Contract and Division 01 Specification Sections.
- B. Submit shop drawings and complete product data on each item. Coordinate the items as they relate to the work, prior to submittal. Shop drawings shall include:
  - 1. All panelboards.

#### **1.4 QUALITY ASSURANCE**

- A. Comply with NEC Article 384 as applicable to the installation of panelboards, cabinets, and cutout boxes.
- B. Comply with applicable requirements of UL 67 "Electric Panelboards", and UL 50, UL 869, UL 486A, and UL 1053 pertaining to panelboards, accessories and enclosures. Provide units that are U.L. listed and labeled.
- C. Where indicated or used, provide service entrance type equipment and accessories and label "SUITABLE FOR USE AS SERVICE EQUIPMENT". Provide all service entrance features per NEC and U.L.
- D. Comply with NEMA Std. Pub./No. 250 "Enclosure for Electrical Equipment (1000 Volts Maximum)", Pub./No. PB 1 "Panelboards", and Pub./No. PB 1.1 "Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less".

### **PART 2 - PRODUCTS**

#### **2.1 GENERAL SERVICE DISTRIBUTION CIRCUIT BREAKER PANELBOARDS - 208/120 VOLT**

- A. General Description: Dead front type, per NEMA Standard PB 1 and UL 67, and consisting of a 3 phase, 4 wire solid copper neutral main bus with main lugs or main circuit breaker as indicated, and branch circuit breakers, all in a flush or surface mounted steel cabinet as indicated.
- B. Ratings: As indicated on the diagrams or details.
- C. All bus bars shall be designed on the basis of 1000 amperes per square inch of cross sectional area for copper bus, and 500 amperes per square inch for lugs and connections.

- D. Circuit Breakers: Bolt-in molded plastic case type, AC rated, 3 pole, quick-make, quick-break, with trip-free operating handle, position indication, common trip from thermal magnetic trip device, and minimum interrupting rating of 65,000 RMS symmetrical amperes at 240 volts AC.
- E. Enclosures: NEMA 1, unless otherwise specified as 1A (gasketed) or, with trim covering wiring gutters only. Minimum enclosure sizes shall be 90 inches high x 36 inches wide unless otherwise specified. Provide sheet metal covers over individual breakers with openings for protrusion of the operating handle and with means for padlocking the operating handle in the "off" position. Equip trim on surface mounted panels in factory areas and all flush mounted panels with an overall hinged door having a flush latch and cylinder lock. Key all locks alike or to the existing master system. Galvanize or phosphatize and prime and finish paint in manufacturer's standard finish. Galvanize all recessed boxes.
- F. Spaces: When future circuit breakers designated as "space" are noted, or when all specified active, spare and grace positions are accommodated and additional spaces result, equip the panelboard with bus and minimum hardware ready to receive future circuit breakers. Furnish a blank removable spacer plate to cover the "space" until future use.
- G. Circuit Directory: Heavy plastic covered metal frame card holder and card on individual breaker covers, or other approved means.
- H. Lugs for Mains: Compression type, Manufacturer's standard.
- I. Manufacturer: Provide one of the following:
  - 1. Schneider Electric/Square D
  - 2. Eaton
  - 3. ABB
  - 4. Siemens

## **2.2 CIRCUIT BREAKER GENERAL SERVICE PANELBOARDS - 208/120 VOLT**

- A. General Description: Dead front type, per NEMA Standard PB 1 and UL 67, and consisting of a 3 phase 4 wire solid copper neutral main bus with main lugs or main circuit breaker as indicated, and branch circuit breakers, all in a flush, surface or column mounted steel cabinet as indicated.
- B. Ratings: As indicated on the panel schedules.
- C. All bus bars shall be designed on the basis of 1000 amperes per square inch of cross sectional area for copper bus, and 500 amperes per square inch for lugs and connections.
- D. Circuit Breakers: Bolt-in molded plastic case type, AC rated 1, 2, or 3 pole as indicated, quick-make, quick-break, with trip-free operating handle, position indication and thermal magnetic trip device. Furnish 2 and 3 pole breakers having a common operating handle and common trip mechanism. Furnish breakers having a minimum interrupting capacity of 10,000 symmetrical amperes at 120 volts AC for single pole breakers and at 240 volts for 2 and 3 pole breakers.
- E. Enclosure: NEMA 1, unless otherwise specified as 1A (gasketed) or 12, minimum 20 inch wide box except column type, and with trim having hinged door with flush latch and cylinder lock. Key all locks alike or to the existing master system. Minimum enclosure sizes shall be 20 inches wide x 48 inches high x 5.75 inches deep, except when column type is specified. Furnish cable duct and pullbox with neutral for column mounting panels. Galvanize or phosphatize and prime and finish paint in manufacturer's standard finish, including cable duct and pullbox. Galvanize all recessed boxes.

- F. Spaces: When future circuit breakers designated as "space" are noted, or when all specified active, spare and grace positions are accommodated and additional spaces result, equip the panelboard with bus and minimum hardware ready to receive future breakers. Furnish a blank removable spacer plate to cover the "space" until future use.
- G. Circuit Directory: Heavy plastic covered metal frame and card on inside of door.
- H. Lugs for Mains: Compression type, Manufacturer's standard.
- I. Manufacturer: Provide one of the following:
  - 1. Schneider Electric/Square D
  - 2. Eaton
  - 3. ABB
  - 4. Siemens

### **PART 3 - EXECUTION**

#### **3.1 GENERAL**

- A. Assemble and install the panelboards.
- B. Mount panelboards at uniform heights throughout the building as indicated, and such that the distance from the floor to the center of the top switch or circuit breaker does not exceed 78 inches. Install handle locking devices on all breakers for night lighting, emergency lighting and similar circuits.

#### **3.2 EQUIPMENT SUPPORTS**

- A. Mount all electrical equipment, not self supporting, including panelboards securely to walls and columns with 1/4 inch minimum separation from same, and provide all necessary spacers, brackets, structural pieces, inserts, anchors and bolts for this purpose. For equipment fastened to exterior walls below grade, use 1/2" spacers. Provide supports for truss structural pieces, inserts, anchors and bolts for this purpose. Anchor all self-supporting equipment such as distribution panelboards securely to floors and to supporting steel where such supports are indicated or required.

#### **3.3 EQUIPMENT IDENTIFICATION**

- A. Provide identification on all electrical equipment installed. Refer to Section 260553.

#### **3.4 TOUCH-UP PAINTING**

- A. On all equipment installed, touch-up paint all manufacturer's standard finished equipment surfaces damaged during construction to "as new" condition with original manufacturer's finish paint.

**END OF SECTION 26 2416**

## **SECTION 26 2726 - WIRING DEVICES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to work of this Section.
- B. Related Sections:
  - 1. Section 26 0923 "Lighting Control Devices" for line voltage lighting control devices
  - 2. Section 26 0943 "Performance Based Networked Lighting Controls"

#### **1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Line voltage toggle switches.
  - 2. Receptacle services as required, and all materials and equipment, including receptacles and device plates, as indicated or specified.
  - 3. Device cover plates including for devices specified in other sections.

#### **1.3 SUBMITTALS**

- A. General: Submit the following according to the Conditions of the Contract and Division 01 Specification Sections.
- B. Product Data: Submit product data on each item. Coordinate the items, as they relate to the work, prior to submittal. Include the following:
  - 1. Wall switch device plates
  - 2. All receptacles including device plates.

### **PART 2 - PRODUCTS**

#### **2.1 WALL SWITCHES**

- A. Switches for Controlling Lighting Directly on AC Systems in General: Toggle-operated, white, specification grade, composition base, heavy duty, flush, quiet type, with provision for back and side wiring, and rated 20 amperes, 120/277 volts AC.
  - 1. Manufacturer: Provide one of the following:
    - a. Arrow-Hart 1990 Series
    - b. Bryant 4900 Series
    - c. General Electric GE5950 Series
    - d. Hubbell 1220 Series
    - e. Pass & Seymour 20AC Series
- B. Key-Operated Switches for Controlling Lighting Directly on AC Systems: Identical to toggle-operated switches specified above except for key operation. Furnish 4 keys to the Owner.

## 2.2 CONVENIENCE RECEPTACLES

- A. 20 Ampere Duplex Convenience Receptacles for 120 Volt, Single Phase Service: Two straight blade, 2 pole, 3 wire, NEMA configuration 5-20R receptacles rated 20 amperes, 125 volts, NEMA performance standard, specification grade, for back and side wiring, white color.
  - 1. Manufacturer: Provide one of the following:
    - a. Arrow-Hart 5362
    - b. Bryant 5362
    - c. General Electric GE4108-1
    - d. Hubbell 5362
    - e. Pass & Seymour 5362
- B. 20 Ampere Duplex Ground Fault Circuit Interrupter (GFCI) Convenience Receptacles for 120 Volt, Single Phase Service: Two straight blade, 2 pole, 3 wire grounding, NEMA configuration 5-20R receptacles rated 20 amperes, 125 volts, NEMA performance standard, specification grade, with provisions for back and side wiring, white color.
  - 1. Units shall have a test and reset button on the face of the receptacles and visible indication of a tripped condition.
  - 2. Units shall have line and load terminal screws such that connection to load terminals shall provide feed through ground fault protection for "downstream" receptacles and/or loads connected to these terminals.
  - 3. All receptacles shall be Underwriters' Laboratories, Listed under 498 Receptacle requirements and 943 Class A requirements.
    - a. Manufacturer: Provide one of the following:
      - 1) Arrow-Hart GF5342
      - 2) Bryant GFR53FT
      - 3) Hubbell GF5362
      - 4) Pass & Seymour 2091-S

## 2.3 DEVICE PLATES

- A. Device Plates in Offices and Other Finished Areas: Stainless steel No. 302 finish.
- B. Device Plates in Wet or Damp Areas and Outdoors: Weatherproof type. Provide spring-hinged gasketed covers on outdoor receptacles suitable for wet locations as defined in NEC Article 406.8.
- C. Screws: Provide screws having a finish matching the plate.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Mount equipment at locations indicated.
- B. Install devices in outlet boxes as specified in Section 26 0533 "Raceways and Boxes for Electrical Systems" unless otherwise specified in this Section. Mount devices at uniform heights above the floor for various areas as indicated.

- C. Install plates on flush mounted devices with all four edges in continuous contact with finished wall surfaces without the use of plaster mats or similar devices. Do not use plaster or similar fillings. Install plates vertically, unless otherwise noted, with an alignment tolerance of 1/16 inch.

**END OF SECTION 26 2726**

## **SECTION 26 2813 - FUSES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Cartridge fuses rated 600-V ac and less for use in {control circuits, enclosed switches, panelboards, switchboards, enclosed controllers, and, motor-control centers}.
  - 2. Spare-fuse cabinets.
- B. Related Sections:
  - 1. Applicable sections of Division 26.

#### **1.3 SUBMITTALS**

- A. Product Data:
  - 1. Provide for each type of fuse specified.
  - 2. Provide construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinet.

#### **1.4 SPARE FUSES**

- A. Furnish spare fuses that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Fuses: Provide three (3) of each size and type installed on this project.

#### **1.5 QUALITY ASSURANCE**

- A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA FU 1 for cartridge fuses, and NFPA 70.

#### **1.6 COORDINATION**

- A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size, with system short-circuit current levels and with coordination study.

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Manufacturers: Provide one of the following:

1. Eaton (Bussman & Edison)
2. Littelfuse, Inc.
3. Mersen/Ferraz Shawmut

## 2.2 SPARE-FUSE CABINET

- A. Characteristics: Wall-mounted heavy gauge steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.
  1. Size: Adequate for storage of spare fuses specified with **{15}** percent spare capacity minimum. Minimum size 24" W x 30" H x 12" D.
  2. Finish: Gray, baked enamel.
  3. Identification: "SPARE FUSES" in 1-1/2-inch- (38-mm-) high letters on exterior of door.
  4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 FUSE APPLICATIONS

- A. Cartridge Fuses:
  1. Service Entrance: {Class L, fast acting; Class L, time delay; Class RK1, fast acting; Class RK1, time delay; Class J, fast acting; Class J, time delay; Class T, fast acting}.
  2. Feeders: {Class L, fast acting; Class L, time delay; Class RK1, fast acting; Class RK1, time delay; Class RK5, fast acting; Class RK5, time delay; Class J, fast acting; Class J, time delay}.
  3. Motor Branch Circuits: **{Class RK1, Class RK5}**, time delay.
  4. Other Branch Circuits: {Class RK1, time delay; Class RK5, time delay; Class J, fast acting; Class J, time delay}.
  5. Control Circuits: Class CC, **{fast acting, time delay}**.

### 3.3 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- B. Install spare-fuse cabinet(s).

### 3.4 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.



B. Install fuses where required with the ampacity shown on the drawings or where not indicated as follows:

1. Feeder Circuits: Sized to provide overcurrent protection of the conductors and to provide short circuit protection of the downstream equipment and shall have an ampacity equal to or less than the conductor ampacity.
2. Lighting and Appliance Branch Circuits: Sized to provide overcurrent protection of the conductors and to provide short circuit protection of the downstream equipment and shall have an ampacity equal to or less than the conductor ampacity.
3. Motor Branch Circuits: Sized to provide motor back-up overcurrent protection, short circuit protection and ground fault protection. Fuses shall be rated 125% of motor and full load amperes. Where motor service factors are greater than 1.0 increase the full load current accordingly. Where standard fuse size is not available, use next larger standard size fuse.
4. Fuses shall be selected to provide selective coordination.

**END OF SECTION 26 2813**

## **SECTION 26 2913 - ENCLOSED CONTROLLERS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Motor control as required, and all material and equipment, including:
    - a. Motor control centers.
    - b. Control devices.
    - c. Terminal cabinets.
    - d. Individually mounted shunt capacitors.

#### **1.3 SUBMITTALS**

- A. General: Submit the following according to the Conditions of the Contract and Division 01 Specification Sections.
- B. Submit shop drawings and product data on the following:
  - 1. Motor Control Centers.
  - 2. Three phase magnetic motor starters full voltage combination type.
  - 3. Three phase magnetic motor starters full voltage non-combination type.
  - 4. Three phase manual motor starters full voltage type.
  - 5. Single phase manual motor starters fractional horsepower type.
  - 6. Control devices.
  - 7. Individually mounted shunt capacitors.

### **PART 2 - PRODUCTS**

#### **2.1 480 VOLT MOTOR CONTROL CENTERS**

- A. Motor Control Centers and Components: NEMA Standard ICS and requirements herein, and consisting of an incoming line compartment, fusible switch type or circuit breaker type combination starters, feeder fusible switches or feeder circuit breakers, other equipment as specified, and spaces fully equipped to receive future units, all mounted individually in sectionalized free-standing compartments joined together to give a complete dead front assembly having a NEMA 1, 1A (gasketed), 12, enclosure in factory areas, NEMA 1 enclosure in other indoor areas, and NEMA 3R non-walk-in or 3R walk-in enclosure in outdoor areas with wiring for NEMA Class I or II, Type A, B, or C terminal arrangement with all equipment and wiring accessible from the front or front and back.
  - 1. Manufacturer: Provide products of one of the following:
    - a. Schneider Electric/Square D
    - b. Eaton
    - c. ABB
    - d. Siemens

- B. Structure: Fabricate from sheet metal and weld and bolt together as necessary to form a rigid self-supporting section approximately 90 inches high by 20 inches wide by 20 inches deep. Bolt the required number of uniform sections together on suitable floor sills and coordinate overall length with the floor space shown.
- C. Formed Cover Plates: Equip compartments to contain equipment with hinged doors. Provide bolted removable cover plates on blank compartments and on compartments for future installation of equipment. Provide cover plates at the rear of each section of the bolted removable type. Provide bolted removable covers for openings necessary for the bolting on of future sections and for future bus and wiring trough extensions.
- D. Wiring Troughs: Provide wiring troughs vertically and horizontally in each section, complete with wiring clamps. Align horizontal troughs in each section with troughs in each adjacent section to form a convenient pullbox throughout the entire length of the control center.
- E. Control Units: Provide control units in minimum 12 inch module and locate as indicated, using guide supports for positioning plug-in units in place on all applicable sizes. Provide control center assembled and wired, ready to receive line, motor and control circuit connections, and finished in manufacturer's standard synthetic enamel or lacquer.
- F. Control Center Buses: Design buses for (480) (480/277) volt, 3 phase, (3) (4) wire, 60 hertz service, as indicated. Provide main horizontal bus rated (600) (800) (1000), (1200) (1600) amperes minimum capacity with 1/4 inch by 2 inch high conductivity bar (copper) (aluminum), as the minimum allowable size. Provide vertical branch buses of (copper) (aluminum), bar with a minimum rating of 300 amperes. Ampere ratings are continuous ratings required at a maximum of 50 degC rise above an ambient temperature of 40 degC. Silverplate contact surfaces of all bus connections. Provide mechanical bracing for all bus bars to withstand a phase to phase or phase to ground short circuit current of (42,000) (65,000) RMS symmetrical amperes. Provide taps from individual units to vertical bus of a capacity equivalent to No. 4 AWG copper as a minimum. Provide, where required, an isolated neutral bus continuous for the entire length of the motor control center, and having a continuous current rating of (300) (400) (500) (600) (800) amperes. Drill neutral bus for connection of incoming and branch circuit neutral conductors as indicated. Provide a 300 ampere minimum ground bus continuous for the entire length of the motor control center.
- G. Incoming Line Compartment: Provide adequate space for termination of incoming line conductors and equip main buses with lugs as specified in Section 16120, except where a main fusible switch or main circuit breaker is indicated. Provide main fusible switch or main circuit breaker as indicated and specified.
  - 1. Main Fusible Switch: 3 pole, single throw, visible blade, NEMA "HD" heavy duty, quick-make, quick-break type rated 600 volts, with continuous current and fuse rating as indicated. Silver or cadmium plate all contact surfaces including fuse clips.
  - 2. Main Circuit Breaker: Non-automatic, thermal magnetic, molded plastic case type, 3 pole, quick-make, quick-break, AC-DC rated, with trip-free common operating handle, position indication, and minimum interrupting rating of (30,000) (50,000) (100,000) RMS symmetrical amperes at 480 volts AC.
  - 3. Interlocking: Equip switch or breaker with an external operating handle. Interlock the operating handle with the cover door such that the door cannot be opened unless the switch or breaker is in the "off" position. Provide means for padlocking the operating handle in the "off" position with three 5/16 inch shackle padlocks such that when the operating handle is padlocked in the "off" position, the cover door cannot be opened and the switch or breaker cannot be closed.
- H. Single-Speed Non-reversing Starter Units: Combination type consisting of a fusible switch or circuit breaker as indicated, a full voltage magnetic starter, thermal overloads, control transformer and control devices as indicated and as specified, all mounted in a unit door frame assembly.
  - 1. Fusible Switch: 600 volt, 3 pole, single throw, visible blade, NEMA "HD" heavy duty, quick-make, quick-break type, horsepower rated in ratings up to 200 amperes, with continuous current and fuse ratings as indicated. Where ratings are not indicated, provide fuse clips to accommodate a dual-element type fuse as specified and having a minimum current rating of 150% of the motor full

- load current, with switch of equivalent rating. Silver or cadmium plate all contact surfaces including fuse clips.
2. Motor Circuit Protector: Molded plastic case type, 3 pole, quick-make, quick-break, with trip-free common operating handle, position indication, and common trip from an adjustable magnetic-only element which provides instantaneous short circuit protection. For energy-efficient motors, the mechanism shall be an appropriate transient inrush suppressor type. A manual push-to-trip button shall be provided. The application fault duty shall not exceed the manufacturer's listed rating for the motor circuit protector in combination with the starter contactor and overload devices.
  3. Circuit Breaker: Molded plastic case type, 3 pole, quick-make, quick-break, AC rated, with trip-free common operating handle, position indication, common trip from a thermal magnetic trip device of trip rating indicated and with minimum interrupting capacity of (14,000) (22,000) (50,000) (100,000) RMS symmetrical amperes at 480 volts AC. Where trip ratings are not indicated, provide trip ratings of approximately 250% of motor full load current.
  4. Interlocking: Equip switch or breaker with an external operating handle. Interlock the operating handle with the cover door such that the door cannot be opened unless the switch or breaker is in the "off" position. Provide means for padlocking the operating handle in the "off" position with three 5/16 inch shackle padlocks such that when the operating handle is padlocked in the "off" position, the cover door cannot be opened and the switch or breaker cannot be closed.
  5. Starter: Size starters in accordance with NEMA Standards for the horsepower of the motors with which they will be used, except do not furnish starters smaller than NEMA Size 1 for motors of 5 horsepower or less. Provide coils for operation on 120 volts unless other requirements are indicated. Equip each starter with a minimum of two convertible auxiliary contacts in addition to the normally-open seal-in contact, unless additional requirements are indicated. Provide additional contacts as indicated.
  6. Thermal Overloads: One in each phase wire, externally manual reset type. Select overloads after final installed horsepower of motors is determined. Do not use ratings exceeding 100% of motor full load current adjusted for ambient temperatures. Provide thermal overload rating table inside each door of each motor starter.
  7. Control Transformer: Provide a 480-120 volt control transformer in each individual starter unit, except where a common 120 volt control power source is indicated. Fuse and ground the secondary winding as indicated. Where indicating lights, solenoid valves or other control components are to be energized from the control transformer, increase the capacity of the control transformer proportionately for loading above the minimum requirements of the operating coil.
- I. Reversing Starter Units: Combination type consisting of a fusible switch or circuit breaker as indicated, two full voltage magnetic starters, thermal overloads, control transformer and control devices as indicated and as specified, with similar features to those specified for single-speed non-reversing starter units. Interlock starters mechanically and electrically to prevent both starters from being closed at the same time.
- J. Two-Speed Starter Units: Combination type consisting of a fusible switch or circuit breaker as indicated, two full voltage starters for two-speed, two-winding type motors, two sets of thermal overloads, control transformer and control devices as indicated and as specified, with similar features to those specified for single-speed non-reversing starter units. Interlock starters mechanically and electrically to prevent both starters from being closed at the same time, and provide an automatic sequence deceleration relay where starters supply two-speed cooling tower fan motors.
- K. Feeder Units: Consisting of a fusible switch or circuit breaker as indicated and as specified.
1. Fusible Switches: 600 volt, 3 pole, single throw, visible blade, NEMA "HD" heavy duty, quick-make, quick-break type, horsepower rated in ratings up to 200 amperes, with continuous current and fuse ratings as indicated. Silver or cadmium plate all contact surfaces including fuse clips.
  2. Circuit Breakers: Integrally fused, or high interrupting capacity, molded plastic case type, 3 pole, quick-make, quick-break, AC rated, with a trip-free common operating handle, position indication, common trip from a thermal magnetic trip device of trip rating indicated and with minimum interrupting capacity of (30,000) (50,000) (100,000) RMS symmetrical amperes at 480 volts AC. When integrally fused breakers are furnished to meet interrupting requirements, provide coordinated current-limiting fuses which will trip the breaker on blowing of any and all fuses for fault currents larger than the interrupting ability of the thermal magnetic trip devices. Provide blown fuse indication and interlock the cover over the fuses with the breaker such that removal of the cover will trip the breaker.

3. Interlocking: Equip switch or breaker with an external operating handle. Interlock the operating handle with the cover door such that the door cannot be opened unless the switch or breaker is in the "off" position. Provide means for padlocking the operating handle in the "off" position with three 5/16 inch shackle padlocks such that when the operating handle is padlocked in the "off" position, the cover door cannot be opened and the switch or breaker cannot be closed.
- L. Common Control Transformer Unit: Consisting of a transformer and a secondary circuit breaker, all mounted in a hinged and louvered unit door frame assembly located immediately below the serving feeder device unit, as indicated and as specified.
1. Transformer: Indoor dry, quiet, two winding type rated (480-120 volts) (480-240/120 volts), with Class B, 80 degC rise insulation, exposed core construction with metal-enclosed junction box, of KVA rating indicated, and connected on the primary side to the feeder device in the compartment above. Connect the secondary winding for 120 volts service to the circuit breaker.
  2. Interlocking: Interlock the cover door with the operating handle of the feeder device above such that the cover door cannot be opened unless the feeder device is in the "open" position and the feeder device cannot be closed with the cover door open. Ground one terminal of the secondary winding, if indicated.
  3. Circuit Breaker: Molded plastic case type, 1 or 2 pole as indicated, quick-make, quick-break, AC rated, with trip free operating handle, position indication, thermal magnetic trip device of trip rating indicated and with minimum interrupting capacity of 10,000 RMS symmetrical amperes at 120 volts.
- M. Shunt Capacitor Section: Consisting of individual metal-enclosed capacitor units contained in an additional section located on the end of the motor control center adjacent to incoming line compartment and similar in external appearance to the adjoining motor control center construction, all as indicated and specified. Provide one or more full height hinged and bolted doors for access to the compartment.
1. Capacitor Assemblies: Consisting of one or more individual elements, wound from a metalized film dielectric, resin-encapsulated, non-flammable, non-PCB impregnated and assembled to provide the specified KVAR output, providing satisfactory operation over an ambient temperature range of minus 40 degF to plus 104 degF, equipped with an internal fuse for each element and discharge resistors to reduce the voltage to less than 50 volts within one minute after de-energization, rated for use on a 480 volt, 3 phase, 60 hertz system, and enclosed in a sturdy dustproof, welded heavy gage steel container, complete with mounting brackets, cradles and racks, all prime and finish painted in manufacturer's standard finish. Provide KVA ratings as indicated and not exceeding the maximum value required to raise the running no-load power factor to unity, when applied to individual motors.
    - a. Manufacturer: Provide products of one of the following:
      - 1) Schneider Electric/Square D
      - 2) Eaton
      - 3) ABB
      - 4) Siemens
  2. Wiring: Do not provide horizontal or vertical bus in the compartment. Wire connect capacitor units back to the load side of individual motor starters ahead of the overloads. Wire connect the cases of capacitor units to the motor control center ground bus in the compartment.
- N. Control Devices: Locate control devices at individual unit compartments except where common control compartments are indicated. Provide a hinged and bolted door over common control compartments.
1. Push Buttons and Selector Switches: Heavy duty, oil-tight type, with contacts rated 10 amperes continuous, 600 volts AC, with legend plate and operation as indicated.
  2. Indicating Lights: Heavy duty, oil-tight type with 6 volt lamp, integral 120-6 volt transformer, push-to-test feature, color cap and legend plate as indicated.

3. Control Relays: Heavy duty industrial type with convertible contacts rated 10 amperes continuous, 600 volts AC. Provide coils for operation on 120 volts AC unless other requirements are indicated. Provide number and type of contacts as indicated.
  4. Timing Relays in General: Electrically-operated, pneumatically-controlled type, convertible from time-delay after de-energization to time-delay after energization, or vice-versa, in the field, with timing range adjustable from 0.2 seconds to 180 seconds, repeat accuracy of plus or minus 10%, one single pole double throw time contact rated 10 amperes continuous, 600 volts AC, and coil for operation on 120 volts AC unless other requirements are indicated. Provide instantaneous contacts as indicated.
  5. Motor-Driven Timing Relays: As indicated.
- O. Wiring: NEMA Type and Class as specified. Use single conductor stranded copper wire with insulation for 600 volts working and 1500 volts test, rated 90 degC for switchboard wiring. Do not use wire sizes smaller than No. 14 AWG. Terminate all outgoing wiring on molded, barrier type terminal blocks rated 600 volts, with white-face marking strip. Identify all wires by numbers of letters corresponding to elementary diagrams at terminal blocks and devices. Provide lugs for incoming line and outgoing power cable connections as specified in Section 26 0519 "Low Voltage Electrical Power Conductors and Cables."
- P. Nameplates: White-black-white laminated plastic with black engraved letters, identifying the circuit and equipment served on each unit door and on each capacitor unit. Provide a similar nameplate, 1 inch by 3 inch size, near the top of the control center identifying the motor control center by numbers and letters as indicated.

## 2.2 THREE PHASE MAGNETIC MOTOR STARTERS FULL VOLTAGE COMBINATION TYPE

- A. Single-Speed Non-Reversing Starters: Per NEMA Standard ICS and consisting of a fused or non-fused disconnect switch, motor circuit protector, or circuit breaker as indicated, a full voltage magnetic starter, thermal overloads, control transformer and control devices as indicated and as specified, all mounted and wired in a NEMA {1, 1A (gasketed), 12} enclosure in factory areas and NEMA 1 enclosure in other indoor areas and NEMA 3R in outdoor areas unless otherwise indicated.
1. Non-fused Disconnect Switch: 600 volt, 3 pole, single throw, visible blade, NEMA "HD" heavy duty, quick-make, quick-break type, horsepower rated in ratings up to 200 amperes, with continuous current rating as required by NEMA Standards. Silver or cadmium plate all contact surfaces.
  2. Fused Disconnect Switch: 600 volt, 3 pole, single throw, visible blade, NEMA "HD" heavy duty, quick-make, quick-break type, horsepower rated in ratings up to 200 amperes, with continuous current fuse ratings as indicated. Where ratings are not indicated, provide fuse clips to accommodate a dual element type fuse as specified and having a minimum current rating of 150% of the motor full load current, with switch of equivalent rating. Silver or cadmium plate all contact surfaces including fuse clips.
  3. Motor Circuit Protector: Molded plastic case type, 3 pole, quick-make, quick-break, with trip-free common operating handle, position indication, and common trip from an adjustable magnetic-only element which provides instantaneous short circuit protection. For energy-efficient motors, the mechanism shall be an appropriate transient inrush suppressor type. A manual push-to-trip button shall be provided. The application fault duty shall not exceed the manufacturer's listed rating for the motor circuit protector in combination with the starter contactor and overload devices.
  4. Circuit Breaker: Molded plastic case type, 3 pole, quick-make, quick-break, AC rated, with a trip-free common operating handle, position indication, common trip from a thermal magnetic trip device of trip rating indicated and with minimum interrupting capacity of (14,000) (22,000) (30,000) (50,000) (65,000) RMS symmetrical amperes at 480 volts AC. Where trip ratings are not indicated, provide trip ratings of approximately 250% of motor full load current.
  5. Interlocking: Equip switch or breaker with an external operating handle. Interlock the operating handle such that the door cannot be opened unless the switch or breaker is in the "off" position. Provide means for padlocking the operating handle in the "off" position with three 5/16 inch shackle padlocks such that when the operating handle is padlocked in the "off" position, the cover door cannot be opened and the switch or breaker cannot be closed.
  6. Starter: Size starters per NEMA Standards for the horsepower of the motors with which they will be used, except do not furnish starters smaller than NEMA Size 1 for motors of 5 horsepower or less.

- Provide coils for operation on 120 volts AC unless other requirements are indicated. Equip each starter with a minimum of two convertible auxiliary contacts in addition to the normally-open seal-in contact, unless additional requirements are indicated. Provide additional contacts as indicated.
7. Thermal Overload: One in each phase wire, externally manual reset type. Select overloads after final installed horsepower of motor is determined. Do not use ratings exceeding 100% of motor full load current adjusted for ambient temperatures.
  8. Control Transformer: Provide a 480-120 volt control transformer in the starter enclosure, except where a common 120 volt control power source is indicated. Fuse and ground the secondary winding as indicated. Where indicating lights, solenoid valves or other control components are to be energized from the control transformer, increase the capacity of the control transformer proportionately for loading above the minimum requirements of the operating coil.
  9. Control Devices: Provide control devices as specified, in starter enclosures when required by elementary diagrams.
- B. Reversing Starters: Per NEMA Standard ICS and consisting of a fused or non-fused disconnect switch or circuit breaker as indicated, two full voltage magnetic starters, thermal overloads, control transformer and control devices as indicated and as specified, with similar features to those specified for single-speed non-reversing starters. Interlock starters mechanically and electrically to prevent both starters from being closed at the same time.
- C. Two-Speed Starters: Per NEMA Standard ICS and consisting of a fused or non-fused disconnect switch or circuit breaker as indicated, two full voltage starters for two-speed two-winding type motors, two sets of thermal overloads, control transformer and control devices as indicated and as specified, with similar features to those specified for single-speed non-reversing starters. Interlock starters mechanically and electrically to prevent both starters from being closed at the same time, and provide an automatic sequence deceleration relay where starters supply two-speed cooling tower fan motors.
- D. Manufacturer: Provide products of one of the following:
1. Schneider Electric/Square D
  2. Eaton
  3. ABB
  4. Siemens

## **2.3 THREE PHASE MAGNETIC MOTOR STARTERS FULL VOLTAGE NON-COMBINATION TYPE**

- A. Single-Speed Non-Reversing Starters: Per NEMA Standard ICS and consisting of a full voltage magnetic starter, thermal overloads, control transformer and control devices as indicated and as specified, all mounted and wired in a NEMA 1, 1A (gasketed), 12 enclosure in factory areas and NEMA 1 enclosure in other indoor areas and NEMA 3R in outdoor areas unless otherwise indicated.
1. Starter: Size starters per NEMA Standards for the horsepower of the motors with which they will be used, except do not furnish starters smaller than NEMA Size 1 for motors of 5 horsepower or less. Provide coils for operation on 120 volts AC unless other requirements are indicated. Equip each starter with a minimum of two convertible auxiliary contacts in addition to the normally-open seal-contact, unless additional requirements are indicated. Provide additional contacts as indicated.
  2. Thermal Overloads: One in each phase wire, externally manual reset type. Select overloads after final installed horsepower is determined. Do not use ratings exceeding 100% of motor full load current adjusted for ambient temperatures.
  3. Control Transformer: Provide a 480-120 volt control transformer in the starter enclosure, except where a common 120 volt control power source is indicated. Fuse and ground the secondary winding as indicated. Where indicating lights, solenoid valves or other control components are to be energized from the control transformer, increase the capacity of the control transformer proportionately for loading above the minimum requirements of the operating coil.
  4. Control Devices: Provide control devices as specified, in starter enclosures when required by elementary diagrams.

- B. Reversing Starters: Per NEMA Standard ICS and consisting of two full voltage magnetic starters, thermal overloads, control transformer and control devices as indicated and as specified, with similar features to those specified for single-speed non-reversing starters. Interlock starters mechanically and electrically to prevent both starters from being closed at the same time.
- C. Two-Speed Starters: Per NEMA Standard ICS and consisting of two full voltage starters for two-speed two-winding type motors, two sets of thermal overloads, control transformer and control devices as indicated and as specified for single-speed non-reversing starters. Interlock starters mechanically and electrically to prevent both starters from being closed at the same time, and provide an automatic sequence deceleration relay where starters supply two-speed cooling tower fan motors.
- D. Manufacturer: Provide products of one of the following:
  - 1. Schneider Electric/Square D
  - 2. Eaton
  - 3. ABB
  - 4. Siemens

## **2.4 THREE PHASE MANUAL MOTOR STARTERS FULL VOLTAGE TYPE**

- A. Single-Speed Non-Reversing Starters: Per NEMA Standard ICS and consisting of a full voltage manual starter and thermal overloads, as indicated and as specified, all mounted and wired in a NEMA 1, 1A (gasketed), 12 enclosure in factory areas and NEMA 3R enclosure in outdoor areas unless otherwise indicated.
  - 1. Starter: NEMA Size M-1 equipped with two convertible auxiliary contacts and with toggle or push-button operator.
  - 2. Toggle Operator: Trip-free, having position indication for "on", "off", "reset" and "tripped", and means for padlocking the operator in the "off" position such that the cover door cannot be opened.
  - 3. Push-Button Operator: Trip-free "on" or "start" push button interlocked with "stop-reset" push button providing "tripped" indication and having means of padlocking the "stop-reset" push button in the "stop" position such that the cover door cannot be opened and the "on" or "start" push button cannot be depressed.
  - 4. Thermal Overloads: One in each phase wire, externally manually reset type. Select overloads after final installed horsepower is determined. Do not use ratings exceeding 100% of motor full load current adjusted for ambient temperatures.
- B. Reversing Starters: NEMA Standard ICS and consisting of two full voltage manual starters, thermal overloads, as indicated and as specified, with similar features to those specified for single-speed non-reversing starters. Interlock starters mechanically to prevent both starters from being closed at the same time.
- C. Two-Speed Starters: Per NEMA Standard ICS and consisting of two full voltage starters for two-speed two-winding type motors and two sets of thermal overloads as indicated and as specified, with similar features to those specified for single-speed non-reversing starters. Interlock starters mechanically to prevent both starters from being closed at the same time.
- D. Manufacturers: Provide products of one of the following:
  - 1. Schneider Electric/Square D
  - 2. Eaton
  - 3. ABB
  - 4. Siemens

## **2.5 SINGLE PHASE MANUAL MOTOR STARTERS FRACTIONAL HORSEPOWER TYPE**



- A. Single-Speed Starters for 115 Volt Motors: Per NEMA Standard ICS and consisting of a toggle-operated, or key-operated when indicated, single pole, quick-make, quick-break type starter, one thermal overload element, and pilot lights in cover when indicated all mounted in a NEMA 1 surface mounting enclosure, or with a stainless steel plate for flush mounting in an outlet box, as indicated. Provide means for padlocking the toggle operator in the "off" position. Provide a total of four keys for operation of key-operated starters.
- B. Single-Speed Starters for 230 Volt Motors: Per NEMA Standard ICS and consisting of a toggle-operated, or key-operated when indicated, two pole quick-make, quick-break type starter, one thermal overload in each phase, and pilot lights when indicated, with similar features to those specified for starters for 115 volt motors.
- C. Manufacturer: Provide one of the following:
  - 1. Schneider Electric/Square D
  - 2. Eaton
  - 3. ABB
  - 4. Siemens

## **2.6 CONTROL DEVICES**

- A. Manufacturer: Provide one of the following:
  - 1. Schneider Electric/Square D
  - 2. Eaton
  - 3. ABB
  - 4. Siemens
- B. Push Buttons and Selector Switches: Heavy duty, oil-tight type, with contacts rated 10 amperes continuous, 600 volts AC, with legend plate and operation as indicated.
- C. Indicating Lights: Heavy duty, oil-tight type with 6 volt lamp, integral 120-6 volt transformer, push-to-test feature, color cap and legend plate as indicated.
- D. Control Relays: Heavy duty industrial type with convertible contacts rated 10 amperes continuous, 300 volts AC. Provide coils for operation on 120 volts AC unless other requirements are indicated. Provide number and type of contacts as indicated.
- E. Timing Relays in General: Electrically-operated, pneumatically-controlled type, convertible from time-delay after de-energization to time-delay after energization, or vice-versa, in the field, with timing range adjustable from 0.2 seconds to 180 seconds, repeat accuracy of plus or minus 10%, one single pole, double throw contact rated 10 amperes continuous, 300 volts AC, and coil for operation on 120 volts AC unless other requirements are indicated.
- F. Motor-Driven Timing Relays: As indicated.
- G. Enclosures: NEMA 12 factory areas and NEMA 1 in other areas unless otherwise indicated.

## **2.7 TERMINAL CABINETS FOR DISTRIBUTING CONTROL OR POWER WIRING**

- A. General Description: Code gage galvanized sheet steel construction in indoor dry locations, and galvanized cast iron or steel with threaded hubs in damp or wet locations, of inside dimensions indicated, with gasketed screwed cover fastened with brass machine screws, complete with 3/4 inch plywood backboard and terminal blocks.
- B. Terminal Blocks: Molded barrier type rated 30 amperes, 600 volts, complete with washer head binding screws and white marking strip.

1. Manufacturers: Provide products of one of the following:

- a. Eaton
- b. Schneider Electric/Square D
- c. ABB
- d. Siemens

## **2.8 INDIVIDUALLY MOUNTED SHUNT CAPACITORS**

- A. Capacitor Assemblies: Per NEMA Standard CP 1, rated for use on a 480 volt, 3 phase, 60 hertz system, of KVAR ratings indicated and not exceeding the maximum limitations set by the NEC, and consisting of one or more individual elements, wound from a self-healing metalized film dielectric, filled with an environmentally safe, non-PCB, non-flammable fluid and designed to provide the specified KVAR output, providing satisfactory operation over an ambient temperature range of minus 40 degF to plus 104 degF, complete with an internal fuse for each cell and discharge resistors to reduce the voltage to less than 50 volts within one minute after de-energization.
- B. Enclosures: In indoor dry locations, furnish units in a single sturdy, welded heavy gage steel dustproof container complete with mounting brackets, cradles or racks for floor, wall or pendent support as required at each location. Prime and finish paint metal surface of units and accessories with manufacturer's standard finish. In moist or wet locations, furnish units in containers similar to units for dry locations, except having a zinc undercoating in addition to the standard paint finish and equipped with bushings for conduit connection.
- C. Manufacturers:
  1. Manufacturer: Provide products of one of the following:
    - a. Eaton
    - b. Schneider Electric/Square D
    - c. ABB
    - d. Siemens

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Motors: Refer to Section 26 0500 "Common Work Results for Electrical" for furnishing and mounting responsibility for all electric motors. Motors 1/2 horsepower and larger are 460 volts, 3 phase, 60 hertz, and motors less than 1/2 horsepower are 115 volts, single phase, 60 hertz, unless other requirements are indicated. In all cases where the capacity or rating of equipment being furnished under this Section is based on the rating of equipment being furnished under other Sections, confirm such ratings before purchasing the equipment.
- B. Control Equipment: Install equipment at locations indicated. Install motor starters, safety switches and control devices at uniform heights in general throughout the building with operating means at convenient heights above the floor and as indicated. Do not locate the operating means for individually mounted equipment at a height greater than 66 inches above the floor unless prior approval is obtained from the Architect-Engineer.
- C. Capacitors: Install capacitors for all motors rated 20 horsepower and greater. Locate capacitors in motor control centers, except where capacitors are indicated to be individually mounted. Locate individually mounted shunt capacitors adjacent to motors with which they are to be used and convenient for conduit connection to the motor terminal box; do not locate capacitor units in aisles or in locations interfering with normal maintenance of adjacent equipment without prior approval of the Architect-Engineer.

- D. Fuses: Install fuses, of required ampere rating, in all fusible equipment installed under Division 26 Sections. Verify all fuse ratings based on actual motor horsepower provided and manufacturer's requirements for equipment protection.

**END OF SECTION 26 2913**

## **SECTION 26 4313 – SURGE PROTECTIVE DEVICES FOR LOW VOLTAGE ELECTRICAL POWER CIRCUITS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Waveform Correctors (WC) as required, and all material and equipment as indicated or specified.
- B. The WC will be rated as Type 1 or Type 2 Devices per UL 1449, applied to the line or load side as indicated on the Drawings.
- C. Contractor shall provide labor, materials, and equipment as indicated on drawings, specified and required for installation of surge protective device(s).

#### **1.3 REFERENCE SPECIFICATIONS AND STANDARDS**

- A. The system shall be designed, manufactured, tested, and installed in compliance with the following standards:
  - 1. ANSI/IEEE C62.4 Recommended Practice for Surge Voltages in Low Voltage AC Power Circuits
  - 2. ANSI/IEEE C62.45 Guide for Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits
  - 3. IEEE 1100 Emerald Book
  - 4. CSA
  - 5. FIPS Pub 94
  - 6. Federal Specification (W-P-115b and W-C-375a,b)
  - 7. MIL-STD-E220A
  - 8. NEC
  - 9. NEMA SPD 1.1
  - 10. NFPA 70
  - 11. OSHA
  - 12. UL 1449
  - 13. UL 50, 67, 489, 943, 1283
- B. The WC shall be listed and rated under UL Standard 1449. Each unit shall pass the entire UL duty cycle and life test for a minimum of ten (10) times with less than 10% degradation.

#### **1.4 SUBMITTALS**

- A. Submit manufacturer's certified drawings showing unit dimensions, weights, mounting provisions, connection details, layout diagrams, and all required data, specifications and drawings to show conformance with all portions of this Specification for each unit.
- B. Submit manufacturer's certified documentation stating the WC is listed from a Nationally Recognized Testing Laboratory (NRTL) (UL, ETL, etc.) and is tested and multi-listed to UL 1449 and UL 1283.
- C. Submit manufacturer's certified documentation listing the actual let through voltage data in the form of oscilloscope results for both ANSI/IEEE C62.41 Category C3 (Combination wave) and B3 (Ring wave) tested in accordance with ANSI/IEEE C62.45.
- D. Submit manufacturer's certified test documentation including noise rejection. Noise rejection (dB) must be measured between 50 kHz and 100 MHz, and include verification of attenuation levels over a range of frequencies.

- E. Submit manufacturer's certified test reports from a recognized independent testing laboratory capable of producing 200 kA surge current waveforms, verifying the specified WC model survive published surge current rating on a per mode basis using the ANSI/IEEE C62.41 impulse waveform C3 (8x20 microsecond, 20kV/10kA). Test data on individual modules not acceptable.
- F. Submit electrical single-line diagram showing location and model of each waveform corrector.
- G. Submit manufacturer's warranty statement.

## **1.5 WARRANTY**

- A. The system and equipment shall be warranted by the manufacturer for a period of ten (10) years from date of Owner's acceptance.

## **1.6 MAINTENANCE**

- A. Furnish a complete set of manufacturer's installation, operation, and maintenance manuals and instruction books for each specified unit.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

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

- 1. Schneider Electric/Square D
- 2. Eaton
- 3. ABB
- 4. Siemens
- 5. Raycap

### **2.2 SURGE PROTECTIVE DEVICE**

- A. Surge Protection Device Description: Sine-wave-tracking type, with the following features and accessories:
  - 1. MOV technology for each suppression mode.
  - 2. Fuses, rated at 200-kA interrupting capacity. Provide fusing for each suppression path.
  - 3. Fabrication using bolted compression lugs for internal wiring. No plug-in component modules, quick disconnect terminals or printed circuit boards shall be used in current-carrying paths.
  - 4. Integral disconnect switch which has been tested to the surge current rating of the SP to match or exceed the fault current rating of the board. Use of circuit breakers for disconnecting means is acceptable.
  - 5. LED indicator lights for power and protection status for each phase mounted in panelboard front cover:
    - a. Green indicates fully operational circuit.
    - b. Red indicates loss of protection.
  - 6. EMI-RFI Noise Rejection: based on MIL-STD-E220A, 50-ohm standard Insertion Loss Test:
    - a. 34dB at 100 kHz.
    - b. 51dB at 1 MHz.
    - c. 54dB at 10 MHz.
    - d. 48dB at 100 MHz.
  - 7. The maximum continuous operating voltage (MCOV) for all voltage configurations shall be 115% if nominal or greater.
  - 8. Audible alarm, with silencing switch, to indicate when protection has failed.

9. One set of dry contacts rated at 5 A and 250-V ac, for remote monitoring of protection status. Coordinate with building power monitoring and control system, where present.
- B. Peak Single-Impulse Surge Current Rating for service entrance equipment (B2 Rating): 240 kA per phase; 120 kA per mode based on a single pulse, IEEE C62.41 standard 8 x 20 microsecond waveform. Device shall not suffer more than 10% deviation in clamping voltage at specified surge current.
- C. Minimum Repetitive Surge Current Capability: 10,000 for service entrance and 5,000 for distribution panels and panelboards impulse per mode in accordance with ANSI/IEEE C62.41 and ANSI/IEEE C62.45 utilizing a Category C3 bi-wave at one minute intervals without suffering either performance degradation or more than 10% deviation of specified UL 1449 Suppression Voltage Ratings at specified surge current.
- D. Connection Means:
  1. Integral: Bus mounted, parallel connection
- E. Protection modes and UL 1449 Listed and Recognized Component Surge Voltage Rating for grounded wye circuits with voltages of 208Y/120V, 3-phase, 4-wire circuits shall not exceed the following:
  1. Line to Neutral: 700V.
  2. Line to Ground: 700V
  3. Neutral to Ground: 700V
  4. Line to Line: 1500V

## **2.3 ENCLOSURES**

- A. NEMA 1, with type matching the enclosure of panel or device being protected.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION OF SURGE PROTECTION DEVICES**

- A. Surge protective device shall be factory installed in the new main distribution panel.
- B. Surge protective devices shall be provided for all emergency system switchboards and panelboards per NEC 700.8.

### **3.2 PLACING SYSTEM INTO SERVICE**

- A. Do not energize or connect distribution equipment to their sources until surge protection devices are installed and connected.

### **3.3 FIELD QUALITY CONTROL**

- A. Perform tests as specified in Section 26 0570 "Electrical Testing and Power System Studies."
- B. Remove and replace malfunctioning units and retest as specified above.

### **3.4 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain surge protection devices. Refer to Division 01.

**END OF SECTION 26 4313**

## **SECTION 26 5119 - LED INTERIOR LIGHTING**

### **PART 1 - PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Interior solid-state luminaires that use LED technology.
  - 2. Materials.
  - 3. Finishes.
  - 4. Lighting fixture supports.
- B. Related Requirements:
  - 1. Section 26 0529 "Hangers and Supports for Electrical Systems."
  - 2. Section 26 0553 "Identification for Electrical Systems."
  - 3. Section 26 0923 "Lighting Control Devices."
  - 4. Section 26 0943 "Relay Based Lighting Controls" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multiple lighting relays and contactors.

#### **1.3 DEFINITIONS**

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.
- H. L70: Point in time where light fixture output is 70% of initial light output.
- I. MacAdam Ellipse: Color consistency of LEDs from chip to chip.

#### **1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of lighting fixture indicated.
  - 1. Arrange in order of luminaire designation.
  - 2. Include data on features, accessories, finishes and listings.
  - 3. Include physical description and dimensions of luminaires.
  - 4. Include emergency lighting units, including batteries and chargers.
  - 5. Include life, output (delivered lumens, CCT, and CRI), and energy efficiency data.
  - 6. Provide finish samples for all finishes specified with custom or non-standard colors.

7. Photometric data, including IES file, and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing and Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps and accessories identical to those indicated for the lighting fixture as applied in this Project, IES LM-79 and IES LM-80.
  - a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
  - b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
8. LED drivers. Original manufacturer's cut sheet for specific driver used for each lighting fixture type.

B. Shop Drawings: For custom luminaires.

1. Include plans, elevations, sections and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power and control wiring.

**1.5 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For testing laboratory providing photometric data for luminaires.
- B. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Product Certificates: For each type of luminaire.
- D. Product Test Reports: For each luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency or by a qualified testing agency.
- E. Sample warranty.

**1.6 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.
  1. A complete submittal package of all lighting products provided as part of this project. This includes, but is not limited to, lighting fixtures and all installed components (drivers, emergency battery packs, etc.).

**1.7 QUALITY ASSURANCE**

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
- B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.
- C. Provide luminaires from a single manufacturer for each luminaire type.



- D. Each luminaire type shall be within a three-step MacAdam Ellipse centered on the black body curve to ensure color consistency among luminaires.
- E. Comply with NFPA 70.

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

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

## **1.9 WARRANTY**

- A. Manufacturer and installer agree to provide and install replacement fixtures for any components or fixtures (drivers, LED modules, etc.) that fail prior to Substantial Completion and project commissioning.
- B. Warranty: Manufacturer and Installer agree to repair or replace components, including driver/power supplies and thermal management, of luminaires that fail in materials or workmanship within specified warranty period.
- C. Warranty Period: Five (5) years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

### **2.2 LUMINAIRE REQUIREMENTS**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Recessed Fixtures: Comply with NEMA LE 4.
- C. CRI of minimum 80. CCT of 3500K or as indicated in the Lighting Fixture Schedule.
- D. Lamps dimmable from 100 percent to 0 percent of maximum light output or as indicated in the Lighting Fixture Schedule.
- E. Internal Driver: Driver shall be individually fused with fuses accessible from outside of the fixture chassis.
- F. LED (Light Engine): Complies with IEC and FCC Standards with ratings and compliances as stated below, or as indicated in Lighting Fixture Schedule.
  - 1. LED Color Temperature: 3500°K.
  - 2. Minimum rated lifetime of L70 @ 50,000 hours based on IES LM-80 testing.
  - 3. Operating Temperature: -40°C to +50°C (-40°F to 122°F).
  - 4. Operating Hours: Designed for 60,000+ hours of maintenance free operation.
  - 5. Warranty: Minimum 5-year warranty. If 15% or more of light emitting diodes fail to illuminate within the 5-year warranty period the manufacturer shall replace the light fixture. 5-year no color shift warranty.
  - 6. IP66 rated.
  - 7. Tested in compliance with IES LM-79, LM-80 and TM-21.
  - 8. Minimum ETL listed.

- G. Driver: Complies with IEC and FCC standards with ratings and compliances as stated below, or as indicated in Lighting Fixture Schedule.

1. Driver: Components are fully encased in potting material for moisture resistance.
2. Operating Temperature: -40°C to +50°C (-40°F to 122°F).
3. Operating Hours: Designed for 60,000+ hours of maintenance free operation.
4. Provides transient voltage protection in accordance with IEEE/ANSI C62.41.2 guidelines.
5. Warranty: 5-year warranty.
6. Minimum ETL listed.
7. Acceptable Manufacturers:
  - a. eldoLED
  - b. Osram
  - c. Philips
  - d. Lutron
  - e. Meanwell

## **2.3 FINISHES**

- A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

## **2.4 LUMINAIRE FIXTURE SUPPORT COMPONENTS**

- A. Comply with requirements in Section 26 0529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
- C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gauge.
- D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.
- F. All fixture support hardware shall be finished to match luminaire in finished spaces. This includes, but is not limited to, surface mounted junction boxes used as final connection point to fixture mounted, stem hangers, conduit stems and threaded rod.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before fixture installation. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 TEMPORARY LIGHTING**

- A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting.

### **3.3 INSTALLATION**

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls, and secure according to manufacturer's written instructions and approved submittal materials, unless otherwise indicated. There shall be no gaps between adjacent fixtures or between luminaires and surrounding surfaces. Lenses, reflectors and trims of luminaires shall be properly and uniformly aligned.
- C. Supports:
  - 1. Sized and rated for luminaire weight.
  - 2. Provide support for luminaire without causing deflection of ceiling or wall.
  - 3. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.
- D. Flush-Mounted Luminaire Support:
  - 1. Secured to outlet box.
  - 2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
  - 3. Trim ring flush with finished surface.
- E. Wall-Mounted Luminaire Support:
  - 1. Attached to a minimum 20 gauge backing plate attached to electrical box.
  - 2. Do not attach luminaires directly to gypsum board.
- F. Suspended Luminaire Support:
  - 1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
  - 2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
  - 3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and wire support for suspension for each unit length of luminaire chassis, including one at each end.
  - 4. Continuous Rows of Luminaires: Suspend from cable installed according to fixture manufacturer's written instructions and details on drawings.
  - 5. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.
- G. Ceiling-Grid-Mounted Luminaires:
  - 1. Secure to any required outlet box.
  - 2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
  - 3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

### **3.4 IDENTIFICATION**

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 0553 "Identification for Electrical Systems."

### **3.5 FIELD QUALITY CONTROL**

- A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation and that luminaires are switched according to the Drawings.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
3. A visual inspection shall be performed to verify cleanliness and alignment of the fixtures. Misalignment and light leaks shall be corrected and rattles due to ventilation system vibration shall be eliminated.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

### **3.6 STARTUP SERVICE**

A. Comply with requirements for startup specified in Section 26 0943 "Relay-Based Lighting Controls."

### **3.7 ADJUSTING**

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.

1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
3. Adjust the aim of luminaires in the presence of the Architect.

**END OF SECTION 26 5119**

## **SECTION 26 5613 - LIGHTING POLES AND STANDARDS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Poles and accessories for support of luminaires.

#### **1.3 DEFINITIONS**

- A. EPA: Equivalent projected area.
- B. Luminaire: Complete luminaire.
- C. Pole: Luminaire-supporting structure, including tower used for large-area illumination.
- D. Standard: See "Pole."

#### **1.4 ACTION SUBMITTALS**

- A. Product Data: For each pole, accessory, and luminaire-supporting and -lowering device, arranged as indicated.
  - 1. Include data on construction details, profiles, EPA, cable entrances, materials, dimensions, weight, rated design load, and ultimate strength of individual components.
  - 2. Include finishes for lighting poles and luminaire-supporting devices.
  - 3. Anchor bolts.
  - 4. Manufactured pole foundations.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, and mounting and attachment details.
  - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Detail fabrication and assembly of poles and pole accessories.
  - 4. Foundation construction details, including material descriptions, dimensions, anchor bolts, support devices, and calculations, signed and sealed by a professional engineer licensed in the state of installation.
  - 5. Anchor bolt templates keyed to specific poles and certified by manufacturer.
  - 6. Method and procedure of pole installation. Include manufacturer's written installations.

#### **1.5 QUALITY ASSURANCE**

- A. Testing Agency Qualifications: Qualified according to ASTM C1093 for foundation testing.

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

- A. Store poles on decay-resistant skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.

- B. Retain factory-applied pole wrappings on metal poles until right before pole installation. Handle poles with web fabric straps.

## **1.7 WARRANTY**

- A. Special Warranty: Manufacturer agrees to repair or replace components of pole(s) that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within a specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs from special warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.
  - 2. Warranty Period for Corrosion Resistance: Five years from date of Substantial Completion.
  - 3. Warranty Period for Color Retention: Five years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. Seismic Performance: Foundation and pole shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
  - 1. The term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified and the system will be fully operational after the seismic event."
  - 2. Component Importance Factor: 1.5.
- B. Structural Characteristics: Comply with AASHTO LTS-6-M.
- C. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied according to AASHTO LTS-6-M.
- D. Live Load: Single load of 500 lbf distributed according to AASHTO LTS-6-M.
- E. Ice Load: Load of 3 lbf/sq. ft., applied according to AASHTO LTS-6-M for applicable areas on the Ice Load Map.
- F. Wind Load: Pressure of wind on pole and luminaire, calculated and applied according to AASHTO LTS-6-M.
  - 1. Basic wind speed for calculating wind load for poles 50 feet high or less is 100 mph.
    - a. Wind Importance Factor: 1.0.
    - b. Minimum Design Life: 25 years.
    - c. Velocity Conversion Factor: 1.0.
- G. Strength Analysis: For each pole, multiply the actual EPA of luminaires and brackets by a factor of 1.1 to obtain the EPA to be used in pole selection strength analysis.
- H. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.

### **2.2 STEEL POLES**

- A. Source Limitations: Obtain poles from single manufacturer or producer.
- B. Poles: Comply with ASTM A500/A500M, Grade B carbon steel with a minimum yield of 46,000 psig; one-piece construction up to 40 feet in height with access handhole in pole wall.

1. Shape: See fixture schedule.
  2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.
- C. Steel Mast Arms: Single-arm type, continuously welded to pole attachment plate. Material and finish same as plate.
- D. Brackets for Luminaires: Detachable, cantilever, without underbrace.
1. Adaptor fitting welded to pole, allowing the bracket to be bolted to the pole-mounted adapter, then bolted together with stainless-steel bolts.
  2. Cross Section: Tapered oval, with straight tubular end section to accommodate luminaire. Match pole material and finish.
- E. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.
- F. Fasteners: Stainless steel, size and type as determined by manufacturer. Corrosion-resistant items compatible with support components.
1. Materials: Compatible with poles and standards as well as the substrates to which poles and standards are fastened and shall not cause galvanic action at contact points.
  2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.
- G. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Section 26 0526 "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size indicated, and accessible through handhole.
- H. Handhole: Oval shaped, with minimum clear opening of 2-1/2 by 5 inches, with cover secured by stainless-steel captive screws.
- I. Powder-Coat Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.
1. Surface Preparation: Clean surfaces according to SSPC-SP 1 to remove dirt, oil, grease, and other contaminants that could impair powder coat bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, according to SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
  2. Powder Coat: Comply with AAMA 2604.
    - a. Electrostatic-applied powder coating; single application and cured to a minimum 2.5- to 3.5-mils dry film thickness. Coat interior and exterior of pole for equal corrosion protection.
    - b. Color: As selected by Architect from manufacturer's full range.

## **2.3 POLE ACCESSORIES**

- A. Base Covers: Manufacturers' standard metal units, finished same as pole, and arranged to cover pole's mounting bolts and nuts.

## **2.4 MOUNTING HARDWARE**

- A. Anchor Bolts: Manufactured to ASTM F1554, Grade 55, with a minimum yield strength of 55,000 psi.
1. Galvanizing: Hot dip galvanized according to ASTM A153, Class C.
  2. Bent rods; diameter and length per manufacturer's recommendation.
  3. Threading: Uniform National Coarse, Class 2A.

- B. Nuts: ASTM A563, Grade A, Heavy-Hex.
  - 1. Galvanizing: Hot dip galvanized according to ASTM A153, Class C.
  - 2. Four nuts provided per anchor bolt, shipped with nuts pre-assembled to the anchor bolts.
- C. Washers: ASTM F436, Type 1.
  - 1. Galvanizing: Hot dip galvanized according to ASTM A153, Class C.
  - 2. Two washers provided per anchor bolt.

## **2.5 GENERAL FINISH REQUIREMENTS**

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine poles, luminaire-mounting devices, lowering devices, and pole accessories before installation. Components that are scratched, dented, marred, wet, moisture damaged, or visibly damaged are considered defective.
- C. Examine roughing-in for foundation and conduit to verify actual locations of installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 POLE FOUNDATION**

- A. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Structural steel complying with ASTM A36/A36M and hot-dip galvanized according to ASTM A123/A123M; and with top-plate and mounting bolts to match pole-base flange and strength required to support pole, luminaire, and accessories. Concrete, reinforcement, and formwork are specified in Section 03 3000 "Cast-in-Place Concrete."
- B. Anchor Bolts: Install plumb using manufacturer-supplied steel or plywood template, uniformly spaced.

### **3.3 POLE INSTALLATION**

- A. Alignment: Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on pole.
- B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features unless otherwise indicated on drawing.
  - 1. Fire Hydrants and Water Piping: 60 inches.
  - 2. Water, Gas, Electric, Communications, and Sewer Lines: 10 feet.
  - 3. Trees: 15 feet from tree trunk.



- C. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified in Section 03 3000 "Cast-in-Place Concrete."
- D. Foundation-Mounted Poles: Mount pole with leveling nuts and tighten top nuts to torque level according to pole manufacturer's written instructions.
  - 1. Use anchor bolts and nuts selected to resist seismic forces defined for the application and approved by manufacturer.
  - 2. Grout void between pole base and foundation. Use nonshrink or expanding concrete grout firmly packed to fill space.
  - 3. Install base covers unless otherwise indicated.
  - 4. Use a short piece of 1/2 -inch diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.
- E. Poles and Pole Foundations Set in Concrete-Paved Areas: Install poles with a minimum 6-inch-wide, unpaved gap between the pole or pole foundation and the edge of the adjacent concrete slab. Fill unpaved ring with pea gravel. Insert material to a level 1 inch below top of concrete slab.
- F. Raise and set pole using web fabric slings (not chain or cable) at locations indicated by manufacturer.

### **3.4 CORROSION PREVENTION**

- A. Steel Conduits: Comply with requirements in Section 26 0533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch-thick, pipe-wrapping plastic tape applied with a 50-percent overlap.

### **3.5 GROUNDING**

- A. Ground Metal Poles and Support Structures: Comply with requirements in Section 26 0526 "Grounding and Bonding for Electrical Systems."
  - 1. Install grounding electrode for each pole unless otherwise indicated.
  - 2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.
- B. Ground Nonmetallic Poles and Support Structures: Comply with requirements in Section 26 0526 "Grounding and Bonding for Electrical Systems."
  - 1. Install grounding electrode for each pole.
  - 2. Install grounding conductor and conductor protector.
  - 3. Ground metallic components of pole accessories and foundation.

### **3.6 IDENTIFICATION**

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 0553 "Identification for Electrical Systems."

### **3.7 FIELD QUALITY CONTROL**

- A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:
  - 1. Inspect poles for nicks, mars, dents, scratches, and other damage.
  - 2. System function tests.

**END OF SECTION 26 5613**

## **SECTION 26 5619 – LED EXTERIOR LIGHTING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.
  - 2. Luminaire supports.
- B. Related Requirements:
  - 1. Section 26 0943 "Networked Lighting Controls" for manual or programmable control systems with low-voltage control wiring or data communication circuits.
  - 2. Section 26 5613 "Lighting Poles and Standards" for poles and standards used to support exterior lighting equipment.

#### **1.3 DEFINITIONS**

- A. CCT: Correlated color temperature.
- B. CRI: Color rendering index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. Lumen: Measured output of lamp and luminaire, or both.
- F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

#### **1.4 SUBMITTALS**

- A. Product Data: For each type of luminaire.
  - 1. Arrange in order of luminaire designation.
  - 2. Include data on features, accessories, and finishes.
  - 3. Include physical description and dimensions of luminaire.
  - 4. Lamps, include life, output (lumens, CCT, and CRI), and energy-efficiency data.
  - 5. Photometric data and adjustment factors based on laboratory tests, complying with IES Lighting Measurements Testing and Calculation Guides, of each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project.
    - a. Manufacturer's Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the NVLAP for Energy Efficient Lighting Products.
    - b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
  - 6. Wiring diagrams for power, control, and signal wiring.

7. Photoelectric relays.
8. Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. Maintenance Data: For lighting fixtures to include in maintenance manual. Refer to Division 01.

D. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

### **1.5 QUALITY ASSURANCE**

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products and complying with applicable IES testing standards.
- B. Provide luminaires from a single manufacturer for each luminaire type.
- C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.
- D. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

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

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

### **1.7 FIELD CONDITIONS**

- A. Verify existing and proposed utility structures prior to the start of work associated with luminaire installation.
- B. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

### **1.8 WARRANTY**

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
    - a. Structural failures, including luminaire support components.
    - b. Faulty operation of luminaires and accessories.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
  2. Warranty Period: Five (5) years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.
  - 1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

### **2.2 LUMINAIRE REQUIREMENTS**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.
- C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- D. UL Compliance: Comply with UL 1598 and listed for wet location.
- E. CRI and CCT as indicated on Fixture Schedule.
- F. Minimum L70 lamp life of 50,000 hours.
- G. Lamps dimmable from 100 percent to 1 percent of maximum light output.
- H. Internal driver.
- I. Nominal Operating Voltage: As indicated on Fixture Schedule.
- J. In-line Fusing: Separate in-line fuse for each luminaire at the pole base hand hole.
- K. Lamp Rating: Lamp marked for outdoor use and in enclosed locations.
- L. Source Limitations: Obtain luminaires from single source from a single manufacturer.

### **2.3 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS**

- A. Comply with UL 773 or UL 773A.
- B. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc and off at 4.5 to 10 fc with 15-second minimum time delay. Relay shall have directional lens in front of photocell to prevent artificial light sources from causing false turnoff.
  - 1. Relay with locking-type receptacle shall comply with ANSI C136.10.
  - 2. Adjustable window slide for adjusting on-off set points.

## **2.4 LUMINAIRE TYPES**

- A. Refer to Fixture Schedule on Drawings.

## **2.5 MATERIALS**

- A. Metal Parts: Free of burrs and sharp corners and edges.
- B. Sheet Metal Components: Epoxy-coated steel. Form and support to prevent warping and sagging.
- C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses.
- D. Diffusers and Globes:
  - 1. Acrylic Diffusers: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
  - 2. Glass: Annealed crystal glass unless otherwise indicated.
  - 3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
- E. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- F. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:
  - 1. White Surfaces: 85 percent.
  - 2. Specular Surfaces: 83 percent.
  - 3. Diffusing Specular Surfaces: 75 percent.
- G. Housings:
  - 1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.
  - 2. Provide filter/breather for enclosed luminaires.
- H. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
  - 1. Label shall include the following lamp characteristics:
    - a. "USE ONLY" and include specific lamp type.
    - b. Lamp diameter, shape, size, wattage and coating.
    - c. CCT and CRI for all luminaires.

## **2.6 FINISHES**

- A. Variations in Finishes: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- B. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

- C. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
  - 1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
  - 2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20 requirements; and seal aluminum surfaces with clear, hard-coat wax.
  - 3. Class I, Clear-Anodic Finish: AA-M32C22A41 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
- D. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
  - 1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
  - 2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
    - a. Color: As selected from manufacturer's standard catalog of colors.

## **2.7 LUMINAIRE SUPPORT COMPONENTS**

- A. Comply with requirements in Section 26 0529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire electrical conduit to verify actual locations of conduit connections before luminaire installation.
- C. Examine walls, roofs, canopy ceilings and overhang ceilings for suitable conditions where luminaires will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 GENERAL INSTALLATION REQUIREMENTS**

- A. Comply with NECA 1.
- B. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.
- C. Fasten luminaire to structural support.
- D. Supports:
  - 1. Sized and rated for luminaire weight.
  - 2. Able to maintain luminaire position after cleaning and relamping.
  - 3. Support luminaires without causing deflection of finished surface.

4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.
- E. Wall-Mounted Luminaire Support:
  1. Attached to a minimum 1/8 inch backing plate attached to wall structural members.
- F. Wiring Method: Install cables in raceways. Conceal raceways and cables.
- G. Install luminaires level, plumb, and square with finished grade unless otherwise indicated.
- H. Coordinate layout and installation of luminaires with other construction.
- I. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.
- J. Comply with requirements in Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables (0-1000V)" and Section 26 0533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

### **3.3 CORROSION PREVENTION**

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
- B. Steel Conduits: Comply with Section 26 0533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch-thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

### **3.4 IDENTIFICATION**

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 0553 "Identification for Electrical Systems."

### **3.5 FIELD QUALITY CONTROL**

- A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.
- B. Perform the following tests and inspections:
  1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
  2. Verify operation of photoelectric controls.
- C. Luminaire will be considered defective if it does not pass tests and inspections.
- D. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

### **3.6 DEMONSTRATION**

- A. Train Owner's maintenance personnel to adjust, operate, and maintain luminaires and photocell relays.

**END OF SECTION 26 5619**

## **SECTION 27 0015 - TECHNOLOGY GENERAL REQUIREMENTS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. General provisions of the Bidding Documents and the Contract apply to work of this Section.

#### **1.2 SUMMARY**

- A. This Section includes general administrative and procedural requirements for technology installations. The following administrative and procedural requirements are included in this Section to expand the requirements specified in Division 01 sections.

1. References
2. Work restrictions
3. Related work provided by others
4. Job conditions
5. Contract modification procedures
6. Project management and coordination
7. Project progress documentation
8. Project record documents
9. Quality assurance
10. Delivery, storage, and handling
11. Warranty
12. Training/ Support

- B. This Section includes basic requirements for materials and installations for technology work, including but not limited to:

1. General installation requirements
2. Installation user accounts
3. Technology demolition work
4. Cutting and patching
5. Coordination with other trades

#### **1.3 REFERENCES**

- A. Specification Format and Content Explanation:

1. Specification Format: These Specifications are organized into Divisions and Sections based on the Construction Specifications Institute's MASTER FORMAT numbering system.
2. Words, which have well known technical, or construction industry meanings are used in the Contract Documents in accordance with such, recognized meanings.
3. Abbreviated Language: In the interest of brevity, the Contract Documents frequently omit modifying words such as "all" and "any" and articles such as "the" and "an" but the fact that a modifier or an article is absent from a statement and appears in another is not intended to affect the interpretation of either statement.
4. Trades: Use of titles such as "carpentry" is not intended to imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespersons of the corresponding generic name.

- B. Definitions:

1. Indicated: Refers to graphic representations, notes or schedules on the Drawings, or other Paragraphs or Schedules in Specifications, and similar requirements in Contract Documents.



- Where terms such as "shown", "noted", "scheduled", and "specified" are used, it is to help locate the reference; no limitation on location is intended except as specifically noted.
2. Directed: Terms such as "directed", "requested", "authorized", "selected", "approved", "required", and "permitted" mean "directed by the Technology Designer/ Engineer", "requested by the Technology Designer Engineer", and similar phrases. However, no implied meaning shall be interpreted to extend the Technology Designer/ Engineer's responsibility into the Contractor's area of construction supervision.
  3. Approve: The term "approved", where used in conjunction with the Technology Designer/Engineer's action on the contractor's applications and requests, is limited to the duties and responsibilities of the Technology Designer/ Engineer as stated in the Contract. Such approval shall not release the Contractor from responsibility to fulfill Contract requirements unless otherwise provided in the Contract Documents.
  4. Regulation: The term "Regulations" includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work, whether lawfully imposed by authorities having jurisdiction or not.
  5. Furnish: The term "furnish" is used to mean "supply and deliver to the Project site, ready for unloading, unpacking, assembly, installation, and similar operations."
  6. Install: The term "install" is used to describe operations at project site including the actual "unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations."
  7. Provide: The term "provide" means "to furnish and install, complete and ready for the intended use."
  8. Installer: An "Installer" is the Contractor engaged by the Contractor, either as an employee, subcontractor, or sub-subcontractor for performance of a particular construction activity, including installation, erection, application, and similar operations. Installers are required to be experienced in the operations they are engaged to perform.
  9. Project Site: Is the space available to the Contractor for performance of construction activities, either exclusively or in conjunction with others performing other construction activities as part of the Project. The extent of the Project Site is shown on the Drawings and may or may not be identical with the description of the land upon which the Project is to be built.
  10. Testing Laboratories: A "testing laboratory" is an independent entity engaged to perform specific inspections or tests, either at the Project Site or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.

#### **1.4 WORK RESTRICTIONS**

- A. Design Requirements: Furnish all labor, materials, equipment, technical supervision, and incidental services required to complete, test, and leave ready for operation the technology systems as specified and as indicated on Drawings.
  1. The Drawings indicate the general design and extent of the technology system. Comply with the Drawings as closely as actual construction of the building and the work of other Trades permit.
- B. Performance Requirements: Perform all work in a first class and workmanlike manner, in accordance with the latest accepted standards and practices for the Trades involved.
  1. All equipment of the same or similar systems shall be by the same manufacturer.
  2. All equipment shall be new, of modern design, and current standard production of the manufacturer.
- C. Permits and Fees: Obtain all permits, licenses, inspections, and tests required. Upon completion of the Work, obtain and send certificates of inspections and approvals to the Technology Designer/ Engineer.
  1. Pay all fees and expenses for permits, licenses, tests, and inspections.
- D. Use of Premises: Limit the use of the premises to work in areas indicated. Do not disturb portions of the site beyond areas in which the Work is indicated. Allow for Owner occupancy and use by the public.

1. The Contractor and each Subcontractor will be expected to have visited the site and appraise the existing situation and circumstances of operation. All site visits shall be coordinated with the Owner and shall occur so as not to disrupt the education environment.
  2. Consult with the Owner as to the availability of space for storage of materials and places of access to the work, etc. Materials and equipment must be placed to avoid interferences with the Owner's operations and shall be moved when so required.
  3. Comply with the Owner's requirements with regard to entrance, movement within and exit of all trucks, equipment, and personnel.
  4. The Owner reserves the right to perform construction work similar in nature to the work included under this Contract, in the same area concurrently with the Contractor, with his own forces, or with other Contractors, without conflict of any nature.
- E. Full Owner Occupancy: The Owner will occupy the site and existing buildings during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner operations.
- F. Owner's Right to Place Equipment: The Owner reserves the right to occupy and to place and install equipment in completed areas of the building, prior to Substantial Completion, provided that such occupancy does not interfere with completion of the Work. Such placing of equipment and partial occupancy shall not constitute acceptance of the total Work.
- G. Damage to Other Work: The Contractor shall repair, replace, or touch-up all finished surfaces in the existing building which may be damaged as a result of his work or operations.
- H. Hazardous Materials: Hazardous materials may be present in construction to be selectively demolished. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.
1. Hazardous material remediation where required, shall be coordinated with the Owner for removal by others.
  2. Do not disturb hazardous materials or items suspected of containing hazardous materials.
  3. Make Owner aware of any remediation requirements within two (2) weeks of Contract award.
- I. Use only adult or staff designated toilet facilities. Use of student toilet facilities is prohibited.
- J. Enforce strict discipline and good order among the Contractor's employees and subcontractor's.
1. Foul, abusive, or lewd language or demeanor will not be tolerated.
  2. Conversations with students by the Contractor's employees or subcontractors are prohibited.
  3. Contractor's employees and subcontractor's shall dress in a neat workmanlike manner.
- K. Smoking is prohibited anywhere on the Owner's property.
- L. Possession, sale, or consumption of alcoholic beverages on Owner's property is strictly prohibited.
- M. The Owner's facilities are considered a "Weapons Free School Zone" as defined in Section 237a of the Michigan penal code, Act No. 328 of the Public Acts of 1931, being Section 750.237a of the Michigan Compiled Laws and are subject to the following:
1. If you own a firearm and obtain a concealed weapons permit, you are required by Michigan law to know that there are "Pistol Free" zones in Michigan. It is illegal to carry a pistol on school property, into public or private day care centers, sports arenas, churches, hospitals, casinos, a dormitory, or classroom of a college or university, an entertainment facility that seats 2,500 people or more, and a dining room, lounge, or bar area of a premises licensed under the Liquor Control Commission (MCL 28.425.01).

- N. The manufacturing, distribution, dispensing, possession, or use of unlawful drugs on Owner's property is strictly prohibited and may result in criminal prosecution.
- O. Parking: Park in designated spaces only.
  - 1. Do not park vehicles on sidewalks or lawn areas surrounding the building unless written approval is received from the Owner.
  - 2. Loading and unloading shall be done only at the loading dock. Coordinate use of loading dock with Owner.
    - a. No vehicles shall be left unattended for more than 30 minutes and no vehicle will be permitted to be left in the loading dock overnight.
- P. Contractor Employee Identification: All persons working on-site are required to have and wear an identification badge at all times. Badges will be provided by the Owner at no charge and must be returned to the Owner. Additional badges to replace lost badges will be charged at the Owner's standard rate/ charge.
- Q. Waste Material Removal and Cleaning: Remove and properly dispose of, on a daily basis, all waste materials and debris resulting from the Work. The Owner's dumpsters shall not be used. The Project and adjacent grounds shall be kept free of accumulations of rubbish.
  - 1. Construction debris shall not be stored overnight, nor shall it be left in common corridors. Keep debris confined to work areas only until such time as it is being removed.
  - 2. No burning of waste materials will be permitted on the premises.
  - 3. Provide general "broom cleaning" of the site at the completion of the project.
- R. Use of Owner's Cafeteria: Contractor will not be allowed the use of Owner's cafeteria.

#### **1.5 JOB CONDITIONS**

- A. Keep the job adequately staffed at all times. Unless illness, loss of personnel or other circumstances beyond the control of the contractor, maintain the same individual in charge throughout.
- B. Cooperate with all appropriate parties in order to achieve well-coordinated progress with the overall construction completion schedule and satisfactory final results.
- C. Watch for conflicts with work of other contractors on the job and execute, without claim for extra payment, moderate moves or changes as are necessary to accommodate other equipment or to preserve symmetry and aesthetically pleasing appearance.
- D. Immediately report to the Engineer/ Technology Designer any design or installation irregularities, so that appropriate action may be taken.

#### **1.6 QUALITY ASSURANCE**

- A. Regulatory Requirements:
  - 1. The system shall be registered under the most current applicable rulings of the Federal Communications Commission (FCC). All components and installations shall bear an Underwriters' Laboratories (UL) listing.
  - 2. Ordinances and Codes: Perform all work in accordance with applicable Federal, State, and local ordinances and regulations and in accordance with the Rules, Regulations and Accepted Practices of the following Agencies:
    - a. ANSI American National Standards Institute
    - b. ASTM American Society for Testing and Materials

- |    |       |  |
|----|-------|--|
| c. | BICSI | Building Industry Consulting Service International   |
| d. | CSA   | Canadian Standards Association                       |
| e. | EIA   | Electronics Industries Association                   |
| f. | ETL   | Intertek Testing Services (ETL Testing Laboratories) |
| g. | FCC   | Federal Communications Commission                    |
| h. | ICEA  | Insulated Cable Engineers Association                |
| i. | IEEE  | Institute of Electrical and Electronics Engineers    |
| j. | ISO   | International Organization for Standardization       |
| k. | NEC   | National Electrical Code                             |
| l. | NEMA  | National Electrical Manufacturer's Association       |
| m. | NFPA  | National Fire Protection Association.                |
| n. | TIA   | Telecommunications Industry Association              |
| o. | UL    | Underwriters Laboratories, Inc.                      |
| p. | VESA  | Video Electronics Standards Association              |
3. Notify the Engineer/ Technology Designer before submitting this proposal should any changes in Drawings or Specifications be required to conform to the above codes, rules, or regulations. After entering into Contract, make all changes required to conform to above ordinances, rules, and regulations without additional expense to the Owner.
4. The code or standard establishing the more stringent requirement shall be followed where areas of conflict occur between codes and standards or between codes and standards and specifications.
5. Barrier-Free Regulations: All materials and installations shall comply with the requirements of the State of Michigan Handicapped Barrier-Free Regulations and with the Americans with Disabilities Act (ADA).
6. Comply with federal, state, and local labor regulations and applicable union regulations.
- B. Equipment Manufacturer Qualifications: The equipment shall be built and tested by a manufacturer who has regularly engaged in the production of said equipment for a minimum of five (5) years to assure one source of supply and responsibility.
- C. Equipment Supplier Qualifications: The supplier of the equipment shall maintain permanent service facilities within a 50-mile radius of the area of the installation. The supplier of the equipment shall be able to design, program and support the equipment and have experience on the design and installation of projects of this size or larger and certify they have no less than five (5) years of continuous experience in this area. The facilities shall include a permanent source of factory-trained service technicians on 24-hour call experienced in servicing this type of equipment and shall provide warranty and routine maintenance service to afford the Owner maximum coverage. They shall also provide a central source of support to warranty immediate answers to Owner's problems resulting from misunderstanding of the operation of the equipment.
- D. Equipment Installer Qualifications: The installation of the equipment shall be performed by fully qualified personnel, having had experience on the installation of this type and able to certify that they have had no less than five (5) years of continuous experience in this area and have made installation similar to this and of this size or larger.
- E. Equipment installers will be approved by Oakland Community College's IT department prior to the award of any contracts. All unapproved contractors will be required to withdraw their prospective bid. At no time can an unapproved contractor or his staff be subcontracted to perform this type of installation under another awarded contract.
- F. Project Management Qualifications: The Contractor Project Manager shall be RCDD certified for 3-5 years with this organization or has held the certificate for at least five (5) years. Contractor shall provide a resume for all staff assigned to these positions.
- G. Sequencing and Scheduling: Sequence and schedule work so as to avoid interference with the work of other Trades and the educational environment where students are present. Be responsible for removing and relocating any work, which in the opinion of the Owner's Representatives causes interference.

- H. Parts listed shall be complete, accurate part/ model numbers and equipment furnished shall conform to manufacturer's specifications.
- I. All materials shall be new and shall conform to applicable provisions of Underwriters Laboratories and the American Standards Association.

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

- A. Store technology equipment, at the vendor's location, as recommended in manufacturer's written instructions and in manufacturer's sealed protective packages until time of installation.
- B. If spare parts are specified, store spare parts at the vendor's location, as recommended in manufacturer's written instructions and in manufacturer's sealed protective packages. Deliver spare parts as part of the project close-out procedure.
- C. Protect technology equipment from damage and theft.

#### **1.8 GUARANTEE, SERVICE AND TRAINING**

- A. Warranty: All products shall be warranted to be free from defects in material and workmanship upon Owner acceptance.
- B. All systems and components shall be repaired or replaced within twenty-four (24) hours following report of defects by the Owner. All service will be provided on-site at Oakland Community College.
- C. The equipment Contractor (Vendor) shall be available and shall respond on-site within four (4) hours' notice and without cost to the Owner during the duration of the warranty period.
- D. The date of acceptance shall be defined as the date the Certificate of Substantial Completion is signed by the Engineer/Technology Designer and the Owner.
- E. Provide to the Owner direct access to all equipment manufacturers' technical support structures for hardware and software support. All equipment shall have direct manufacturer support for the duration of the warranty period.
- F. As part of the project closeout documentation, provide proof of warranty showing the Owner as the warranty holder. Documentation shall list warranty terms, who is providing warranty coverage, start and end dates as defined above and Owner contact information including shipping address and phone contact information.
- G. The installing contractor is responsible for the procurement of all warranty certificates from the manufactures. This contractor is also responsible for registering all warranties in the colleges name and on their behalf.
- H. Structured Cabling Systems: The network cabling and related components of this project, upon completion will be warranted by the manufacturer. The warranty for this wiring system shall be provided as follows:
  - 1. A minimum twenty (20) year Warranty shall ensure against product defects, that all approved cabling components exceed the specifications of TIA 568-C.2, TIA 568-C.3 and ISO/IEC IS 11801. The end-to-end passive product solution shall be capable of delivering Category 6 to the station. The warranty shall apply to all passive network cabling components.
  - 2. A minimum twenty (20) year Product Warranty shall cover the replacement or repair of defective product(s) including travel and labor for the replacement or repair of such defective product(s).
  - 3. A twenty (20) year Application Assurance shall cover the failure of the cable system to support the application which it was designed to support, as well as additional application(s) introduced in the

future by recognized standards or user forums that use the TIA/EIA 568-C or ISO/IEC IS 11801 component and link/channel specifications for cabling, for a twenty (20) year period.

- I. Security Access Control Systems:
  - 1. All systems and components shall be guaranteed free of defects in materials and workmanship from the date of acceptance as follows:
    - a. Warranty and licensing shall be for a five (5) year term.
    - b. Warranty shall include major, minor and maintenance updates and support. Any updates will be installed by this Contractor.
    - c. Cabling and all other equipment - standard manufacturer's warranty.
- J. The following shall apply for all equipment specified that includes a standard manufacturer warranty less than a lifetime in duration unless otherwise noted.
  - 1. A five (5) year warranty period covering all equipment defined in the technology sections including all hardware, firmware, software, and major and minor software updates.
  - 2. The equipment contractor (Vendor) shall be available and shall respond on-site within four (4) hours' notice and without cost to the Owner during the duration of the warranty period to provide support for warranty related issues.
  - 3. Systems and components shall be repaired or replaced within twenty-four (24) hours following report of defects by the Owner.

#### **1.9 TRAINING/ SUPPORT**

- A. Technical Training:
  - 1. This Contractor shall include time for training support personnel on system maintenance, configuration, and problem diagnosis. Technical training shall be used at the Owner's discretion in a minimum of 2-hour time blocks. All training sessions shall be coordinated onsite with the Owner's Technology Director. Provide technical training as follows:
    - a. Security Access Control: four (4) hours
- B. System Operator/ Support Training:
  - 1. This Contractor shall provide end-user system operation and support training. The person providing this training shall have no less than three (3) years of experience providing this type of training to end users. This training shall not be provided by a salesperson. Contractor shall develop and provide electronic and five (5) hard copies of training documentation. Training documentation shall include a "quick start/ cheat sheet" summary document as well as a step-by-step guide to common tasks for each system. Specific topics shall be discussed with the Owner and included in the step-by-step guide. Training shall be used at the Owner's discretion in a minimum of 2-hour time blocks. System usage training shall be provided as follows:
    - a. Security Access Control: four (4) hours

#### **1.10 PRODUCTS - GENERAL**

- A. All miscellaneous equipment required for a complete, professional installation shall be included in the Base Bid. No allowances for any additional equipment, cabling, or miscellaneous will be considered unless specifically excluded from the base bid.
- B. No exposed cabling shall be permitted in the wiring of any functions of the provided system. All cable shall be housed in appropriate raceways suitable and designed for such purposes.
- C. All work materials shall be removed at the end of the workday and the work area left in the same condition as found.
- D. While classes are in session, work shall be performed after normal school hours or during periods in which the building is not occupied by students (i.e., holiday breaks, half days, etc.). Adherence to a schedule of working hours, which is agreeable with the Owner, will be required.

#### **1.11 TECHNOLOGY DEMOLITION WORK (WHERE APPLICABLE)**

- A. General: Perform technology demolition work in a systematic manner. Use such methods as outlined below to complete Work indicated on the Drawings.
- B. Obtain approval from the Owner prior to interrupting existing services. All service interruptions shall be at a time suitable to the Owner. Where the Owner approves service interruptions at times resulting in premium time work to the Contractor, the Contractor shall include the premium time in his Base Bid.
- C. The associated conduit, raceway, wire, junction boxes, supports, etc., of demolished equipment shall be removed from the utilization equipment back to the source panel or backboard. All associated wiring shall be removed back to the "sources" as noted below:
  - 1. Network Equipment: Remove wiring from existing network equipment, turn over to Owner. Remove all cabling, as required, back to communication room or other source.
  - 2. Conduit in walls to remain: Abandon in place. Install blank cover plates.
  - 3. Conduit accessible above ceilings and/ or other location: Remove conduit.
- D. Conduit in floor slabs shall be cut 1/2" below the floor and patched.
- E. Where applicable, existing in-place conduit and raceway may be reused for new work providing that the installation is in accordance with requirements for new work.
- F. Where equipment is removed, outlets shall be properly blanked-off, conduits capped, mounts and brackets removed, and surfaces patched and painted. After alterations are completed, the entire installation shall present a "finished" look, as approved by the Technology Designer/ Engineer. The original function of the present technology systems shall not be changed unless required by the specific revisions to the system as specified or as indicated.
  - 1. Where equipment is removed or a wall is otherwise left in an unfinished or damaged state, contractor shall patch and paint the wall to match the existing wall color. Contractor shall paint the wall from vertical break to vertical break (i.e., from edge of door to edge of first window).
- G. Materials salvaged from this work shall not be reused except where reuse is specifically indicated.
- H. Existing technology equipment removed, not reused, and not specifically indicated to be turned over to the Owner, shall be legally and properly disposed of off Owner's property.
- I. Existing technology equipment specifically indicated to be turned over to the Owner shall be disconnected, removed, and turned over to the Owner in an undamaged condition to an onsite storage area as directed by the Owner.

#### **1.12 CUTTING, PATCHING, AND PAINTING**

- A. Direct miscellaneous cutting and patching of the existing building construction for the installation of the Technology Work.
- B. The cutting of holes through the existing building construction shall only be done by the use of abrasive saws and rotary coring machines. The use of hammer and drill points will not be permitted. The openings shall not be cut larger than necessary for the installation of the technology work. Openings shall then be grouted in. Where existing piping, etc. is removed; the unused openings shall be grouted in.
- C. The drilling or punching of structural members, such as holes through beams or columns, shall not be done without the specific permission of the Technology Designer/ Engineer.
- D. Cutting of holes through floors and walls shall be done only at such locations as may be directed by the Technology Designer/ Engineer.

- E. Where equipment is removed or a wall is otherwise left in an unfinished or damaged state, Contractor shall patch and paint the wall to match the existing wall color. Contractor shall paint the wall from vertical break to vertical break (i.e., from edge of door to edge of first window).
- F. Cooperate with the other Contractors so that all cutting and repairing in any given area will be done simultaneously.

**1.13 COORDINATION WITH OTHER TRADES**

- A. Install Work so as to avoid interferences with the Work of other trades. Be responsible for removing and relocating any work, which, in the opinion of the Owner's Representative, causes interferences.
- B. Should construction conditions prevent the installation of technology equipment at locations shown on the drawings, minor deviations may be permitted and shall be as directed by the Technology Designer/ Engineer and shall be made without additional cost to Owner.
- C. The Technology Trades will be responsible for all damage to other Work caused by their Work or through the neglect of their workers.

**END OF SECTION 27 0015**



## **SECTION 27 0526 - GROUNDING PROCEDURES**

### **PART 1 - GENERAL (NOT APPLICABLE)**

### **PART 2 - PRODUCTS**

#### **2.1 GROUNDING PROCEDURES**

- A. Communication bonding and grounding shall be in accordance with the NEC® and NFPA. Horizontal cables shall be grounded in compliance with ANSI/NFPA 70 and local requirements and practices. Horizontal equipment includes cross connect frames, patch panels, and racks, active telecommunication equipment and test apparatus and equipment. When required by local code, provide a Telecommunications Bonding Backbone utilizing a #6-AWG or larger bonding conductor that provides direct bonding between equipment rooms and telecommunications closets. This is part of the grounding and bonding infrastructure (part of the telecommunications pathways and spaces in the building structure) and is independent of equipment or cable.
- B. The telecommunication main grounding bus bar (provided and installed by licensed electricians under a separate contract) will be installed in each new BDF and IDF, as shown on the drawings. This contractor shall provide and install all required (2) two lug grounding straps from the telecommunication equipment (termination racks, ladder/cable tray) to the TMGBB (Telecommunication Main Grounding Bus Bar).
- B. In order to minimize problems resulting from improper grounding, and to achieve maximum signal-to-noise ratios, the following grounding procedures shall be adhered to:
  - 1. Under no circumstances shall the racks contact the conduit raceway system, the steel structure of the building, or ventilation ducts.
  - 2. Under no conditions shall the AC neutral conductor, at any location, be used for a system ground.
- C. There shall be no deviations from the above unless specifically required by the manufacturer of the equipment or when necessary to minimize crosstalk and to maximize signal-to-noise ratios.
- D. If a different installation practice is desired by the Installing Contractor in regard to the signal grounding, the Installing Contractor may submit alternate grounding methods to the Consultant for approval. Installing contractor shall bear all responsibility for any deviations from the above stated grounding procedure, even if allowed by the Consultant, Owner, or Architect.
- E. All wall-mounted equipment must be connected to the TMGBB using a #6 AWG cable.
- F. The cable grounding strap kit shall have a (2) two lug style grounding connector with stainless steel connecting hardware.
  - 1. Manufacturer(s):
    - a. Chatsworth Cable Runway Ground Strap Kit (length to be determined in field)
    - b. Approved Equal

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install conductors of minimum size required by the NEC, except that where sizes are otherwise indicated, provide these sizes. Thoroughly clean all bonding surfaces of non-conducting materials. Where bolted connections are used, treat surfaces with a corrosion-inhibiting compound.

- B. Where insulated conductors are used, thoroughly tape all exposed splices and connections. Encapsulate below grade splices and connections so that bare conductors are not in contact with earth.
- C. Where metallic conduit is used for mechanical protection of a ground conductor, bond conductor to the conduit at each end.
- D. Where non-metallic conduit is used, install a ground conductor in the conduit with the circuit conductors. The ground conductor may be a separate conductor, a conductor of a multi-conductor cable, or wires in the interstices of cabled circuit conductors. Size the ground conductors per NEC requirements except where noted otherwise.
- E. Ground Testing: All grounding shall not exceed 5 Ohms, at any connection. Test all connections prior to grounding equipment.
- F. The Telecommunications Main Grounding Bus Bar (TMGGB) will be certified by the installing Electrical Contractor. All connections from the telecommunications equipment to the TMGGB will be certified by the structured cabling contractor. Certifications will be turned over, as part of the final close-out documentation.

**END OF SECTION 27 0526**

## **SECTION 27 1116 - RACKS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Specification Section 27 0015 "Technology General Requirements"
- C. Specification Section 27 0526 "Grounding Procedures"
- D. Specification Section 27 1517 "Structured Cabling Systems"

#### **1.2 SUMMARY**

- A. Section includes, but is not limited to the following:
  - 1. Equipment Racks
- B. Provide as part of the bid proposal, each contractor shall provide a complete bill of materials, including catalog cut sheets and equipment configuration for the equipment racks.
- C. The equipment racks shall be comprised of new equipment that is of modern design, and current standard production of the manufacturer.
- D. Verify dimensions and conditions at the job site prior to installation, and perform installation in accordance with these Specifications, manufacturer's recommendations and the latest edition or revision of all applicable codes and BICSI standards.
- E. Provide any additional items, not specifically mentioned herein, necessary to meet system requirements as specified, without claim for additional payment.

#### **1.3 DESCRIPTION OF WORK**

- A. Oakland Community College is constructing a Driving Pad, on their Southfield Campus.
- B. A new BDF will be constructed on the 1<sup>st</sup> floor (Storage 105). Refer to the Drawings.

#### **1.4 WARRANTY**

- A. Refer to Specification Section 27 0015, Article "GUARANTEE, SERVICE AND TRAINING" for warranty requirements.

### **PART 2 - PRODUCTS**

#### **2.1 RACKS**

- A. Network Equipment Racks – BDF (Storage 105)
  - 1. Procure and install new 2-post universal racks, as shown on the Drawings.
  - 2. Each 2-post universal rack shall be configured, as follows:
    - a. The rack shall be 19" wide x 7' high with front and rear threaded mounting holes.

- b. The rack shall be grounded with a #6 green ground cable to the ground bus bar in the BDF. The ground bus bar is provided by others.
  - c. The rack shall have vertical cable management on each side of front with grommets pass throughs. Cable management shall include front cable management for equipment patch cables and rear cable management for horizontal cable management.
  - d. Horizontal cable management shall be 2U high and 2U deep.
  - e. Furnish 2-lug grounding connectors.
3. Approved Manufacturer(s):
- a. Chatsworth 2-Post Universal Rack (48353-703)
  - b. Chatsworth CCS - EFX Combination Cabling Section Extended Fingers (40098-703)
  - c. Chatsworth Single-Sided Horizontal Cable Manager (13930-702)
  - d. Chatsworth Concrete Floor Kit, 1/2" Hardware Kit (40604-003)
  - e. Primary Battery Backup - Eaton 2200W 208V Interactive UPS (5PX2200HRTG2) including the gigabit network interface (NETWORK-M2) (Quantity of 1)
  - f. Extended Battery Module - Eaton 5PX G2 (5PXEBM72RTG2) including any cables to connect to the primary battery backup (Quantity of 1)
  - g. Power Distribution Unit - Chatsworth Vertical PDU (12850-706) including any vertical mounting brackets (Quantity of 1).
  - h. Approved Equal

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION - GENERAL**

- A. Material, workmanship, and installation methods shall be performed, as specified.
- B. If, in the opinion of the Installing Contractor, an installation practice is desired or required, which is contrary to these Specifications or Drawings, a written request for modification shall be made to the Construction Manager, Architect/Engineer and Owner. Modifications shall not be implemented without the written approval from the Technology Consultant. All materials and labor shall be furnished whether mentioned or not to form a complete system operational as per the intentions and description set forth within these Specifications. Include delivery, unloading, placement, fastening to walls, floors, ceiling, or other structures where required, interconnecting of the system components, and all other work and materials necessary to form a complete functional system.
- C. Provide any additional items, not specifically mentioned herein, necessary to meet system requirements as specified, without claim for additional payment. Such items may include installation hardware, and other devices for proper installation.
- D. Verify dimensions and conditions at the job site prior to installation and perform installation in accordance with these Specifications, manufacturer's recommendations and the latest edition or revision of all applicable codes and standards.
- E. Remove ceiling tiles as required to accommodate new work under this Contract. Notify Owner of any damaged tiles prior to removal. Tiles damaged during construction shall be replaced by the Contractor.
- F. All relay racks, vertical wire management, patch panels and associated hardware shall be bonded and grounded to the Telecommunication main grounding bus bar (TMGBB) in each telecommunications room as shown on the contract Drawings and listed in the Specifications.
- G. All relay racks shall be secured to the floor with drop in, expandable anchors designed for this type of installation. Refer to manufacturer's installation instructions for proper installation methods.

**END OF SECTION 27 1116**

## **SECTION 27 1517 - STRUCTURED CABLING SYSTEMS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Specification Section 27 0015 "Technology General Requirements"
- C. Specification Section 27 0526 "Grounding Procedures"
- D. Specification Section 27 1116 "Racks"

#### **1.2 SUMMARY**

- A. Section includes, but is not limited to the following:
  - 1. Horizontal cabling
  - 2. Patch panels compatible with the Structured Cabling System
  - 3. Patch cords compatible with the Structured Cabling System
  - 4. Pathways
  - 5. Modular jacks
  - 6. Termination of all horizontal cabling
  - 7. Testing of all horizontal cabling
- B. This Specification, in conjunction with the Drawings, establishes the requirements necessary to achieve the intended performance and function of the Structured Cabling System (SCS).
- C. The structured cabling system consists of information processing, and/or information delivery and distribution equipment integrated together to form a cohesive integrated data system.
- D. Provide as part of the bid proposal a complete bill of materials, including catalog cut sheets, and equipment configuration for the structured cabling system.
- E. Provide the services necessary to furnish, install and to provide maintenance to support the structured cabling system including an integrated system of peripheral apparatus conforming to acceptable industry standards. All work shall be in accordance with the true intent of these Drawings and Specifications, and as required to leave the structured cabling system complete and in satisfactory operating condition, excluding those items listed under "Work by Others."
- F. The structured cabling system shall be comprised of new equipment that is of modern design, and current standard production of the manufacturer.
- G. Verify dimensions and conditions at the job site prior to installation, and perform installation in accordance with these Specifications, manufacturer's recommendations and the latest edition or revision of all applicable codes and Bicsi standards.
- H. The structured cabling system includes providing, testing, and integrating the following principal systems:
  - 1. Data Distribution Equipment
  - 2. Data Cabling
- I. Furnish and install a structured cabling system incorporating the hardware, equipment, Ethernet LAN, and appropriate testing equipment to perform testing, as hereinafter described.

- J. Provide any additional items, not specifically mentioned herein, necessary to meet system requirements as specified, without claim for additional payment.

### **1.3 DESCRIPTION OF WORK**

- A. Oakland Community College is constructing a Driving Pad, within their Southfield campus. A new structured cabling system will provide connectivity to the various endpoints. Refer to the Drawings for the quantity required.
- B. With the installation of the new structured cabling system, the following technology closet(s) will be constructed:
  - 1. BDF (Storage 105)
- C. All technology closets will require all new equipment. This Contractor will be required to provide all cable tray and ladder rack within all technology closets, as specified on the Drawings.
- D. Provide labor, material, equipment, terminations, and accessories necessary for a complete new and operational communications copper horizontal cabling system as indicated on the Drawings and as specified herein. This Contractor shall furnish the equipment, accessories and necessary material, as described herein.
- E. Provide and install a separate pathway for the new cabling infrastructure. This Contractor shall not utilize existing pathways.
- F. Provide all supports, plenum, cable ties, Velcro, conduits, sleeves, etc. and all related materials for the pathways for the structured cabling system as described herein. Support service loop properly above ceiling.
- G. Provide wide base cable support that meets UL, NEC, and TIA/EIA requirements for structured cabling system. Bridle rings with saddles are not allowed.
- H. The support system shall attach to the building structural elements or be wall-mounted.
- I. Cabling infrastructure shall be supported by cable supports that meet BICSI, EIA, TIA requirements and must be provided by the cabling contractors unless otherwise noted. (NO cable shall be allowed to be supported at or on ceiling grid, ceiling supports, mechanical or electrical piping, HVAC ductwork, etc.).
- J. The supports shall be made of fire retardant and low smoke emission products, which meet UL 2034 requirements for air plenum spaces.
- K. The support products shall have a minimum of a 1" wide platform for the cable to rest.
- L. Individual supports shall be installed at intervals not greater than 60".
- M. Cable supports shall be installed a minimum of 6" above lay-in ceiling system. (Cable sags shall not allow the cable to touch ceiling grid or tiles, or additional supports shall be provided.)
- N. Minimum clearances from sources of EMI and RFI must be adhered to as specified in TIA/EIA-568B, TIA/EIA-569 and the latest version of the BICSI TDM.
- O. The data horizontal cabling system shall be capable of 10G transmissions via 4 PR UTP copper augmented Category 6 horizontal cables and shall comply with TIA/EIA 568B requirements.
- P. The cabling for the data horizontal cabling system shall include but not limited to the following:
  - 1. Provide UTP cables (horizontal)

2. Provide patch panels and patch cords compatible with the horizontal cabling system
3. Provide modular jacks and cover plates compatible with the horizontal cabling system
4. Provide and terminate cabling within each area, room, and the data cabinets (BDF and IDFs)

Q. The modular computer/data eight-position jack shall match the color scheme of EIA-568 B as follows:

1. Pair 1: Pin 4 - Blue; Pin 5 - White-Blue
2. Pair 2: Pin 1 - White-Orange; Pin 2 - Orange
3. Pair 3: Pin 3 - White-Green; Pin 6 - Green
4. Pair 4: Pin 7 - White-Brown; Pin 8 - Brown

#### **1.4 QUALITY ASSURANCE**

- A. Communications cabling system components and equipment shall be listed by Underwriters Laboratories, Inc. for Computer use, and the components shall bear the UL label.
- B. The system shall be installed in accordance with requirements set by ANSI/NFPA-70 National Electric Code.
- C. All equipment shall comply with the latest ANSI/TIA 607-B grounding and bonding standards.
- D. All equipment and installation practices shall comply with latest BICSI (TDM) standards.
- E. All equipment shall comply with the latest ANSI/TIA/EIA-568, 569, 60, 607, and 862 standards, as applicable.
- F. Cables shall be installed in accordance with ANSI/EIA/TIA and BICSI standards.
- G. Provide labeling per ANSI/EIA/TIA-606 requirement and in accordance with the Owner and the Technology Consultant.
- H. All cabling shall be tested in accordance with the ANSI/TIA/EIA-568-B2 standards with the required testing equipment.

#### **1.5 WARRANTY**

- A. Refer to Specification Section 27 0015, Article 1.8 "GUARANTEE, SERVICE AND TRAINING" for warranty requirements.

#### **1.6 SPECIAL EQUIPMENT INSTALLER QUALIFICATIONS**

- A. This Contractor must meet one of the two (2) following special criteria:
  1. Demonstrate that at least 30 percent of installation personnel are BICSI Registered Telecommunications Installers. Of that number, at least 15 percent shall be registered at the Technician Level, at least 40 percent shall be registered at the Installer Level 2, Installer Level 2, Copper or Installer Level 2, Optical Fiber, and the balance shall be registered at the Installer Level 1.

OR

2. Demonstrate that all work will be performed by fully qualified personnel having had experience on the installation of this type of system and able to certify that the primary on-site field foreman has no less than fifteen (15) years of continuous experience in this area and have made installations similar to this and of this size or larger. Additionally, 30 percent of installation personnel shall have an average of no less than ten (10) years of continuous experience in this area and have made installations similar to this and of this size or larger.

- B. This Contractor must include references of similar jobs. Final determination of equipment installer qualifications shall be the decision of the owner and may include inspections of recent work.

## 1.7 SPARE PARTS

- A. None

## PART 2 - PRODUCTS

### 2.1 GENERAL

1. The structured cabling system shall include providing complete operational and tested data wiring to support the network communications needs. The structured cabling system will consist of providing new equipment and utilizing existing equipment as they pertain to the following principal features:
  - a. Category 6A horizontal cabling
  - b. Category 6A modular patch cables
  - c. Media outlets and connectors
  - d. Cable termination equipment
  - e. Testing
  - f. Documentation
2. Design, manufacture, test, and install telecommunications cabling networks per manufacturer's requirements and in accordance with NFPA-70 (2011 edition of the *National Electrical Code*®), IEEE C2 2007 (NESC 2007), state codes, local codes, requirements of authorities having jurisdiction, and particularly the following standards:
  - a. ANSI/TIA/EIA Standards
    - 1) TIA-568-C.0 - Generic Telecommunications Cabling for Customer Premises
    - 2) ANSI/TIA/EIA-568-C.1 - Commercial Building Telecommunications Cabling Standard, Part 1: General Requirements
    - 3) ANSI/TIA/EIA-568-C.2 - Commercial Building Telecommunications Cabling Standard, Part 2: Balanced Twisted Pair Cabling Components
    - 4) ANSI/TIA/EIA-568-C.3 - Optical Fiber Cabling Components Standard
    - 5) TIA-569-B - Commercial Building Standard for Telecommunications Pathways and Spaces
    - 6) TIA/EIA-606(A) - The Administration Standard for the telecommunications Infrastructure of Commercial Buildings
    - 7) J-STD-607(A) - Commercial Building Grounding and Bonding Requirements for Telecommunications
    - 8) TIA-526-14A - OFSTP-14 Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant
    - 9) TIA TSB-140 Additional Guidelines for Field Testing Length, Loss, and Polarity of Optical Fiber Cabling Systems
3. Install cabling in accordance with the most recent edition of BICSI® publications:
  - a. BICSI - Telecommunications Distribution Methods Manual
  - b. BICSI - Installation Transport Systems Information Manual
  - c. BICSI - Electronic Safety and Security Design Reference Manual

- B. Refer to Section 27 0015 for additional general requirements.

### 2.2 AUGMENTED CATEGORY 6A CABLING

- A. Description of System:



1. This Contractor is responsible for providing a complete and operational structured cabling system. Provide the following principal items:

- a. Provide new augmented Category 6 unshielded twisted pair cabling
- b. Provide new 24-port augmented Category 6 modular patch panels
- c. Tone, test, label, and certify all new data drops

- B. The computer/data cable shall be four unshielded twisted pair (UTP), 23 AWG, solid bare copper.
- C. The insulated conductors shall be twisted in pairs and shall be insulated with FEP material, and all 4 insulated pairs shall be set into an insulated plastic jacket.
- D. UL listed CMP-LP with transmission characteristics that meet or exceed those of FCC-68/ TIA /EIT, 568A-5 and TIA /EIT TSB-95 performance and NEMA low loss, extended frequency, jacket shall be sequentially marked at 2' intervals and must be plenum rated. UL listed 1459 and 1863.
- E. Pair twisting shall be maintained to meet the cable performance, but maximum cable, untwisting allows is one half (1/2) inch.
- F. Cable shall meet ANSI/TIA/EIA-658-B2-AD10 transmission performance specifications for 4-pair UTP augmented category 6 cabling.
- G. Design bandwidth - 500MHZ, cable bandwidth - 500+MHZ, standard data rate 10G.
- H. Provide a fifteen (15') foot service loop at each end of each cable run.
- I. Approved Manufacturer(s):
  1. Commscope Uniprise® 6A with a white jacket (UN874026814/10)
  2. Approved Equal

## **2.3 AUGMENTED CATEGORY 6 PATCH CABLES:**

- A. Provide augmented Category 6A patch cords with modular RJ45 at each end, UL listed and shall meet T568B wiring scheme.
- B. Each patch cord shall be bootless.
- C. Provide a white 15' patch cord for each wireless access point and surveillance camera location.
- D. Patch cords within the equipment closets shall be a minimum of one foot (1') in length. This is to keep excess patch cord length to a minimum. This Contractor to coordinate the required length of equipment cords with the network switch and wireless access system contractor(s) prior to placing the order.
- E. This Contractor shall be responsible for furnishing 10' patch cords at wireless access point locations.
- F. Contractor must provide patch cords for activating 90% of the newly installed Category 6A cable.
- G. Approved Manufacturer(s):
  1. Commscope Uniprise® Reduced Diameter MiNo6A™ Cat 6A Patch Cords – Closet-side (White)
  2. Commscope Uniprise® Ultra 10® Category 6A U/UTP Patch Cords, Snagless – Device-side (White)
    - a. Closet:

- 1) 100%: 1 foot
- 2) 35%: 3 feet
- 3) 10%: 5 feet

b. Workstation:

- 1) 15%: 5 feet
- 2) 20%: 7.5 feet
- 3) 20%: 10 feet
- 4) 20%: 15 feet
- 5) 15%: 25 feet

## 2.4 DATA JACKS

A. Unshielded Twisted Pair media outlet terminations shall conform to the following:

1. Eight (8) position, eight (8) conductor modular plug, certified Category 6, or Category 6A, T568B plug pin assignment. Modular Category 6A plug will be specifically designed for use in conjunction with 22-24 AWG solid conductor unshielded twisted pair cabling.
2. Data jacks shall be UL listed and must meet TIA/EIA 568B.2-AD10 requirements.
3. Data only faceplates shall be stainless steel of a size to accommodate the raceway and gang boxes identified on drawings with adequate punch-outs for appropriate snap-in jacks.
4. Faceplates that contain both A/V and data connections shall be provided by this Contractor. This Contractor shall provide data connectors for the shared faceplate.
5. Approved Manufacturer(s):
  - a. Commscope Uniprise® M-Series Modular Jack - Grey (760241174 / UNJ10G-GY)
  - b. Approved Equal

## 2.5 FACEPLATES

- A. Provide decorative modular cover plates with number of modular data jack(s) as shown on the drawing and as specified in this section.
- B. Provide modular mounting frames for all jacks in exposed surface raceway.
- C. Cover plate shall be adjustable either in field or by factory (1/4" minimum).
- D. Provide blanks, as necessary.
- E. Approved manufacturer(s):
1. Commscope Uniprise® M-Series, Single/Double-Gang Stainless Steel Faceplate with Label
  2. Approved Equal

## 2.6 2-PORT SURFACE-MOUNT BOX

- A. Provide a universal standard surface-mount boxes that can be attached to any flat surface with the provided screws or with double-sided adhesive tape.
- B. All data jacks should simply snap into place.
- C. Provide surface-mount boxes with number of modular data jack(s) as shown on the drawings and as specified in this section.
- D. Provide blanks, as necessary.

E. Approved manufacturer(s):

1. Commscope Uniprise® Universal Surface-Mount Box in White (SMB-2P-262)
2. Approved Equal

**2.7 COPPER PATCH PANELS**

- A. Provide 24-port RJ45 modular patch panels for termination of all UTP cable.
- B. Patch panels shall meet or exceed all transmission performance for Category 6A, as outlined in TIA/EIA-568B.2-10.
- C. Patch panels shall have a rear strain relief bar to organize cables and maintain proper bend radius.
- D. Each RJ45 jack port shall be terminated with 4 pair of UTP wire and shall be wired to meet TIA/EIA 568B color scheme.
- E. Approved manufacturer(s):
1. Commscope GigaSPEED X10D® M-Series, M2400 U1 Modular Panel, 24-Port (760118323 / M2400-1U-GS)
  2. Approved Equal

**PART 3 - EXECUTION**

**3.1 GENERAL**

- A. Recognizing College and community events occur during the day or evenings throughout the campus, network outages shall be minimized. Installation shall be based upon the construction sequence and coordinated with the Owner.
- B. All cables must be routed and managed for a neat and aesthetically pleasing appearance. All work must be installed in a neat and workman like manner.
- C. Install patch cables in a professional manner. Utilize existing wire management where applicable. Where wire management is not available, provide wire management, route patches neatly in such a way to protect the patch cables from damage. Utilize Velcro tie wraps as needed. Plastic tie wraps are not acceptable and will be rejected.
- D. Communication bonding and grounding shall be in accordance with the NEC® and NFPA. Horizontal cables shall be grounded in compliance with ANSI/NFPA 70 and local requirements and practices. Horizontal equipment includes cross connect frames, patch panels and racks, active telecommunication equipment and test apparatus and equipment.
- E. This Contractor shall not place any distribution cabling alongside power lines, or share the same conduit, channel, or sleeve with electrical apparatus unless the conduit, channel or sleeve is divided and manufactured specifically for the purpose of cohabitation. Maintain separation as follows:
1. 5' for large motors and transformers
  2. 1' for conduit and cables used for electrical power distribution
  3. 6" for fluorescent lights
- F. This Contractor shall provide any necessary screws, anchors, clamps, distribution rings, miscellaneous grounding, and support hardware, etc., necessary to facilitate the installation of the system.

- G. It shall be the responsibility of this Contractor to furnish any special installation equipment or tools necessary to properly complete the system.
- H. Remove ceiling tiles as required to accommodate new work under this Contract. Notify Owner of any damaged tiles prior to removal. Tiles damaged during construction shall be replaced by this Contractor.
- I. Refer to Specification Section 27 0015 for additional technology general requirements.

### **3.2 PRE-INSTALLATION SITE SURVEY**

- A. Prior to start of systems installation, meet at the project site with the Owner's representative, camera installers, and Technology Designer/Engineer to coordinate efforts. Review areas of potential interference and resolve conflicts before proceeding with the work.
- B. Examine areas and conditions under which the system is to be installed. Do not proceed with the work until satisfactory conditions have been achieved.

### **3.3 INSTALLATION - DATA WIRING**

- A. Provide all new pathways for all new cabling installed under this contract. This Contractor is discouraged from using existing pathways, to minimize damages to existing cables and avoiding network outages. This Contractor will be responsible for any and all damages to the existing network cables where pathways are shared.
- B. Installation practices shall follow BICSI standards and guidelines. TIA/EIA-568-C standards will be strictly followed and practiced.
- C. All cabling in equipment cabinets/racks shall be managed utilizing wire organizers provided by the Contractor. All cabling and patch cables in closets shall be secured using Velcro straps.
- D. Category 6A cables shall be continuous from telecommunications room to work area outlet and free from splices, reverses, grounds, or other connections. Provide a 15' service loop at the workstation and follow existing service loop within telecommunications closet. Service loop shall be neatly coiled and secured above accessible ceiling, for each terminated cable, to accommodate future changes.
  - 1. Closed office areas shall have cables placed within the drop ceiling allowing re-routing to any wall in the room. Additional slack may be required.
- E. Terminate Category 6A cable according to T568B jack pin assignments.
  - 1. Remove only the amount of cable jacket necessary for termination. Maintain wire twist for all pairs of augmented Category 6 cable to within 0.5 inches maximum from termination point.
- F. Do not run cable longer than the maximum 90-meter EIA/TIA recommended length. Notify the Technology Designer for all cable lengths longer than 90-meters.
- G. All cables installed in ceiling spaces shall be plenum-rated.
- H. Horizontal data cable pairs shall run from each work area outlet to the telecommunications room and terminate on modular Category 6A patch panels, as appropriate.
- I. All cables shall be installed using "J" hooks, conduits, cable tray or an approved raceway system. Where cable tray is not available, horizontal cable will be supported every five (5') feet with "J" hooks sufficient in size to handle all bundled cables while minimizing crushing. If cable slack exceeds twelve (12") inches between supports, additional supports will be installed to take up slack and relieve cable stress.

- J. The use of "bridle rings" is strictly prohibited.
- K. Carefully lay all cable with appropriate radius of curvature and protect at bends and corners. Observe minimum bend radius and tension limitations as specified by EIA/TIA for augmented Category 6A cable.
- L. Loosely bundle cables with Velcro® straps, suitable for plenum environments, every twenty (20') feet.
- M. Patch panels shall be arranged to allow for natural wiring progression in functional fields, minimize crossing of wires and allow for the easy access to each component.
- N. This Contractor shall assure that at the completion of cable installation, cables are free from twists, kinks, sharp bends, cuts, gouges, or any other physical damage that might cause alterations to the electrical or optical characteristics of the cables.
- O. Installation of new communications cabling through existing cable bundles is strictly prohibited to minimize cable burning.
- P. In specific areas of the buildings: Gymnasiums, Natatoriums, Cafeterias, Auditoriums, Pools, and Exterior locations, this Contractor is responsible to supply and install all metallic Wiremold and conduit, or flexible weathertight conduit systems required for a complete installation of the cabling system. All raceways and conduits must be mechanically fastened, no plastic raceway will be accepted.
- Q. It is the responsibility of the installing contractor to provide any and all types of specialty equipment needed to provide a complete installation of the structured cabling system (IE: lift, scaffolding, extension ladders, boom trucks, temporary protection).

### **3.4 UNSHIELDED TWISTED PAIR CABLE (UTP)**

- A. Maximum pulling force shall be as recommended by the manufacturers and the maximum bending radius shall be (10) times the cable diameter.
- B. Terminate all data jacks per the manufacturer's recommendations and ensure the termination bar is positioned as close as possible to the cable jacket edge.
- C. Cable rollers shall be used when pulling cable. Cable pulleys must be used when pulling cable around bends and corners of wireways. Pulleys shall have a minimum diameter of six (6") inches.
- D. Contractor shall use basket grips wherever possible and exercise care while pulling cable as not to exceed the maximum allowable pulling tension of the cable.
- E. Cable rollers used for pulling cable in cable tray shall be mounted close to wire way supports and shall be placed at the beginning of the run and spaced every twenty-five (25') feet along the run.
- F. Provide 15-foot service loop at device location.
- G. Provide 15-foot service loop in each BDF and IDF.

### **3.5 LABELING AND MARKING**

- A. All cable designations and color-coding shall be in full compliance with EIA/TIA 606-A.
- B. Clearly label all horizontal copper cables at both ends with permanently applied mechanically printed labels. Handwritten labels will not be acceptable. Use standardized colors and alphanumeric codes. Technology Designer/Engineer/ Owner will approve labeling system and method.

- C. Label each wireless access cable or faceplate with a mechanically produced identification label utilizing the Owner's existing label scheme.
- D. Contractor shall install labels as follows:
  - 1. One label at each end of each cable, 6 inches from the end of the cable sheath, after stripping.
  - 2. One label on the outside of each face plate in the space provided.
  - 3. All markings shall be carefully done so as to present a neat, professional appearance.
- E. The College has a standard numbering system that was established over 20 years ago. The Contractor shall label all locations to meet this standard. Contact the College IT Representative prior to labeling to assure adherence to the OCC standard.
- F. Each label will reflect the building, workstation room number and technology closet drop number.
  - 1. Workstation Drop Label: C-130-117
    - C = Building Identification
    - 130 = Technology Closet
    - 117 = Drop Number
  - 2. Technology Closet Label: 117-C-120
    - 117 = Drop Number
    - C = Building Identification
    - 120 = Workstation Room Number

### **3.6 CABLE SEPARATION FROM POWER WIRING**

- A. Between the cabling system and any fluorescent, neon, incandescent, or high intensity discharge lamp fixtures, the minimum distance shall be 5 inches.
- B. Cable may be installed closer to lighting and convenience outlet power cable (single phase, 120V, 20A maximum), in metal cable channels (conduit) for limited distances if the following guidelines are observed:
  - 1. Coincident (parallel) runs of no more than 15 feet are permissible if a 1-inch separation between the power cable and the cabling system cable is maintained by separators or suitable retention hardware. If necessary, the separation may be less than 1 inch for a run of up to 6 inches if no contact between the cabling system cable and the power cable occur.
  - 2. Coincident runs of no more than 30 feet are permissible if a 2-inch separation is maintained. The separation may be less than 2-inches for a run of up to 12 inches, if no contact occurs between the cabling system cable and the power cable.

### **3.7 TESTING**

- A. The Cabling Contractor shall be responsible for testing each horizontal cable run, patch panel, and patch cables to verify the performance of the channel warranty for the horizontal cabling system as defined in TIA/EIA TSB-67 and ANSI/TIA/EIA-658-B2-AD10 transmission performance specification.
- B. The contractor shall configure the tester for the cable and connectors used in the installation.
- C. The contractor shall use the same tester(s) from the same manufacturer for the entire project(s).
- D. All test reports shall look the same and all test reports shall be done with the same manufacture tester to assure all test results have the same appearance.

- E. The contractor shall turn in all tests, partial or quick tests shall NOT be accepted, all test results shall be in a PDF and FLW format when submitted with the close out documents.
- F. System and Wiring Testing, Checking, and Reports
  - 1. Cabling Contractor shall provide necessary technical personnel and testing instruments as required to perform complete testing of all systems installed by Contractor and coordinate this testing activity with the Architect/Engineer and Owner's representative.
  - 2. All wiring, terminations, equipment, etc. shall be checked and tested by qualified field representative or equipment vendor. A report shall be submitted to Architect/Engineer and Commissioning Agent by vendor representative and/or Contractor indicating results of such final check-out and testing processes. Final payment will not be approved until such report is submitted and any "failure" results are corrected.
  - 3. Cabling Contractor shall conduct such other tests and make necessary adjustments of equipment and installation infrastructure required by Architect/Engineer and/or Commissioning Agent, as requested or necessary to verify performance requirements. Submit all data gathering information taken during such tests to Architect/Engineer and Commissioning Agent.
  - 4. Cabling Contractor must input the specified cable parameters, manufacturers' name, and number in the tester. (Test results will not be accepted with generic cable type.)
  - 5. Reporting to be done in compliance with standards and schedules published by authority and agencies defined in the Specifications.
- G. Cable test results shall be stored and presented to the architect/engineers in both hard copy and electronic format for approval, and cable tester records designations shall match the associated cable labels and associated patch panel label designations.
- H. Submit one complete cable test results in electronic format and 1 complete set of paper format in a 3-ring binder.
- I. Test results submitted on USB Drive's must NOT require special software to download, read or open.
- J. UTP cable certification must be performed with a Fluke DSX analyzer.
- K. The test instruments shall be within the calibration period recommended by manufacture. Certificate of calibration shall be available for review.
- L. Test instruments shall have the latest firm ware/software installed.
- M. Tests results shall be identified and saved by the corresponding, labeled, Cable ID in the closet. Test must include wire map, resistance, length, propagation delay, impedance, return loss, attenuation, and crosstalk.
- N. In addition to a binder set, all test results must be provided in a LinkWare .FLW file format.
- O. The project RCDD will certify with his signature, that all test results have been verified to be authentic before they will be accepted by Owner.

### **3.8 PROJECT RECORD DOCUMENTS**

- A. Fully detailed documentation and record drawings of installation layout and performance shall be submitted for review within thirty (30) days of completion of work and shall include as a minimum:
  - 1. Marked drawings showing distance and routing of all inside cable with gauge, type, and numbering scheme.
  - 2. Location of outlets with their college standard numbering system prepared on the most recent installation drawing.
  - 3. Drawings showing distribution frame layouts, cross connect locations, cable routing from rooms.
  - 4. Drawings showing layout of panels and equipment in cabinets.

5. Drawings shall accurately record actual locations of each item of fixed equipment and show interconnecting wiring. Drawings will indicate location of equipment and tagged circuits. A functional block diagram will also be required.
  6. On electronic drawings, provide data cabling on a separate layer from the architectural layer so the Owner can turn the data layer on and off.
  7. AutoCAD base drawings will be provided by the Technology Designer.
- B. Documentation Requirements:
1. Drawings, whenever submitted, shall be submitted with three (3) E-sized copies to the Owner.
  2. Cable and outlet identification, locations, performance, and test results will be entered into Excel or approved PC based spreadsheet. The Contractor spreadsheet template and format will be approved by the Owner.
  3. Final record drawings shall be submitted as three (3) E-sized sets of scaled 20# bond drawings and two (2) USB drives containing both PDF and AutoCAD LT 2004 formats. Drawings shall be professionally done with architectural floor plan on one layer and all technology equipment and cabling on a second layer. Hand drawings and notations will not be accepted.
- C. Cable Record Book:
1. The Contractor shall prepare and deliver complete and accurate cable records entered into Excel or approved PC based spreadsheet. Minimum information to be included for each cable in this Cable Record Book is:
    - a. Location (room number)
    - b. Jack Number
    - c. Serving Closet
    - d. Patch Panel Number
    - e. Patch Panel Port
    - f. Cable Type and Use (data, CCTV, Wi-Fi)
    - g. Final Test Results
    - h. Final As-Built Drawings
- D. Refer to Specification Section 27 0015 for additional general project record document requirements.
- E. All drawings and the information contained therein become the sole property of the Owner.

**END OF SECTION 27 1517**



## **SECTION 28 1300 – SECURITY ACCESS CONTROL**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and General Provisions of the Bidding Documents, including the Division 01 Specification Sections apply to work of this Section.
- B. Section 27 0015 "Technology General Requirements."

#### **1.2 SUMMARY OF WORK**

- A. This Specification, in conjunction with the Drawings, establishes the requirements necessary to achieve the intended performance and function of the Access Control Systems.
- B. This section includes the following:
  - 1. Security / Perimeter Access Control System
  - 2. Accessories

#### **1.3 SYSTEM DESCRIPTION - SECURED ENTRANCES**

- A. Oakland Community College (OCC) is constructing a Driving Pad, within their Southfield campus. As part of the construction project, OCC expanding their Access Control System to include the functionality of secured main and exterior doors and the scheduling of interior instructional space doors. This contract will consist of adding all of the necessary access control components necessary for a fully functioning system. The door operations are as follows:
  - 1. General:
    - a. Exterior Doors: Control access into building at locations as shown on Drawings.
    - b. Interior Building Areas: Control access into areas as shown on the Drawings.
    - c. Restrict Access of individual credential-holders by time of day, day of week/month/year and specific points of entry via user-configurable software.
    - d. Unlock doors to building and selected areas automatically, where shown on Drawings, for a scheduled period of time throughout the day allowing free access and egress without the use of a card and avoiding the generation of an alarm condition on the access control system. The system GUI computer operator shall be able to unlock doors from the computer system.
    - e. At locations with Automatic Door Operators, provide integration to the door operator upon presentation of a valid credential with ADA conditions:
      - 1) If the door is on an unlock schedule, presentation of the credential will activate the door operator cycle.
      - 2) If the door is on a lock schedule, presentation of the credential will unlock the door, and then activate the door operator cycle.
    - f. Monitor points in building and selected areas as shown on Drawings that may provide unauthorized access or egress and may be a point for forced entry. The system shall report changes in status for all monitored points indicating the specific location so the operator can respond appropriately.
    - g. Photo identification for all credential-holders to be stored in conjunction with database information.
    - h. Video Monitoring of doors and alarms when access is requested, or a door is opened. This is provided by connection between the Access Control System and the Video Surveillance System.

2. Access Control Panels (ACP's) and new enclosures shall be installed in the equipment rooms as indicated on the Contract Documents, communicating to the Central Access Control Server over a local LAN connection. The ACP's shall connect to all reader's interior and exterior doors and alarming devices. All card readers, door position switches, request-to-exit (RTE) devices and other access control devices shall connect to the ACP's. Connect ACP relay to each power supply provided by others to provide functionality as specified.

#### **1.4 GUARANTEE, SERVICE AND TRAINING**

- A. Refer to Section 27 0015 "Technology General Requirements".

#### **1.5 SPARE PARTS**

- A. One (1) single gang card reader
- B. One (1) door/reader controller board

### **PART 2 - PRODUCTS**

#### **2.1 GENERAL**

- A. The access control systems shall be provided and installed as specified. Equipment shall be provided with all ancillary components necessary for a complete installation and configured as a turn-key project.
- B. Refer to the Drawings for diagrammatic design intent, quantities, and installation location of each product.
- C. Approved Manufacturer(s):
  1. Genetec - Synergis™
  2. Lenel/S2 OnGuard®
  3. Verkada
  4. Approved Equal

#### **2.2 ACCESS CONTROL AND MANAGEMENT SYSTEM**

- A. System Requirements:
  1. All devices required to complete the installation may not be described but shall be provided as if specifically called for within the Specification. It is the responsibility of the Contractor to provide a complete working system.
  2. All system components shall be approved and certified for the function they will perform.
  3. The system shall be of an open architecture design and shall support industry standard databases such as Microsoft SQL Server, MSDE or SQL Server Express.
  4. A system server for enterprise-wide database services, system programming, system monitoring, administrative services, report and proximity card generation. The College will provide a VM instance for the Contractor's use.
  5. A workstation computer shall provide interfacing and control of the local, site specific, Access/Security System.
  6. The system shall be capable of utilizing a true client server network configured to support the system database service, all panel services and user interfaces optimizing the users' options for system programming, event monitoring and record keeping.
  7. The database service shall be ODBC compliant, allowing the system to access an existing compatible ODBC compliant database as the system data source. A single system database shall maintain both credential-holder's records as well as access system information and programming parameters.
  8. Wiring, power supplies and all ancillary equipment.
  9. Access control system shall be enterprise-class and capable of supporting the quantity of control points and user credentials as specified as well as growth/expansion of 1%.

B. Power Supply Systems

1. LifeSafety Power
2. Altronix
3. Approved Equal

C. Life Safety

1. This Contractor shall provide any wire/cabling necessary between the card access system and fire alarm system. Card access system shall be connected to the fire alarm system by the Fire Alarm Contractor.
2. All electric doors in the pathway of building egress shall release as required by life safety code.

D. Software Capacities:

1. System software and language development software shall be existing, industry accepted, and of a type widely used in commercial systems. Operating system shall be multi-user/ multi-tasking capable of operating in a non-proprietary CPU. The application software, substantially as offered, shall be written in a high level, industry standard programming language. The system shall be modular in nature, allowing the system capacities to be easily expanded without requiring major changes to the system operation and maintaining all defined system data as well as historical information.
2. All System functions shall be accessible via point and click mouse control. Systems requiring command string control or complex syntax are not acceptable. The system software shall include the following features and be configurable for a minimum:
  - a. Unlimited credential records (at the database).
  - b. Microsoft Active Directory (AD) Integration capable.
  - c. User-definable time schedules per loop/site.
  - d. Programmable holidays.
  - e. Access Groups.
  - f. Customizable Operator Privileges - limit site, commands, and viewing rights.
  - g. Primary and auxiliary door outputs for each defined reader.
  - h. Dedicated Door Contact and Request to Exit (REX) inputs for each defined reader.
  - i. Global Anti-Passback.
  - j. Door Groups.
  - k. Door Interlocking (Mantrap).
  - l. Remote Door Control.
  - m. Scheduled Unlock, with Valid Unlock on "day of" option.
  - n. Schedulable PIN Required option.
  - o. Automatic Active/Expire Dates for Credentials.
  - p. Maximum "number of uses" settings per credential.
  - q. Americans with Disabilities Act (ADA) compliance in door and access operation.
  - r. Input/Output linking with Boolean (AND/OR) logic.
  - s. Routable Alarm events.
  - t. User-selectable LED behavior.
  - u. Traced Cards.
  - v. Badge Print Tracking.
  - w. Setup Wizards.
  - x. Online Help.
  - y. Dynamic Device Status Screen.
  - z. Loop Diagnostic Software Tools.
  - aa. User Definable Fields - plain text and user-populated select lists.
  - bb. User-Select Mandatory Fields.
  - cc. Extensive Reporting.
  - dd. ODBC Data Import/Export.
  - ee. Event Log Output.
  - ff. Data Audit Trail.
  - gg. Video Verification.

E. Software Operation:

1. The system shall provide a top-down configuration methodology. Top-down programming shall allow the system operator to configure the system software and hardware configurations in a logical flowing method. The system shall allow the operator to start at the highest configuration level of the system and then move down through the lower configuration levels without having to move back and forth between a variety of menus.
2. The system shall utilize dynamic icons. The dynamic icons shall change appearance, in both color and icon display based upon the status of the associated object. This appearance change shall occur in real time and shall not require the system operator to perform a screen refresh or exit the current screen.
3. Dynamic icons shall be provided to represent:
  - a. Door lock control.
  - b. Alarm input.
  - c. Output control relay.
  - d. Manual operator actions.
4. For intelligent field panels hard wired to the host computer, the dynamic icons shall reflect the true state of the device represented by the icon. If an operator issues a command to unlock a door, and the field panel which controls that door is not in communication with the host computer, the icon shall not change state or appearance.
5. Where certain data fields within data screens may contain the same information, the system shall provide the ability to define default settings for these data entry fields including "drop-down" select lists. The operator shall be able to change the default setting without impacting objects that have already been defined.
6. Open Database Connectivity: The Security Management Control System shall utilize a database engine which is Open Database Connectivity (ODBC) compliant. This database engine shall be compatible with 32-bit ODBC drivers. The system shall allow the ability to perform ODBC writes to the system database to import personnel data directly into that database.
7. It shall be possible to use third party report tools, such as Crystal Reports, to generate reports not already provided by the Security Management Control Systems, such as statistical or graphical reports of system activity.
8. ODBC password protection: Database level Username and Password protection shall be provided for ODBC users. ODBC users will be required to supply a Username and Password when they connect to the SMCS database. Usernames and passwords shall be configured via the user configuration functionality currently available in the Administration utility.
9. Date format: The system shall support the date being formatted in DD/MM/YY or MM/DD/YY, depending upon local date formatting.

F. Hardware Definitions:

1. Menu Configuration: The System software shall allow for the configuration and programming of the access control modules through the use of simple menu commands. The menu commands may be executed by keystroke and mouse point/ click control.
2. Memory: The allocation of memory, between cardholder records and historical event buffering, within each access control modules shall be separated. Transactions shall not overwrite programmed data but rather maintain an allocated 10,000 event buffer.
3. Clusters/Sites: The system software shall allow the configuration for up to 255 Clusters each maintaining up to 254 intelligent field panels with ability to configure and maintain all Clusters simultaneously.
4. Database Updates: The system software shall download/upload information to/from the System Server automatically while the controller is in communication with the host CPU.
5. Hardware Components: The system shall maintain hot-swappable components for easy repair replace procedures. These components shall include Central Processor, Digital Input/Output board, and Dual-Port Interfaces.
6. Expansion: System expansion shall be modular.

G. Time Specifications:

1. Holidays: The system software shall allow unlimited holidays. Holidays shall have different user programmable parameters from the normal designations for that day. The system shall allow the holiday to be addressed within the system by the user defined name assigned to that holiday, i.e. New Year's Day, can be addressed as New Year's Day.

H. Alarm Events:

1. System Usage: Events shall be used throughout the system to allow the system to react to system activity. For instance, an event may be activated based upon an alarm point going into an alarm state. Events shall merge the links to actions, annunciation, communications port failure and timed activation capabilities into one component. An event shall perform multiple functions determined by the actions the user associates with it.
2. Event Priority: The system shall provide priority levels. The system shall allow the operator to choose an individual priority.
3. Configuration: The system shall allow an event to be configured to:
  - a. Require or not require operator acknowledgment.
  - b. Not be cleared unless a log message is entered by the system operator responding to the event.
  - c. Display or not display the event activation.
  - d. Require the point(s) causing the event activation to reset before the operator may acknowledge the event.
  - e. Display a user defined text message upon event activation.
  - f. Display a user defined text message when event is deactivated.
  - g. Be associated to a map so the map opens automatically on the Monitoring Station when that event activates.
  - h. Configure an event so that if it activates and is unacknowledged for a specified period of time, a second event is activated.
4. Action List: The system shall allow an event (input, valid access, etc.) or trigger to be configured to cause other system actions to occur. These system actions shall include:
  - a. Lock/Unlock door(s) and/or door group(s).
  - b. Momentary unlock of door(s) and/or door group(s).
  - c. Secure door(s) and/or door group(s).
  - d. Incremental counting results.
  - e. Decrementing counting results.
  - f. Limit counting results.
  - g. Alarm/disarm event(s) and/or I/O group(s).
  - h. Alarm/disarm alarm input(s) and/or input group(s).
  - i. Activate/deactivate output control relay(s) and/or output control relay group(s).
  - j. Momentary activate output control relay(s) and/or output control relay group(s).
  - k. Activate CCTV action on the College's VMS System.
  - l. Automatic display of an associated map on a Monitoring Station.
  - m. I/O Group set triggering.
  - n. Activate PC audible alert.
5. Crisis Mode: The system shall control on an action-by-action basis, dynamic access, input and output changes. Thus, when initiating a Crisis Mode on a site, inputs and outputs can react accordingly and access privileges (system-wide) will be modified to an alternate setting.
6. Time Control: It shall be possible to control via a user-defined time schedule the period during which an event shall be armed and therefore capable of being activated by other system actions.
7. Graphic Map Display: The system shall allow a graphic map display to be linked to an event. This graphic map shall be available to the system operator to display when responding to the event activation. Graphical maps shall be centralized in the network on a shared disk and be available for display on all operator workstations.

8. Automatic Graphic Map Display: The system shall allow for the automatic display of a graphic map-linked to an event. This graphic map shall be available to the system operator to display when responding to the event activation. At the Monitoring Station, when an event is configured to automatically display a map, a map will pop up each time the event is activated. The map will disappear when the event is acknowledged. Graphical maps shall be centralized in the network on a shared disk and be available for display on all operator workstations.

I. Door Definitions:

1. Door Names: Each door shall be addressed within the system by a unique hard-coded name relevant to the location within the controller position and a "user-friendly" definable name for easy recognition.
2. Reader Operation: The system shall allow a reader to be configured to operate using the following functions:
  - a. Readers shall read cards while the door is in the open position.
  - b. Door lock shall automatically lock upon the door being opened.
  - c. Door lock may be configured to lock upon the door being closed.
  - d. Separate timers for the operation of the door lock and the software shunting of the door position status alarm point. The shunting of the door contact following the presentation of a valid access card or activation of the request to exit device shall be accomplished by software control.
  - e. Door Alarms: The system shall allow each door to be configured to cause a variety of events to occur based upon activity at that door.
  - f. Ingress areas shall be disarmed based on Valid Access at the door by a software mechanism without the use of an auxiliary relay.
  - g. Reader shall allow for automatic schedule based on time schedules and a provision for refraining from unlock based on no Valid Card for that day (i.e. Snow Day rule).
  - h. Auxiliary relay may be associated to react based on triggerable door events.
  - i. Alarm associations may be made based on the following door actions.
    - 1) Door Forced Open
    - 2) Door Open too long
    - 3) Invalid Attempt
    - 4) Passback Violation
3. Output Activation: The system shall allow each reader to be configured to cause an output to activate based on activity at that door.
4. PIN Required During Time Specification: The system shall allow for a time specification to be configured and associated to a door that will require a valid PIN entry for access during the specified time spec after a card access (unless a manual action or event has disabled PIN).
5. Report View: The system shall allow reports to be generated directly from the reader properties' screen without having to search sub-set report menus. The system shall also allow for a right-click function to run reports from a Hardware Tree or event transaction of the door.

J. Input/Alarm Configuration:

1. Input/Alarm point name: Each alarm point shall be addressed within the system by a unique hard-coded name relevant to the location within the controller position and a "user-friendly" definable name for easy recognition.
2. Input/Alarm point configuration: The system shall accept as an alarm input: supervised alarm inputs, unsupervised alarm inputs and dedicated alarm points such as device tamper alarms and controller AC power failure.
3. Input/Alarm arming: The system shall have the ability of monitoring input points in eight (8) states for triggering conditions:
  - a. Active: Monitored activation of input.
  - b. Alarm: Monitored activation of input while in an armed state.
  - c. Armed: Device placed in armed state either by alarm input or arming schedule.

- d. Disarmed: Device placed in disarmed state either by event trigger or disarm schedule.
  - e. Nothing: No triggering conditions for set input.
  - f. On: Monitored input that has been activated but not armed.
  - g. Trouble: Monitored input maintaining supervision that cannot validate the correct resistance value (due to cut or short).
  - h. Trouble or Alarm: Monitored input is that maintains either a trouble or alarm condition.
4. Report View: The system shall allow reports to be generated directly from the input properties' screen without having to search sub-set report menus. The system shall also allow for a right-click function to run reports from a Hardware Tree or event transaction of the input.
- K. Output Control Relay:
- 1. Output Control Relay Name: Each output point shall be addressed within the system by a unique hard-coded name relevant to the location within the controller position and a "user-friendly" definable name for easy recognition.
  - 2. Activation Control: Output control relays shall be defined as maintained or momentary. Maintained output control relays shall be configured to be activated/deactivated based upon a user defined time schedule, linked to a system event or operator command. Momentary output control relays shall have a user-defined pulse time (defined in 1 second increments). It shall be possible to use the momentary output control relays for the momentary control of devices other than door locking hardware. Output control shall also have the inherent ability to utilize Boolean logic including ability to act upon logic, limiting, and counting triggers.
  - 3. Virtual Outputs: There shall be the ability to trigger software-based outputs that can later be associated as future triggering inputs for advanced logical schemas.
  - 4. Report View: The system shall allow reports to be generated directly from the output properties' screen without having to search sub-set report menus. The system shall also allow for a right-click function to run reports from a Hardware Tree or event transaction of the input.
- L. Operators/Users:
- 1. Password: The system software shall be capable of identifying an unlimited number of system operators. Passwords shall be hidden from the Software GUI
  - 2. Operator Name: Each operator authorized to operate any portion of the system shall be addressed within the system by a unique user defined name. The operator name will be used throughout the system to identify commands and functions that the operator has executed as part of an audit trail.
  - 3. Operator Activity: All commands issued by a system operator while monitoring system activity including locking/unlocking doors, event acknowledgment, etc. shall be stored in the historical archive for later recall. The report command shall include the operator's name, time and date the command was issued and the command issued by the operator.
  - 4. Report View: The system shall allow reports to be generated directly from the operator properties' screen without having to search sub-set report menus.
- M. Operator Privileges:
- 1. Privilege Control: Each operator shall be assigned an operator privilege matrix. Operator privilege matrices define the individual commands within the system which the operator is authorized to execute.
  - 2. Administrative/Master Privilege Construction: When selecting the Master Operator privilege option within the system, the operator shall be given access to assign/modify the Operator privileges along with select Workstation options.
  - 3. Online-Actions Privilege Control Construction: Each operator may be configured to have access to perform online (software generated) actions with Doors/Readers, Inputs, Outputs, I/O Groups, Elevators, and Card Commands to include:
    - a. Unlock: Unlocks the door/reader until a subsequent command, trigger, or schedule relocks the device.

- b. Lock: Locks the door/reader until a subsequent command, trigger, valid access, or schedule unlocks the device.
- c. Pulse: Performs a momentary (pre-configured duration) unlock of the door/reader.
- d. Enable (Reader): Enables the reader after a disable command.
- e. Disable (Reader): Disables the reader (typically for service operation).
- f. Relay 2 On (Reader): Fires (Turns On) the auxiliary relay of the door/reader port.
- g. Relay 2 Off (Reader): Releases (Turns Off) the auxiliary relay of the door/reader port.
- h. Shunt (Input): Masks reporting of the input device until a subsequent command, trigger or schedule unshunts the device.
- i. Unshunt (Input): Enables reporting of the input device until a subsequent command, trigger or schedule shunts the device.
- j. Service Mode (Input): Disables Input actions for service operations.
- k. Restore (Input): Enables input actions after Service Mode is selected.
- l. Arm (Input): Manually places input into an armed state until a subsequent command, trigger, valid access or schedule disarms the device.
- m. Disarm (Input): Manually places input into a disarmed state until a subsequent command, trigger, or schedule arms the device.

N. Credential Record Definitions:

- 1. User Defined Labels: The system shall allow a privileged system operator to specify field name, field type, field restrictions and whether or not a field is mandatory and/or selectable. The system shall provide the operator with the ability to view the credential record layout, including the new labels, before the changes are put into use.
- 2. Personnel Records: Personnel records shall be constructed to contain personnel data and user-defined fields. The personnel data shall consist of a minimum of the following:
  - a. Credential-holder name.
  - b. Encoded card number.
  - c. Employee ID number (system defined, Primary Key).
  - d. Last Access.
  - e. Card Technology.
  - f. Personal Identification Number (PIN) code.
  - g. Facility number.
  - h. Activation date and time.
  - i. Expiration date and time.
  - j. 21 user defined fields.
  - k. Department.
  - l. Card Role (Access Card, Alarm Card).
  - m. PIN Exempt.
  - n. Passback Exempt.
  - o. Number of Uses.
  - p. Stored image of the person.
  - q. Stored signature of the person.
  - r. Store biometric fingerprint identification of the person.
  - s. Identification badge layout assigned to the person.
  - t. Date last identification badge was printed.
- 3. Mandatory Data Fields: The system software shall provide a means whereby the master operator may define certain user-defined fields in the personnel record as being mandatory. Personnel performing data entry on the card holder record shall be required by the system to enter information in all field marked by the system administrator as mandatory.
- 4. Select List Fields: The system software shall provide a means whereby the system administrator may define certain user-defined fields in the personnel record as choice list fields. The system administrator shall be able to define the choice list and the values to be included in the choice list. The operator, when performing data entry, shall be able to choose one of the values defined in the choice list.
- 5. Card Record Import/export: The system software shall provide means for bulk loading and bulk editing of card records through the use of a data file generated from another source. The external file



shall be an ODBC file source. The system shall also provide the ability to generate the same format file of existing card records, allowing the information in the system to be exported to other computers and applications. The system shall allow the user to select the card records that shall be included in the export file.

6. Query Capabilities: The system shall provide a card holder selection list, allowing the system operator to choose individual cardholder records from the selection list. The selection list shall provide a quick sorting display of all cardholder records and advanced SQL query tools including an SQL query builder.
7. Report View: The system shall allow reports to be generated directly from the cardholder properties' screen without having to search sub-set report menus. The system shall also allow for a right-click function to run reports from the event transaction of a cardholder.

O. Automated Personnel Data Import:

1. Overview: The system shall provide a means to import personnel information from an external ODBC database other than import from a flat file. Additionally, the import shall execute in the background periodically to avoid the need to run the Administration application each time personnel data is to be imported. The import procedure shall also perform the necessary validity checking to prevent corruption of the system personnel table.
2. Automated Import Name: Each Automated import shall be user defined name. The profile shall be saved with an import schema on the hard drive of the system workstation.
3. Import Options: The system shall allow the user to specify how the records are retrieved from the external database during the automated process and the amount of detail the import activity log will display after an automated import is run.
4. Data Source(s): The system shall allow the user to select from a list of external databases. It shall allow the user to enter a user ID and password if one is required by the external database.

P. Reports:

1. Data Storage: All programmed and transactional history is automatically stored to the database for later recall. Information written to the database shall be immediately available for report generation.
2. System Function: The system software shall be able to generate reports without affecting the real-time operation of the system.
3. Media: Reports shall be generated from the database and generated to the operator's screen, hard disk, external media or printer(s).
4. Search Criteria: The database shall be structured such that the operator shall determine the search parameters based on variables available on the individual report matrix. Systems requiring the user to type complicated search strings are not acceptable.
5. Report Types: Programmed data reports shall be available for Database Configuration and Historical Activity.
6. Database Configuration Reports: The system shall be capable of producing reports of database configuration information. These database configuration reports shall include hardware and software configuration, group, time zone, activity and audit log reports.
7. Report Selection: Depending upon the type of report being generated by the system operator, the system shall provide a listing of previously defined reports. The operator shall be able to pick an existing report, modify an existing report or generate a new report.
8. System Defined Reports: The system shall contain pre-defined reports that shall report the database configuration for area, holiday, time specifications, time zones, elevator, event, all groups, control outputs and authorized card holders.

- Q. User Status "Who's-In" Report: The "Who's-In" report shall provide a listing of all personnel that the system has determined to be in a user-specified area. The "Who's-In" report can be used in emergency evacuation situations, to determine if personnel are in the building, and where they are in the building. The "Who's-In" report can be initiated by an event or run as a report by a system operator that can be automatically refreshed on the screen to keep current as personnel exit the area.

- R. Audit Trail: The system shall provide an audit trail function that is intended to record all permanent changes in data configured by system operators. The audit trail shall record permanent changes made to the configuration data base by manual operator data entry.
- S. Help Screens: Online help: The system software shall have online help available at any point requiring operator input. The help screen shall be accessible from a pull-down menu. This help screen shall contain information that shall allow the operator to enter correct data without consulting a manual.
- T. Activity Monitoring:
1. General Display Features: The activity monitoring screen shall include the event, date/ time display, user, active events, events require acknowledgement and loop/site information.
  2. Event Audible Annunciation: Event audible annunciation refers to the beeping behavior of the operator workstation when there is at least one active and unacknowledged event. The operator workstation shall beep continuously as long as there is at least one active and unacknowledged event. The beeping shall continue until the operator acknowledges all such events or uses the "Silence" button to silence all audible for all such events.
  3. Pop-Up Events:
    - a. When an event needing acknowledgment becomes active, the alarm monitoring screen shall be displayed on all operator workstations currently logged in designated to receive such a priority alarm.
    - b. If the program has been shrunk to an icon, the alarm monitoring program shall pop open and be displayed on the operator workstation as the top-most window.
    - c. If the event monitoring program is behind other tabs, the alarm monitoring program shall be pop forward and displayed on the operator workstation as the top-most tab.
  4. Scrolling Display: The system shall contain a scrolling display of system activity. The system shall provide a scroll bar to allow the system operator to move up/down among the event messages on the screen. The system operator shall be able to scroll back through the previous 1000 transactions of system activity.
  5. Display Types: The system shall provide an activity-monitoring screen which shall operate in multiple modes. The first mode shall allow the system operator to view all system activity, including scheduled actions, card accesses events, etc. These events shall be displayed in chronological order. The second mode shall display only those system events, which require operator action. The system shall allow the operator to view events in order based upon alarm priority or time of activation. A third mode shall allow for a split screen (on one or multiple monitors) providing the ability to display both General Events and the Alarm Events.
  6. Event Instructions: The operator shall also have the ability to view additional details of the event through the use of a single keystroke. By clicking on the event item with the mouse, the operator shall be presented with alarm response instructions that have been programmed into the system.
  7. Message Color: The system shall allow the operator to select the color that shall be used in displaying event messages on the operator workstation. The operator shall be able to choose from any of fourteen (14) colors. The event message color shall be based upon event message type and event priority.
- U. Graphics:
1. Graphics File Format: The system shall allow graphics and floor plans floor plans to be linked to points and events within the system. These graphics and floor plans shall be configured in a .BMP or .DXF format to allow for the importation of existing Drawings.
  2. Programming: The system software shall, through the use of a mouse, allow for placement of device icons on each graphic/ floor plan. The device icons which may be placed on the graphic/ floor plan shall include alarm inputs, output control points, doors and any other graphics.
  3. Operation: Upon activation of a selected event, the operator shall, by the use of a single keystroke, view the associated graphic/floor plan on the monitor. The operator shall use the mouse to click on any of the icons on the graphic and issue a command associated with the icon.

4. Storage: The graphics feature shall take advantage of the Client/Server system configuration, with all graphics being created/stored on a shared disk in the network. These graphics shall be available to all authorized Operator workstations.

## **2.3 CONTROLLERS**

- A. Controllers connected to the Security Management Control System shall utilize Flash ROM for storage of the operating program used to run the controller. It shall be possible to download the controller's operating program directly from the Security Management Control System. The system shall not require a technician to physically change the ROMs on the controller in order to change the controller's operating system.
  1. Operating Program Distribution: The manufacturer of the Security Management Control System shall offer a variety of methods for distributing the flash program for the controllers. This distribution method shall include but not limited to, external storage (CD-ROM, thumb drive, external drive, etc.) and the manufacturer's web site. The controller's flash program shall be downloaded to the controllers over the communication lines connecting the host system to the controllers.
  2. System Operation:
    - a. The Security Management Control System shall provide the system administrator with a status display indicating the revision level of flash program currently running in each controller.
    - b. The system shall provide controls allowing a privileged system operator to issue a command to download the flash program to the controllers. The operator shall be able to select which controllers shall receive the flash download and the revision level of the flash program the controllers shall receive.
    - c. If a controller is not communicating with the host or is a dial-up panel to which communications cannot be established, the download of the operating program shall be delayed until communications is restored, or the download request is canceled by a system operator.
    - d. The flash program may be downloaded to a controller but not burned into memory allowing for an opportune time to reset a controller without causing system inconvenience.
  3. Controller Operation:
    - a. While the operating program is being downloaded from the host computer, the controller shall continue to operate as normal. The flash program being downloaded shall be stored by the controller in temporary memory until the entire operating program is received. When the entire operating program is received by the controller, the controller shall provide the operator the option of when to restart. The controller shall delete the previous version of the operating program and begin running the new operating program.
    - b. If the controller has insufficient space to receive the new operating program, or the complete new operating program is not received, the controller shall report this to the host computer as an invalid flash load.

## **2.4 ACCESS CONTROL PANEL**

- A. The access control panel shall be an intelligent, modular controller designed to integrate various event management applications on one controller.
  1. Primary Controller: The Primary Controller is the controller responsible for up/downstream communications with the PC/Network. The Primary Controller consists of three major subsystems, software services, hardware and expansion interfaces.
    - a. Software Services: The software services are a set of common functions and applications that shall be installed on every Controller to perform system configuration, generic system event handling and communications between the controller and a host or other controllers.
    - b. Hardware:

- 1) Ethernet Port: The Controller shall support Ethernet Communication. The interface to the Ethernet services shall be through a standard RJ-45 jack connector native to the controller. Provide as many as required for full system integration.
- 2) Inputs/outputs: The controller shall have three (3) on-board inputs. The inputs are reserved for tamper, power fail, and low battery.
- 3) Serviceable Hot-Swap Modules: The Controller shall allow for "Hot-Swap" serviceability. This allows for communications and door modules to be interchanged without a controller power-down.
- 4) Power Requirements: Each Control Module shall accept a regulated input voltage and generate appropriate voltage levels for on-board use as required. The input supply voltage shall be available to be bussed directly to the reader bus connectors to supply operating voltages for field readers. All power supplies shall be equipped with battery backup to operate door controller for 30 minutes minimum.
- 5) Indicators: There shall be LEDs indicating the status of the received and transmitted data for the onboard communications ports, with active data turning on the LED. These LEDs shall be hardware controlled.
- 6) Ports: There shall be multiple ports provided on-board for external read heads, input/output boards. The number of actual ports varies according to the controller configuration.

c. Reader Expansion Interfaces:

- 1) Inputs: 8 Supervised Class A inputs shall be provided on each Digital I/O board. These inputs shall report secure for user selectable ohms and alarm for open or short. Resistors marked for easy identification shall be located near each input connector to be clipped out by the end user when installing inputs.
- 2) Outputs: 6 Class C relay outputs shall be provided on each Digital I/O board. These outputs shall have contacts for Normally Open or Normally Closed states.
  - a) Inputs: 2 reader ports, plus 8 supervised Class A inputs shall be provided on each Digital I/O board. These inputs shall report secure for user selectable ohms and alarm for open or short. EOL resistance values shall be configurable.
- 3) Provide sufficient interface boards/inputs to accommodate existing card readers to be replaced, new card reader locations and a minimum of two (2) additional readers per each ACP being provided for future growth.

## 2.5 ACCESS CONTROL PANEL SOFTWARE

A. Access Control Panel (ACP) Software Features and Settings:

1. The ACP shall provide for configuration, status and event reporting using the embedded system services.
2. An access control system selectively allows certain people to enter an area. The ACP shall allow access to identified individuals, shall control entry by time, and shall record entries. The ACP shall also allow a host to control access or allow an access cycle to be controlled by a request-to-exit input.
3. Access Control Services:
  - a. Door Access Control: The Host shall allow the ACP to handle door configuration and control.
  - b. Door Configuration: The door configuration defines the behavior of a door and includes the following parameters:
    - 1) Inbound and Outbound Access Reader(s) - which readers are monitored at this door.
    - 2) Door Switch Monitor (DSM) - usually a simple switch that changes state when the door is opened or closed. The switch, if enabled, connects to a monitored input. If the DSM input becomes active while not shunted, it will generate a Door Forced Open alarm.
    - 3) Door Shunt Time - how long the DSM should be shunted after the door is opened for access. The configuration may also indicate whether the DSM shall remain shunted

- for the full shunt time, instead of clearing when the door closes. If the DSM remains active after the shunt time expires, it shall generate a Door Held Open event.
- 4) Request to Exit (RTE) Input - an input whose activation triggers an access cycle that allows egress through a door. The RTE Input shall be placed on the protected side of the door. The configuration may indicate whether the DSM shall be shunted as long as the RTE is active, and whether the DLR shall be enabled for an RTE access.
  - 5) Door Latch Relay (DLR) - the output which controls the strike for the Door Unlock Time - the length of time, in seconds, that the DLR is energized during a valid access cycle. The DLR is normally energized for a valid access, and de-energized as soon as the door opens, but a Re-lock Delay may cause the DLR to be energized for a number of seconds after the door opens. Access grant decisions based on presented cards, RTE access based on RTE input activation, and host requests for momentary unlock of the door all cause the door to perform a valid access cycle.
  - 6) ADA Output - an output may be configured to activate at 1 second after the door is unlocked for valid access, for a duration of 1 second when the door is being accessed by cardholders with an ADA flag in their personnel record.
  - 7) Expanded Shunt Time - For certain cardholders, a longer shunt time may also be configured.
  - 8) Door Control: The ACP shall allow door control from a host. The door mode may be set to lock, unlocked, momentarily unlocked, or access disabled modes. A momentary unlock request will start a valid access cycle process on the door.
  - 9) Door Status Reporting: The ACP shall report door alarm status changes including door held open and door forced open.
  - 10) Door Event Configuration: The ACP shall allow the configuration of Events that are activated by certain door events. The supported events shall include:
    - a) Door held open causes Event.
    - b) Door forced causes Event.
    - c) All valid access causes Event.
    - d) All invalid access causes Event.
4. Door Groups: The ACP shall allow the configuration of door groups by a host. Door groups may then be used in emergencies, or to group doors for common control.
5. Reader Configuration: The ACP shall allow reader configuration from a host. The reader configuration defines the behavior specific to a reader on a door and includes the following parameters:
- a. Default PIN Mode - If a card reader includes a keypad, it may be configured to require the cardholder to enter a Personal Identification Number (PIN), in addition to presenting a card, to gain access at a door. A Time Specification may be entered to control this mode on a time basis.
  - b. Card formats - the card formats supported at this reader.
  - c. Card Entry Through Keypad - If card readers include keypads, they may be configured to allow the cardholder to enter their card number through the keypad instead of by presenting a card.
  - d. Exit Area - The area from which this reader exits. This parameter is not applicable for readers that are on an elevator.
  - e. Entry Area - The area to which this reader enters. This parameter is not applicable for readers that are on an elevator.
6. Input Services: The ACP shall allow the configuration and control of inputs connected to AMMs and inputs connected to the ACP and any logical input that may be maintained by the ACP.
- a. Input Control: The ACP shall allow the control of inputs including arming/disarming the input.
  - b. Input Status Reporting: The ACP shall allow the retrieving of the current status of inputs and shall log changes in input status.
  - c. Input Event Configuration: The ACP shall allow the configuration of input Events. These Events will include:

- 1) Activation during a specified time specification causes Event.
  - 2) Activation outside a specified time specification causes Event.
  - 3) Supervision error causes Event.
  - 4) Tamper on AMM input board or ORM board causes Event.
7. Input Groups: The ACP shall allow the configuration of input groups. Input groups may be referenced by Events.
8. Output Services: The ACP shall allow the configuration and control of outputs connected to the ACP.
- a. Output Definition: The ACP shall allow the configuration of outputs. Output configuration controls the behavior of the Output and includes Enabled/Disabled and reversed outputs.
  - b. Output Control: The ACP shall allow the control of outputs, including setting the current state to activated, deactivated, or momentarily activated.
  - c. Output Groups: The ACP shall allow the configuration of output groups.

## **2.6 SYSTEM ENCLOSURE**

- A. Sheet metal, of the appropriate gauge for the cabinet size per UL 294, shall be utilized. The ACPs shall be housed in a locking 18-gauge metal cabinet, suitable for wall mounting. All cabinet locks shall be keyed alike. The cabinet shall be suitably sized to allow installation of the controller and all expansion modules and associated field wiring. The cabinet door shall include illuminated diagnostic indicators, which shall indicate the status of the panel. A single tamper switch shall be incorporated into the door. There shall be at least 4 mounting holes and 10 knockouts on the cabinet. Cabinet shall be equipped with battery backup to provide power to the ACP's in the event of a power outage. Label batteries with installation date.
- B. The Diagnostic Web Server: The Diagnostic Web Server shall generate real-time operational and diagnostic information on a networked ACP to be viewed by a user from a standard web browser. This web server, residing on each ACP, shall answer requests from a standard web browser and shall generate and serve up HTML pages that indicate controller status and diagnostic information.

## **2.7 READERS**

- A. Multitech Smart card readers shall be manufactured by HID Corporation, Schlage, or Approved Equal.
- B. Provide the type (mullion, single gang, etc.) and quantity of Multitech Smart card readers as shown on the Drawings.
- C. Multitech Smart card readers shall provide the following functions:
1. "Typical" Reader: These readers shall provide swipe access to secured spaces based upon the users' credentials.
  2. "Key/Pin Pad" Reader: These readers shall provide swipe access along with the capability to enter a code on the keypad for access to secure spaces. These are located at childcare entrances and other spaces as shown on the Drawings.
- D. For exterior readers, seal with appropriate sealant and in the method as recommended by the manufacturer to prevent water ingress.

## **2.8 EMERGENCY LOCKDOWN BUTTON**

- A. Provide and install a maintained push button lock down station (depress to secure doors, pull to reset system) as shown on the Drawings. This lockdown station will control all doors within each individual building card access system and send all required notifications to the College's central security office.
1. Manufacturer:
    - a. STI Products: station stopper

- b. Faceplate Color: stainless steel, with clear protective cover
- c. Switch configuration: Push to activate, pull to reset
- d. Text: Emergency Lock Down Button
- e. Button Color: Red
- f. Language: English
- g. Coordinate with the Owner for final plate, button, text, and text colors.

## **2.9 DOOR LOCKING DEVICES**

- A. All door locking hardware and select power supplies are "Provided by Others" or are existing.

## **2.10 BADGING SYSTEM**

- A. Provide hardware, software, licensing, installation and configuration for one (1) complete badging system. Badging system shall consist of a dedicated camera, tripod, backdrop, 2-sided color badge printer, desktop style (not handheld) credential card slot punch and any required accessories such as cartridges and cleaning supplies. Provide a dedicated laptop computer for the badging station. Provide all ancillary hardware, software, licensing and components required for a complete operational solution.
- B. Provide 250 facility coded, printable (2 sided) HID or equivalent Smart credential cards compatible with the Multi-Technology card readers included in this Specification.
- C. Provide quantity of consumable supplies (ribbons, cartridges, etc.) to print the quantity of cards being provided.
- D. Work with College personnel to develop the standard layout and information required for the College's standard card.
- E. The College will provide names, photos (if applicable), access security groups and other information required to create and print the user's cards. The successful Contractor shall utilize this information to configure/program the card access system and this Contractor shall print the cards and provide the cards to the College for distribution to personnel.

## **PART 3 - EXECUTION**

### **3.1 INSPECTION AND PREPARATION WORK**

- A. This Contractor shall examine the conditions under which the system installation is to be performed and notify the Owner's Representative or Design Professional in writing of unsatisfactory conditions. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to provide a workmanlike installation.
- B. Review areas of potential interference and resolve conflicts before proceeding with the work. Coordinate ceiling layout and wall layout and other work that penetrates or is supported throughout the space of the building. All work shall be flush and workmanlike in all finished areas.
- C. In spaces undergoing construction, the successful Bidder shall work with the Construction Manager and other trades to sequence their installation with the general building construction schedule.

### **3.2 INSTALLATION**

- A. Wiring:
  - 1. Install all wiring connecting all system components and controlled and monitored devices.
  - 2. All wiring shall be plenum rated.
  - 3. Conductors: Size as recommended in writing by system manufacturer unless otherwise indicated. Provide shielded cabling if required by the manufacturer.

4. Install all ancillary equipment and accessories.
  5. Install all cable and perform all cable splicing and equipment terminations. All splices shall be installed in device boxes.
  6. Pull continuously between connections where possible.
- B. Install materials and equipment in accordance with manufacturer's printed instructions to comply with governing regulations and industry standards applicable to the work and as shown on approved shop Drawings.
- C. Arrange and mount all equipment and materials in a manner acceptable to the Design Professional and Owner.
- D. Installation shall conform to the basic guidelines.
1. Use of approved wire, cable, raceways, wiring, devices, hangers, supports and fastening devices.
  2. Separation of high and low voltage wiring is required throughout the installation.
  3. All wiring shall be thoroughly tested for grounds and opens.
- E. All 120VAC power wiring provided by others.
- F. Cabling and Wire Requirements:
1. Low voltage signal and/or control wiring shall run in separate conduit/raceway from electric power cables. Cables for door locks are power cables. Provide separation from lighting fixtures and other electrical appurtenances. Provide electrical interference protection circuits as required to maintain the signal quality specified herein and required by system manufacturers.
  2. The individual systems low voltage cabling shall use separate junction boxes and enclosures.
  3. The minimum low voltage cabling for security, communications and safety systems shall be as required by the manufacturers for the full function intended. The systems cabling shall meet the requirements of NFPA 70/NEC Articles 725, 760 and 800 as applicable for each type of system specified.
    - a. All dimensions and conditions shall be verified in the field. The Contractor shall notify the Designer of any discrepancies before proceeding with the work.
    - b. Card reader cables shall be NFPA 70, Article 725 compliant.
    - c. Card Readers to Control Panel: maximum length shall not exceed 500 feet.
    - d. Extended Reader Line Drivers: may be used between the Central Unit and the Remote Unit for a maximum length not to exceed 10,000 feet (3050 m). Cabling between the Central unit and the control panel shall be as specified for a reader, request to exit and a relay. Cabling between the Remote Unit shall be as specified for a reader, request to exit and a door strike.
    - e. Alarm Point and Request to Exit Point to Control Panel: maximum length shall not exceed 500 feet (150 m).
    - f. Relay to Device: maximum distance shall not exceed 1,000 feet (300 m).
  4. The minimum bend radius of all security, communication conduits provided under this project shall be 6 inches (150 mm). Provide and maintain pull strings/tapes/ropes in all conduits for future installation of additional fiber optic cabling.
- G. Fire Stopping:
1. Provide code required fire stopping at all fire rated wall, floor and partition penetrations with UL listed fire stopping materials.
- H. Junction Boxes, Enclosures/Cabinets, Equipment Racks:



1. The junction and pull boxes shall be securely attached to the structural members of the building at locations accessible for servicing. Provide access doors at locations accessible for servicing. Provide access doors at locations where access is not readily available.
2. The equipment enclosures shall be installed at approved locations and be typically ventilated as required to maintain the environmental conditions specified by the electronic equipment manufacturers.
3. All junction boxes and pull boxes shall be labeled. The box label shall state the system and use of cabling. The labeling shall be made with markers which are indelible when and after in contact with water and oil. Labeling of junction boxes visible to inmates shall be approved by Architect/Engineer and Owner.
4. Each box and enclosure shall contain a cabling and wiring log identifying all cabling accessible whether is connected or is passing by.

I. Grounding and Surge Protection:

1. Provide single point grounding of the individual systems as recommended by IEEE and system manufacturers. Provide all cabling, bonding and insulation materials as required. Provide surge protection and clamping for all circuits. Coordinate all grounding, surge protection and clamping circuit requirements with the system manufacturers.
2. Coordinate grounding requirements with other trades and Contractors to preclude closing of ground loops via peripheral equipment supplied from different electrical power sources. Provide isolation transformers and other equipment as required.

### **3.3 PROGRAMMING**

A. Complete system programming shall be provided by the installer and system manufacturer.

1. Programming shall be accomplished by direct interface and review with the Owner.
2. Programming shall continue until all interfaces, reports and system operation meet the Owner's requirements.
3. Building CADD drawing (provided by Designer) shall be used as the graphical maps for the backgrounds of device location.
4. Prior to initiating system programming, discuss with the College best practices and options for organizing their credential database.
5. Export existing database from the legacy card access system.
6. Work with the College to cleanup, purge, update and organize legacy users, credentials, schedules and door groups and other data. Upon review of the legacy database, it may become necessary to create a new database rather than export/import the data from the legacy database.
7. The College will provide data for users, credentials, access rights, door groups, schedules, etc. This Contractor shall assist the College in gathering and organizing this data in the proper format for importing or manual entry into the new card access system.
8. This Contractor shall utilize this data and perform all data entry and organization, configuration and testing to configure the new database and new card access system.

### **3.4 FIELD QUALITY CONTROL**

- A. A project manager shall be appointed during the course of the installation. This shall assure complete coordination and technical information when requested by other trades. This person shall be responsible for all quality control during installation, equipment set-up and testing. This individual shall have training to provide firsthand knowledge of the installation.
- B. Prior to starting any work, verify proper operation of systems.

### **3.5 ADJUSTING, TESTING AND CLEANING**

- A. Contractor shall be required to perform complete testing and verification of the following:

1. Card Reader maximum access time shall be 0.75 seconds under all system loads, i.e. regardless of number of cards presented simultaneously.
2. Proper operation of electric door strikes, egress switching (where required), door position monitor switches and exit hardware. Notify Designer and onsite Construction Manager Superintendent of any deficiencies.
3. Proper operation of electro-magnetic locks and strikes, including full interface, control and override by the Card Access System. Notify Designer and onsite Construction Manager Superintendent of any deficiencies.
4. Proper operation of magnetic door switches. Notify Designer and onsite Construction Manager Superintendent of any deficiencies.

### **3.6 MANUFACTURER'S FIELD SERVICES**

- A. Provide manufacturer's field services for the start-up, commissioning and training of this system.
  1. Include services of technician to supervise programming, adjustments, final connections, system testing and training Owner's personnel. Include sixteen (16) hours of training.

### **3.7 DEMONSTRATION**

- A. Provide system demonstration.
  1. Demonstrate normal and abnormal modes of operation and required response to each.
  2. Provide system training.

### **3.8 PROTECTION**

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

**END OF SECTION 28 1300**

**SECTION 31 0000 – Earthwork**

**1.1 GENERAL**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Work shall comply with the 2020 MDOT Standard Specifications for Construction, Section 200, except as otherwise indicated in the Special Provisions specified in this section.

**END OF SECTION 31 0000**

## **SECTION 32 0519 – GEOGRIDS**

### **1.1 GENERAL**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Work shall comply with the 2020 MDOT Standard Specifications for Construction, Section 400, except as otherwise indicated in the Special Provisions specified in this section.
- C. Description: This item of work shall include all labor, materials, and equipment necessary to furnish and install Tensar™ InterAx® NX750 Geogrid, or equal as approved by the Engineer, per the manufacturer's recommendations, additionally.
- D. Material: Tensar™ InterAx® NX750 Geogrid, or equal as approved by the Engineer
- E. Construction: Contract shall install the Geogrid per manufacturer's recommendations and overlap edges a minimum of 12 inches.

**END OF SECTION 32 0519**

## **SECTION 32 1100 – BASE COURSES**

### **1.1 GENERAL**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Work shall comply with the 2020 MDOT Standard Specifications for Construction, Section 300, except as otherwise indicated in the Special Provisions specified in this section.

**END OF SECTION 32 1100**

## **SECTION 32 1200 – FLEXIBLE PAVING**

### **1.1 GENERAL**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Work shall comply with the 2020 MDOT Standard Specifications for Construction, Section 500, except as otherwise indicated in the Special Provisions specified in this section.

**END OF SECTION 32 1200**

## **SECTION 32 1300 – RIGID PAVING**

### **1.1 GENERAL**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Work shall comply with the 2020 MDOT Standard Specifications for Construction, Section 600, except as otherwise indicated in the Special Provisions specified in this section.

**END OF SECTION 32 1300**

**SECTION 32 1600 – CURBS, GUTTERS, SIDEWALKS, AND DRIVEWAYS**

**1.1 GENERAL**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Work shall comply with the 2020 MDOT Standard Specifications for Construction, Section 801, 802 and 803, except as otherwise indicated in the Special Provisions specified in this section.

**END OF SECTION 32 1600**



**SECTION 32 1723 – PAVEMENT MARKINGS**

**1.1 GENERAL**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Work shall comply with the 2020 MDOT Standard Specifications for Construction, Section 811, except as otherwise indicated in the Special Provisions specified in this section.

**END OF SECTION 32 1723**

## **SECTION 32 3100 – FENCES AND GATES**

### **1.1 GENERAL**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Work shall comply with the 2020 MDOT Standard Specifications for Construction, Section 801, 802 and 803, except as otherwise indicated in the Special Provisions specified in this section.
- C. Ornamental Fence:
  - 1. Location: Along Nine Mile Road Frontage and Sections of Rutland Road frontage as depicted on the plans.
  - 2. Manufactured By: Ultra Fencing-Railing, [www.ultrafence.com](http://www.ultrafence.com) , 800-656-4420
    - a. Model: 6' ht, UAF-200 flat top, industrial grade
    - b. Color: Black textured
    - c. Gates: N/A
  - 3. Competitive Bidding: Contractor may provide alternate (or-equal) fencing.
- D. Chain Link Fence:
  - 1. Location: Perimeter of project, except where Ornamental Fence is indicated on the plans.
  - 2. Fence material and coatings per plans and 2020 MDOT Standard Specifications for Construction.
  - 3. Gate: Motorized, 30' Wide, 6' ht. with ability for remote control open/close.
  - 4. Gate Control Keypad: Gooseneck Keypad for local gate control as shown on plans.

**END OF SECTION 32 3100**

**SECTION 33 1400 – WATER UTILITY TRANSMISSION AND DISTRIBUTION**

**1.1 GENERAL**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Work shall comply with the 2020 MDOT Standard Specifications for Construction, Section 823, except as otherwise indicated in the Special Provisions specified in this section.

**END OF SECTION 33 1400**

## **SECTION 33 3100 – SANITARY SEWERAGE PIPING**

### **1.1 GENERAL**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Work shall comply with the 2020 MDOT Standard Specifications for Construction, Section 825, except as otherwise indicated in the Special Provisions specified in this section.

**END OF SECTION 33 3100**

## **SECTION 33 4100 – SUBDRAINAGE**

### **1.1 GENERAL**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Work shall comply with the 2020 MDOT Standard Specifications for Construction, Section 400, except as otherwise indicated in the Special Provisions specified in this section.

**END OF SECTION 33 4100**