# VAN BUREN PUBLIC SCHOOLS

## TYLER AND SAVAGE ELEMENTARY SCHOOLS
## SECURED ENTRY RENOVATIONS

SAVAGE ELEMENTARY SCHOOL
42975 SAVAGE ROAD
BELLEVILLE, MICHIGAN

TYLER ELEMENTARY SCHOOL
42200 TYLER ROAD
BELLEVILLE, MICHIGAN

Project Manual

IDS Project No. 20111-3008

February 10, 2025
Construction Set

# Project Manual

## Van Buren Public Schools
## Secured Entry Renovations
## Belleville, Michigan

## Savage Elementary School
## Tyler Elementary School


INTEGRATED design SOLUTIONS
architecture engineering interiors & technology

1441 w long lake road, suite 200
troy, michigan 48098

5211 cascade road se, suite 300
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IDS Project No. 20111-3008

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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: Van Buren Public Schools, Savage and Tyler Elementary School, Secured Entry Renovation, IDS Project No. 201111-3008.

1. Project Locations:

a. Savage Elementary School
42975 Savage Road
Belleville, Michigan

b. Tyler Elementary School
42200 Tyler Road
Belleville, Michigan

B. Owner: Van Buren Public Schools, 555 West Columbia Avenue, Belleville, 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 From, 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: _____

_____

_____

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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 (1): | |
| IDS Project No. (3): | |
| Submittal Date (4): | |

| From/Return To (2): |
|---|
| |

| | | | | |
|---|---|---|---|---|
| Submittal No.(5): | | ☐ Partial (6) | ☐ Resubmittal (7) | IDS Submittal No.: |

| | |
|---|---|
| Project Manual Section No. (8): | |
| Manufacturer(s) (9): | |

| Item Description (10) | Print (11) | Product Data | Sample | Other | ☐ A | ☐ M | ☐ E | ☐ EN | ☐ S | ☐ C | ☐ DN | ☐ FS | ☐ IN | ☐ TE |
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Contractor's/Construction Manager's Remarks and Deviations (12):

Addendum or Bulletin: (13)

Substitution: (14)

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.

Contractor/Construction Manager: _____

Signature _____

**IDS** Remarks:

**IDS** Construction Administration Approval:

_____

Date: _____

**ACTION CODES:** **IDS Received Stamp**

1. NO EXCEPTIONS TAKEN
2. EXCEPTIONS AS NOTED
3. REVISE AND RESUBMIT
4. REJECTED
5. ACTION NOT REQUIRED

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

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architecture engineering interiors & technology

# 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: | _____ | | _____ |
| Project Name: | _____ | Construction Manager: | _____ |
| 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:

| Drawing No./BIM File Discipline | Drawing Title | Issue Date of Drawing/BIM File |
|---|---|---|
| _____ | _____ | _____ |
| _____ | _____ | _____ |
| _____ | _____ | _____ |

Drawings were prepared on the following:

Software: _____ Operating System: _____

Check appropriate format for requested files.

DWG _____ DXF _____ IGES _____ NWD _____ RVT _____ DGN _____

**TERMS AND CONDITIONS**

1. IDS makes no representation as to the compatibility of the CAD/BIM files with any hardware or software.
2. 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.
3. Contractor will use figured dimensions only and will not “pull” dimensions from the CAD/BIM files.
4. 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.
5. 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.
6. 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.

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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.
2. OSHA - Occupational Safety & Health Administration; www.osha.gov.
3. USDA - Department of Agriculture; 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 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 and 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 – SELECTIVE DEMOLITION

## 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. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.
3. Abandonment and removal of existing utilities and utility structures.
4. Salvage of existing items to be reused or recycled.
5. Removed and reinstalled items.

### 1.3 DEFINITIONS

A. Remove (Demolished): Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.

B. Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.

C. Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.

D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

### 1.4 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

### 1.5 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site.

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.

### 1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For demolition firm.

B. Qualification Data: For refrigerant recovery technician.

C. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for dust control and, for noise control. Indicate proposed locations and construction of barriers.

D. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by demolition operations. Submit before Work begins.

E. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

F. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

**1.7 CLOSEOUT SUBMITTALS**

A. Inventory: Submit a list of items that have been removed and salvaged.

**1.8 QUALITY ASSURANCE**

A. Demolition Firm Qualifications: Company specializing in the type of work required.

1. Minimum of 5 years of documented experience.

B. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

**1.9 FIELD CONDITIONS**

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

1. Before selective demolition, Owner may remove items:

C. Notify Construction Manager of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the work.

1. It is the Contractor’s responsibility to contact Owner and verify that hazardous materials have been identified and/or removed prior to the commencement of the Work.
2. If suspected hazardous materials are encountered, do not disturb; immediately notify Construction Manager and Owner. Hazardous materials will be removed by Owner under a separate contract.
3. Reports on the presence of hazardous materials are available for review and use from the Owner.

a. Examine reports to become aware of locations where hazardous materials are present.

E. Storage or sale of removed items or materials on-site is not permitted.

F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

**1.10 WARRANTY**

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties. Notify warrantor before proceeding.

1. Coordinate with Owner for list of existing warranties still in effect.

B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

**1.11 COORDINATION**

A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

**PART 2 - PRODUCTS**

**2.1 PERFORMANCE REQUIREMENTS**

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ASSE A10.6 and NFPA 241.

**2.2 SOIL MATERIALS**

A. Satisfactory Soils: Comply with requirements in Section 31 2000 "Earth Moving."

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

A. Review Project Record Documents of existing construction or other existing conditions.

B. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.

1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

C. Concrete Floor Slabs: Perform ground penetrating radar (GPR) scans or other approved testing of floor slabs prior to demolition to confirm existence and location of rebars, tensioned tendons, electrical conduits, and other embedded materials.

D. Survey of Existing Conditions: Record existing conditions by use of measured drawings and preconstruction photographs or video.

1. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.

**3.2 PREPARATION**

A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

## 3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Arrange to shut off utilities with utility companies and Owner.
2. Refer to Divisions 20, 21, 22, 23, 26, 27, and 28 for additional requirements.
3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.

    a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
    c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
    d. Equipment to Be Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
    e. Equipment to Be Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
    f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
    g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

## 3.4 PROTECTION

A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
4. Cover and protect furniture, furnishings, and equipment that have not been removed.
5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Division 01.

B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.

C. Remove temporary barricades and protections where hazards no longer exist.

## 3.5 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
5. Maintain fire watch during and for at least 8 hours after flame-cutting operations.
6. Maintain adequate ventilation when using cutting torches.
7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
10. Dispose of demolished items and materials promptly. Comply with requirements of Division 01.]

B. Below-Grade Construction: Demolish foundation walls and other below-grade construction.

1. Remove below-grade construction, including foundation walls and footings.

C. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

D. Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

E. Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

F. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

## 3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.

1. Where concrete cannot be cut full depth, cut concrete to a depth of at least 3/4 inch. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.

B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.

C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.

D. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings." Do not use methods requiring solvent-based adhesive strippers.

E. Acoustic Panel Ceilings:

1. Refer to Section 09 5113 – Acoustic Panel Ceilings, for removing, modifying, and reinstalling portions of existing acoustical panel ceilings.

F. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight. Refer to roofing section(s) in Division 07 for new roofing requirements.

1. Remove existing roof membrane, flashings, copings, and roof accessories, unless otherwise indicated on Drawings.
2. Remove existing roofing system down to substrate unless otherwise indicated on Drawings.

## 3.7 SITE RESTORATION

A. Below-Grade Areas: Completely fill below-grade areas and voids resulting from building demolition operations with satisfactory soil materials according to backfill requirements in Section 31 2000 "Earth Moving."

B. Site Grading: Uniformly rough grade area of demolished construction to a smooth surface, free from irregular surface changes. Provide a smooth transition between adjacent existing grades and new grades.

## 3.8 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
4. Comply with requirements specified in Division 01.

B. Burning: Do not burn demolished materials.

## 3.9 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

**END OF SECTION 02 4119**

# SECTION 03 0130 – CAST-IN-PLACE CONCRETE MAINTENANCE

## 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. Cleaning of existing concrete surfaces.
2. Includes stripping existing paint and other thin-films and sealers off concrete.
3. Resurfacing of concrete surfaces having spalled areas and other damage.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, chemical composition, physical properties, test data, and mixing, preparation, and application instructions.

B. Selection Samples: Where colors and finishes are not specified, submit 3 sets of color and finish selection charts or chips.

### 1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Quality-Control Program: Submit a written plan for concrete maintenance to systematically demonstrate the ability of personnel to properly perform maintenance work, including each phase or process, protection of surrounding materials during operations, and control of debris and runoff during the Work. Describe in detail materials, methods, equipment, and sequence of operations to be used for each phase of the Work.

### 1.5 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 as follows:

1. Engage an experienced concrete-maintenance firm that employs installers and supervisors who are trained and approved by manufacturer.
2. Firm shall have completed work similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance

### 1.6 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer's written instructions for minimum and maximum temperature requirements and other conditions for storage.

B. Store cementitious materials off the ground, under cover, and in a dry location.

### 1.7 FIELD CONDITIONS

A. Cold-Weather Requirements for Cementitious Materials: Do not apply unless concrete-surface and air temperatures are above 40 deg F and will remain so for at least 48 hours after completion of Work.

B. Hot-Weather Requirements for Cementitious Materials: Protect repair work when temperature and humidity conditions produce excessive evaporation of water from patching materials. Provide artificial shade and wind breaks, and use cooled materials as required. Do not apply to substrates with temperatures of 90 deg F and above.

## PART 2 - PRODUCTS

### 2.1 CLEANING MATERIALS

A. Detergent: Non-ionic detergent.

### 2.2 STRIPPERS

A. Strippers: Fast acting gel that quickly removes thin-film coatings and clear coats from concrete.

1. Standard Stripper: Removes basic paints and sealers.

a. Product: Subject to compliance with requirements, provide Prosoco, Inc.; Enviro Klean SafStrip: www.prosoco.com, or a comparable product from one of the following:

1) Dietrich Technologies, Inc.: www.diedrichtechnologies.com.

2. Heavy Duty Stripper: Removes high-strength paints and coatings such as epoxies, polyurethanes, and enamels.

a. Product: Subject to compliance with requirements, provide Prosoco, Inc.; Sure Klean Fast Acting Stripper: www.prosoco.com, or a comparable product from one of the following:

1) Dietrich Technologies, Inc.: www.diedrichtechnologies.com.

### 2.3 CEMENTITIOUS PATCHING AND REPAIR MATERIALS

A. Repair Mortar (Type A) for Horizontal (Traffic) Repairs: Latex and microsilica modified cementitious repair mortar containing a corrosion inhibitor.

1. Properties:

a. Compressive Strength (ASTM C109): 9,000 psi at 28 days, minimum.
b. Flexural Strength (ASTM C 348): 1000 psi at 28 days, minimum.
c. Freeze/Thaw Resistance (ASTM C 666, Procedure A): 300 Cycles; 92 percent relative dynamic modulus.
d. Application Depth: 3/8 inch to 2 inches.
e. Color: Gray.

2. Product: Subject to compliance with requirements, provide The Euclid Chemical Company; Concrete-Top Supreme: www.euclidchemical.com, or a comparable product from one of the following:

a. BASF, Master Builders Solutions: www.master-builders-solutions.com.
b. Dayton Superior Corp.: www.daytonsuperior.com.

c. L&M Construction Chemicals, Inc, a subsidiary of Laticrete International, Inc.: www.laticrete.com.
d. Sika Corp.: usa.sika.com.

B. Repair Mortar (Type D) for Minor Repairs and Patching - Horizontal or Vertical: Latex modified cementitious repair mortar.

1. Properties:

a. Compressive Strength (ASTM C109): 5,000 psi at 28 days, minimum.
b. Flexural Strength (ASTM C 348): 900psi at 28 days, minimum.
c. Freeze/Thaw Resistance (ASTM C 666, Procedure A): 300 Cycles; 91 percent relative dynamic modulus.
d. Application Depth: Featheredge to 1 inch.
e. Color: Gray.

2. Product: Subject to compliance with requirements, provide The Euclid Chemical Company; Tammspatch II: www.euclidchemical.com, or a comparable product from one of the following:

a. BASF, Master Builders Solutions: www.master-builders-solutions.com.
b. Dayton Superior Corp.: www.daytonsuperior.com.
c. L&M Construction Chemicals, Inc, a subsidiary of Laticrete International, Inc.: www.laticrete.com.
d. Sika Corp.: usa.sika.com.

## 2.4 BONDING AGENTS AND ANTI-CORROSION COATINGS

A. Bonding Agent (Type A) with Anti-Corrosion Coating: Multi-component, water-based epoxy and cementitious bonding agent containing a corrosion inhibitor.

1. Properties:

a. Compressive Strength (ASTM C109): 4,000 psi at 28 days, minimum.
b. Flexural Strength (ASTM C 348): 1000 psi at 28 days, minimum.
c. Bond Strength (ASTM C 882): 2000 psi at 7 days, minimum.
d. Shore D Hardness (ASTM D 2240): 90 to 95.
e. Color: Gray.

2. Product: Subject to compliance with requirements, provide The Euclid Chemical Company; Duralprep A.C.: www.euclidchemical.com, or a comparable product from one of the following:

a. BASF, Master Builders Solutions: www.master-builders-solutions.com.
b. Dayton Superior Corp.: www.daytonsuperior.com.
c. L&M Construction Chemicals, Inc, a subsidiary of Laticrete International, Inc.: www.laticrete.com.
d. Sika Corp.: usa.sika.com.

## 2.5 ACCESSORIES

A. Water: Potable.

B. Reinforcing Steel: ASTM A615 Grade 40 (40,000 psi) billet-steel deformed bars, epoxy coated in accordance with ASTM A775.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Verify that surfaces are ready to receive work.

B. Locate areas of deteriorated or delaminated concrete using visual inspection and other methods as recommended by installer and mark boundaries.

C. Do not begin any work until all mockups have been approved by the Architect.

D. Perform surveys as the Work progresses to detect hazards resulting from concrete-maintenance work.

### 3.2 PREPARATION

A. Provide enclosures, barricades, and other temporary construction as required to protect adjacent work from damage.

B. Protect persons, motor vehicles, surrounding surfaces of building being repaired, building site, plants, and surrounding buildings from harm resulting from concrete maintenance work.

1. Comply with each product manufacturer's written instructions for protections and precautions. Protect against adverse effects of products and procedures on people and adjacent materials, components, and vegetation.

    a. Use only proven protection methods appropriate to each area and surface being protected.
    b. Protect floors and other surfaces along haul routes from damage, wear, and staining.

2. Provide temporary barricades, barriers, and directional signage to exclude public from areas where concrete maintenance work is being performed.

    a. Erect temporary protective covers over walkways and at points of pedestrian and vehicular entrance and exit that must remain in service during course of concrete maintenance work.

3. Contain dust and debris generated by concrete maintenance work and prevent it from reaching the public or adjacent surfaces.

    a. Use water-mist sprinkling and other wet methods to control dust only with adequate, approved procedures and equipment that ensure that such water will not create a hazard or adversely affect other building areas or materials.

4. Neutralize and collect alkaline and acid wastes for disposal off Owner's property.
5. Dispose of debris and runoff from operations by legal means and in a manner that prevents soil erosion, undermining of paving and foundations, damage to landscaping, and water penetration into building interiors.

C. Preparation for Concrete Removal: Examine construction to be repaired to determine best methods to safely and effectively perform concrete maintenance work. Examine adjacent work to determine what protective measures will be necessary. Make explorations, probes, and inquiries as necessary to determine condition of construction to be removed in the course of repair.

1. Inventory and record the condition of items to be removed for reinstallation.
2. Provide and maintain shoring, bracing, and temporary structural supports as required to preserve stability and prevent unexpected or uncontrolled movement, settlement, or collapse of construction being demolished and construction and finishes to remain. Strengthen or add new supports when required during progress of removal work.

## 3.3 PAINT REMOVAL

A. Remove all paint, sealers, and other thin film coatings from exposed concrete using standard and heavy duty strippers as appropriate for the coating being removed.

1. Apply strippers according to manufacturer's written instructions.
2. Work from the bottom to the top.
3. Do not let the applied stripper dry; occasionally agitate applied stripper with a stiff bristle brush.
4. After applied stripper has set for 15-30 minutes, rinse with low-pressure water; ensure that all stripper and dissolved coatings are completely removed from the concrete surface and surface pores.
5. Repeat stripping process as necessary to completely remove all coatings.

    a. Ensure that all coatings are completely removed from the concrete substrates.

## 3.4 CLEANING EXISTING CONCRETE

A. Clean concrete surfaces of dirt or other contamination using the gentlest method that is effective.

1. Try the gentlest method first, then, if not clean enough, use a less gentle method taking care to watch for impending damage. Stop immediately if cleaning method causes additional damage.
2. Clean out cracks and voids using same methods.

B. The following are acceptable cleaning methods, in order from gentlest to less gentle:

1. Water washing using low-pressure, maximum of 50 psi, and, if necessary, brushes with natural or synthetic bristles.
2. Increasing the water washing pressure to maximum of 400 psi.
3. Adding detergent to washing water; with final water rinse to remove residual detergent.

C. Do not use any of the following cleaning methods, unless otherwise indicated:

1. Brushes with wire bristles, grinding with abrasives, solvents, hydrochloric or muriatic acid, sodium hydroxide, caustic soda, or lye.
2. Soap or detergent that is not non-ionic.

## 3.5 CRACK REPAIR

A. Fine to Medium Cracks:

1. Size: Cracks that are less than 12 mils (0.012 inches) in width.

2. Repair Method: Remain as-is. Do not repair.

B. Large Cracks:

1. Size: Cracks that are wider than 12 mils (0.012 inches) in width.
2. Repair Method: Route and seal.

    a. Remove all dirt and debris from cracks.
    b. Remove all loose and spalling concrete from the edges of the cracks.
    c. Route out cracks to create a 1/2 inch wide by 1/2 deep groove for sealant.
    d. Apply a bond breaker to the bottom of the groove and fill groove with sealant; strike off sealant flush with surface of concrete or tool sealant concave.

        1) Refer to Section 07 9200 for sealant and bond breaker installation.

## 3.6 DETERIORATED CONCRETE REPAIR

A. General: Remove and replace deteriorated concrete that has severely cracked, spalled or delaminated. Remove and replace failed concrete repair patches.

1. Comply with the American Concrete Institute (ACI) Repair Guide, ACI 546R-14 and the International Concrete Repair Institute (ICRI) Repair Guideline No. 310.1R-08.

B. Concrete Removal: Saw cut perimeter and remove deteriorated concrete by breaking up and dislodging from steel reinforcement.

1. Remove concrete a minimum of 1/4 inch beyond deteriorated concrete.

a. Test areas where concrete has been removed by tapping with hammer and remove any additional concrete failures until only sound concrete remains.

2. Where half or more of the perimeter of reinforcing bar is exposed, bond between reinforcing bar and surrounding concrete is broken, or reinforcing bar is corroded, remove concrete from entire perimeter of bar and to provide at least 3/4-inch clearance around bar to completely expose steel.
3. Thoroughly clean removal areas of loose concrete, dust, and debris.

C. Concrete Patching:

1. Wet substrate thoroughly to attain a saturated surface dry condition (SSD) with no standing water.
2. Apply bonding agent and anti-corrosion coating according to the manufacturer's written instructions and as follows:

a. Apply Bonding Agent Type A to all existing concrete and reinforcing steel that will be patched with repair mortar.

1) Apply Type A Bonding Agent to reinforcing steel in two coats.

3. Apply repair mortar according to the manufacturer's written instructions and as follows:

a. For vertical or horizontal minor repairs up to 1/2 inch deep, including surface holes, voids, and shallow spalling, use Repair Mortar Type D for minor repairs and patching.
b. Use Repair Mortar Type A for all horizontal (traffic) repairs greater than 1/2 inch deep.

1) If depth of repair exceeds 2 inches use Repair Mortar Type C for formed repairs.

c. Place repair mortar by troweling toward edges of patch to promote a solid bonding at the perimeter of the patch.
d. For large patches fill the edges first and then work towards the center, always troweling towards the edges of the patch.
e. At reinforcing steel, force repair mortar to fill space behind bars by compacting repair mortar with trowel from each exposed side of steel.
f. Do not exceed the maximum depth for each applied lift.
g. Repair mortar shall be flush with surface of adjacent existing concrete.
h. Finish to match adjacent existing concrete surfaces.
i. Wet cure repair mortar for not less than seven days by water-fog spray or water-saturated absorptive cover.

**END OF SECTION 03 0130**

# 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.

### 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.

### 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.

**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. Floor and slab treatments.
5. Bonding agents.
6. Vapor retarders.
7. 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:

a. Permeability-Reducing Admixture: Include independent test reports, indicating compliance with specified requirements, including dosage rate used in test.

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 with experience installing and finishing concrete and incorporating permeability-reducing admixtures.

1. Supervisors shall have not less than 5 years of documented experience

C. Obtain permeability-reducing (moisture vapor reduction) admixture from a single manufacturer.

D. 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.

E. 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.

F. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.4/D 1.4M.

**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.

## 1.10 WARRANTY

A. Slabs with Permeability-Reducing (Moisture Vapor Reduction) Admixture: Provide warranty to cover the cost of water vapor permeance testing failures and flooring failures due to moisture migration from slabs for ten years.

1. Include cost of repair or removal of failed flooring, placement of topical moisture remediation system, and replacement of flooring with comparable flooring system.

# 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. Water Vapor Emission and Relative Humidity:

1. Concrete mix designs with a permeability-reducing (moisture vapor reduction) admixture shall comply with the following:

a. Concrete shall have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours per ASTM F1869 (Anhydrous Calcium Chloride Test).
b. Concrete shall have a maximum 75 percent relative humidity level measurement per ASTM F2170 (Relative Humidity Test, using in situ probes).

## 2.2 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, or ASTM C595, Type IL, 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.

## 2.3 ADMIXTURES

A. Air-Entraining Admixture: ASTM C260.

B. Permeability-Reducing (Moisture Vapor Reduction) Admixture: ASTM C494, Type S, hydrophilic, permeability-reducing crystalline admixture, capable of reducing water absorption of concrete exposed to hydrostatic pressure (PRAH); formulated to permanently close capillary systems formed during curing to reduce moisture vapor emission and transmission with no adverse effect on concrete properties or finish flooring.

1. Water Vapor Permeance: Comply with one or more of the following:

a. 0.03 perms, maximum, when tested in accordance with ASTM E96.
b. $6x10^{-8}$ cm/s, maximum, in accordance with ASTM D5084.

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

a. Barrier One, Inc; CPS Admix - Moisture Vapor Reduction Admixture (MVRA): www.barrierone.com.
b. ISE Logik Industries, Inc; MVRA 900: www.iselogik.com.
c. Specialty Products Group; Vapor Lock 20/20: www.spggogreen.com.

C. 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

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

## 2.4 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.

## 2.5 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.

## 2.6 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.
b. Inteplast Group; Barrier-Bac, VB-350: www.barrierbac.com.
c. Reef Industries, Inc.; Griffolyn 15 Mil: www.reefindustries.com.
d. Stego Industries, LLC; Stego Wrap Vapor Barrier (15 Mil): www.stegoindustries.com.
e. Viaflex, Inc.; VaporBlock VB15: www.viaflex.com.
f. W. R. Meadows, Inc; Perminator 15 Mil: www.wrmeadows.com.

## 2.7 LIQUID FLOOR TREATMENTS

A. Concrete Hardener/Densifier (Sealer): Penetrating liquid floor treatment. Clear, chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.

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

a. Dayton Superior; Densifier J13: www.daytonsuperior.com.
b. The Euclid Chemical Company; Euco Diamond Hard: www.euclidchemical.com.

c. Kaufman Products, Inc; SureHard: www.kaufmanproducts.net.
d. L&M Construction Chemicals, Inc, a subsidiary of Laticrete International, Inc; Seal Hard: www.lmcc.com.
e. PROSOCO, Inc; Consolideck LS: www.prosoco.com.
f. W.R. Meadows, Inc; Liqui-Hard: www.wrmeadows.com.

**2.8 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.

**2.9 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.
b. W. R. Meadows, Inc; Fiber Expansion Joint Filler with Snap-Cap: www.wrmeadows.com.
c. W. R. Meadows, Inc; Deck-O-Foam Joint Filler with pre-scored top strip: www.wrmeadows.com.

## 2.10 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. Permeability-Reducing (Moisture Vapor Reduction) Admixture:

1. Provide in slabs to receive adhesively applied flooring and moisture sensitive floor finishes.

a. Includes, but is not limited to, the following:

1) Resilient tile and sheet.
2) Carpet tile and sheet carpeting.
3) Wood gymnasium flooring.
4) Wood stage flooring.
5) Epoxy matrix terrazzo flooring.
6) Other adhesive applied floor finishes.

D. Other 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.

## 2.11 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 C: Normal-weight concrete used for exterior slabs-on-grade and equipment pads.

1. Exposure Class: ACI 318 F3, C2.
2. Minimum Compressive Strength: 4000 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 D: Normal-weight concrete used for interior slabs-on-grade and equipment pads.

1. Exposure Class: ACI 318 F0.
2. Minimum Compressive Strength: 4000 psi at 28 days.
3. Maximum w/cm: 0.50.
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.
6. Permeability-Reducing (Moisture Vapor Reduction) Admixture: Provide in slabs to receive adhesively applied flooring and moisture sensitive floor finishes.

**2.12 CONCRETE MIXING**

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94 and ASTM C1116 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 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.

**3.3 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.

## 3.4 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:

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.

## 3.5 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.

## 3.6 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.

## 3.7 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, concrete surfaces to receive a rubbed finish and concrete to be covered with a coating or covering material applied directly to concrete.

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.

## 3.8 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 restraighten 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.

## 3.9 TOLERANCES

A. Conform to ACI 117.

## 3.10 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.

## 3.11 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

A. Filling In:

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

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. 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.

## 3.12 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.

## 3.13 APPLICATION OF LIQUID FLOOR TREATMENTS

A. Concrete Hardener/Densifier: Prepare, apply, and finish penetrating liquid floor treatment in accordance with manufacturer's written instructions.

1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs prior to applying liquid floor treatment.
2. Locations:

a. Unless otherwise indicated, provide at unfinished exposed concrete floors, equipment pads, ramps, steps, and stairs.

## 3.14 JOINT FILLING

A. Refer to Section 07 9200 - Sealants.

## 3.15 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.

G. Water Vapor Permeance Testing:

1. Allow manufacturer of Permeability-Reducing (Moisture Vapor Reduction) Admixture access to concrete work for any concrete sampling and testing required by admixture manufacturer for compliance with warranty requirements.

2. Refer to Division 09 Finishes sections for water vapor permeance testing required as part of floor finish installations.
3. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents; at no additional costs to Owner.

## 3.16 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. Clay face brick.
3. Clay face brick - salvaged.
4. Mortar and grout.
5. Steel reinforcing bars.
6. Masonry-joint reinforcement.
7. Ties and anchors.
8. Embedded flashing.
9. Cavity wall insulation.
10. Miscellaneous masonry accessories.

### 1.3 ADMINISTRATIVE REQUIREMENTS

A. Product Coordination and Limitations: Provide materials and components that when combined with materials and components specified in other sections form exterior wall assemblies as detailed on Drawings complying with NFPA 285 testing and acceptance criteria.

### 1.4 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

C. TMS: The Masonry Society.

### 1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

### 1.6 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. Samples for Initial Selection:

1. Clay face brick, in the form of straps of five or more bricks or sample boards.

D. Samples for Verification: Submit 3 samples for each type and color of the following:

1. Clay face brick, in the form of straps of five or more bricks or sample boards.

**1.7 INFORMATIONAL SUBMITTALS**

A. Qualification Data: For manufacturers, installers, and testing agency.

B. NFPA 285 Documentation:

1. General: For each product, submit documentation listing all possible compatible materials and components that could be used together in a wall assembly to comply with NFPA 285 testing and acceptance criteria.
2. Project Specific:

a. Provide complete list of products that will be used to form exterior wall assemblies as detailed on Drawings.

1) For each product, include product name, model number, and manufacturer.
2) Indicate which products are provided in this section.

b. Provide documentation certifying that these products when combined to form exterior wall assemblies as detailed on Drawings comply with NFPA 285 testing and acceptance criteria.

C. 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.

D. Field quality-control reports.

E. 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.

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

**1.8 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. Testing Agency Qualifications: Qualified according to ASTM C1093 for testing indicated.

**1.9 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.

**1.10 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 s 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.

**1.11 COORDINATION**

A. Coordinate installation of embedded flashing materials and anchors and fasteners for installing cast stone in masonry construction with Section 04 7200 – Cast Stone.

## 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. Reinforcing Steel: Comply with ACI 315 - Guide to Presenting Reinforcing Steel Design Details.

C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.

D. NFPA 285 Compliance:

1. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components.
2. Provide materials and components that when combined with materials and components specified in other sections form exterior wall assemblies as detailed on Drawings complying with NFPA 285 testing and acceptance criteria.

### 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.
b. Euclid Chemical Company (The); an RPM company; Eucon Blocktite Admixture: www.euclidchemical.com.
c. GCP Applied Technologies Inc.; Dry-Block Block Admixture: 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.
b. Consumers Concrete Corp.: www.consumersconcrete.com.
c. Echelon by Oldcastle: www.echelonmasonry.com.
d. Fendt Builder's Supply, Inc.: www.fendtproducts.com.
e. Grand Blanc Cement Products: www.grandblanccementproducts.com.
f. Michigan Certified Concrete: www.micertconcrete.com.
g. National Block Company: www.nationalblock.com.

## 2.5 CONCRETE AND 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 BRICK

A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units:

1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
3. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
4. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.

B. Clay Face Brick:

1. Field Brick

a. Product: Subject to compliance with requirements, provide the following product; substitutions are not permitted.

1) Brick Tech Architectural; Cloud Ceramics: www.cloudceramics.com.

b. ASTM C216, Grade SW, Type: FBX.
c. Size (Actual Dimensions): 3-5/8 inches wide by 2-1/4 inches high by 7-5/8 inches long (Modular).
d. Color: Midnight.
e. Texture: Velour.

C. Salvaged Clay Face Brick:

1. Reuse salvaged brick.
2. Where salvaged brick is not available provide new brick to match existing adjacent brickwork in color range, texture, and size; subject to Architect's approval, and complying with the following:

a. ASTM C216, Grade SW.
b. Type: FBX or FBS to match existing.

**2.7 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.
b. Lambert Corporation: www.lambertusa.com.
c. Lehigh Hanson: www.lehighhanson.com
d. Solomon Colors: 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.
b. Euclid Chemical Company (The); an RPM company; Blocktite Mortar Admixture: www.euclidchemical.com.
c. GCP Applied Technologies Inc.; Dry-Block Mortar Admixture: 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.
2) The QUIKRETE Companies; wwwquikcrete.com.
3) SPEC MIX, Inc.: 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.
2) The QUIKRETE Companies; wwwquikcrete.com.
3) SPEC MIX, Inc.: 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.
b. The QUIKRETE Companies; wwwquikcrete.com.
c. SPEC MIX, Inc.: www.specmix.com.

## 2.8 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.
b. Heckmann Building Products; www.heckmannbuildingprods.com.
c. Hohmann & Barnard, Inc.; www.h-b.com.
d. Wire-Bond; 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: 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: 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: 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: 270 Ladder LOX-ALL Adjustable Eye Wire with 2X-HOOK.

## 2.9 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.
b. Heckmann Building Products; www.heckmannbuildingprods.com.
c. Hohmann & Barnard, Inc.; www.h-b.com.
d. Wire-Bond; 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 Concrete: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Connector Section: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from 0.030-inch-thick steel sheet.
2. Tie Section: Triangular-shaped wire tie.
3. Basis-of-Design Product: Hohmann & Barnard, Inc.; www.h-b.com: 305 Dovetail Slot with 315 Flexible Dovetail Brick Ties.

E. 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: 359/359FP anchors with 301W or VBT ties.

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: 344 Rigid Partition Anchor.

## 2.10 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.
b. Wire-Bond; Bond-N-Flash SA: www.wirebond.com.
c. York Manufacturing, Inc.; York 304 SA: 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.

**2.11 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
b. Heckmann Building Products; www.heckmannbuildingprods.com.
c. Hohmann & Barnard, Inc.; www.h-b.com.
d. Wire-Bond; www.wirebond.com.
e. York Manufacturing, Inc.; 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.
b. WIRE-BOND: 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.
b. WIRE-BOND: www.wirebond.com/#sle.

D. Bond-Breaker Material (Felt): Asphalt-saturated felt complying with ASTM D226, Type I (No. 15 asphalt felt).

E. 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; MGS or a comparable product by one of the following:

a. Heckmann Building Products; www.heckmannbuildingprods.com.
b. Wire-Bond; www.wirebond.com.

F. 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; QV Quadro-Vent or a comparable product by one of the following:

a. Advanced Building Products Inc.; www.advancedbuildingproducts.com.

b. Heckmann Building Products; www.heckmannbuildingprods.com.
c. Mortar Net Solutions; www.mortarnet.com.
d. Wire-Bond; www.wirebond.com.

G. 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; Mortar Trap or a comparable product by one of the following:

a. Advanced Building Products Inc.; www.advancedbuildingproducts.com.
b. Heckmann Building Products; www.heckmannbuildingprods.com.
c. Mortar Net Solutions; www.mortarnet.com.
d. Wire-Bond; www.wirebond.com.

## 2.12 CAVITY WALL INSULATION

A. Extruded Polystyrene (XPS) Cavity Wall Insulation Board: Complies with ASTM C578, and manufactured using carbon black technology.

1. Type and Compressive Resistance: Type IV, 25 psi, minimum.
2. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
3. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
4. Thermal Resistance, R-value: 5.6, minimum, per 1 inch thickness at 75 degrees F mean temperature.
5. Insulation shall be an approved component of an NFPA 285 tested exterior wall assembly as detailed on Drawings; tested in accordance with, and complying with the acceptance criteria, of NFPA 285.
6. Board Size: 16 inch by 96 inch.
7. Board Thickness: 3 inch, unless otherwise indicated.
8. Board Edges: Square.
9. Water Absorption: Type IV, 0.3 percent by volume, maximum, by total immersion.
10. Products: Subject to compliance with requirements, provide one of the following:

a. Dow Chemical Company; Styrofoam Cavitymate Ultra: www.dow.com/en-us/building.
b. Owens Corning; Foamular High-R CW Plus: www.owenscorning.com.

B. Insulation Accessories:

1. 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.

a. Provide type recommended by insulation manufacturer for application

2. Foam Sealant: Single-component spray polyurethane insulating foam sealant.

a. Gun-applied.
b. Expands to fill gaps up to 3 inches.
c. Closed Cell Content: 70 percent, minimum; ASTM D2856.
d. Flammability: ASTM E84.

1) Flame-spread Index: 25, maximum.
2) Smoke-developed Index: 450, maximum.

e. Thermal Resistance (R) Value: 4 per inch; ASTM C518.

f. Air Permeance: 0.001 cfm per sq ft at 6.24psf at 1 inch, maximum; ASTM E2178.
g. Product: Subject to compliance with requirements, provide one of the following:

1) Dow Building Solutions, Dow Chemical Company/DuPont; GreatStuff Pro Gaps & Cracks Sealant: www.dow.com.
2) Owens Corning Corporation; ProPink ComfortSeal Gun Foam: www.owenscorning.com.

## 2.13 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: Sure Klean 600, Sure Klean Vana Trol or a comparable product by one of the following:

a. Diedrich Technologies, Inc.; www.diedrichtechnologies.com.

B. Proprietary Acidic Cleaner – For 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: Sure Klean Light Duty Concrete Cleaner or a comparable product by one of the following:

a. Diedrich Technologies, Inc.; www.diedrichtechnologies.com.

## 2.14 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 cast stone units, use Type N.
7. For pointing mortar: Type N.

8. For other applications where another type is not indicated, use Type N.

E. Grout for Unit Masonry: Comply with ASTM C476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602/ACI 530.1 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 3000 psi.
3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C143.

## PART 3 - EXECUTION

### 3.1 SALVAGING MASONRY

A. General: Comply with Section 02 4119 - Selective Demolition.

B. Where indicated, remove and salvage existing masonry.

1. Carefully remove masonry units by hand. Cut out full units from joint to joint.

a. If required, use a motor-driven saw designed to cut masonry with clean, sharp, unchipped edges.

2. Salvage as many whole, undamaged masonry units as needed for new construction.
3. Salvage damaged masonry units that may be cut and used where cut units are required.
4. Take care not to chip, crack or otherwise damage surrounding masonry.

C. Remove mortar, loose particles and soil from salvaged masonry units by cleaning with hand chisels, brushes and water. Store masonry units for reuse.

D. Clean remaining masonry at edges of removal areas by removing mortar, dust, and loose debris in preparation for new construction.

E. Support and protect remaining masonry that surrounds removal area. Maintain flashing, reinforcement, lintels, and adjoining construction in an undamaged condition.

### 3.2 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.

### 3.3 INSTALLATION, GENERAL

A. Coursing and Bonding:

1. Match coursing and bonding of existing masonry, unless otherwise indicated on Drawings.
2. Concrete Masonry Units: Unless otherwise indicated:

    a. Coursing: One unit and one mortar joint to equal 8 inches.
    b. Mortar Joints: Concave.
    c. Mortar Joint Thickness: 3/8 inch.

3. Brick Units: Unless otherwise indicated:

    a. Coursing: Three units and three mortar joints to equal 8 inches.
    b. Mortar Joints: Concave.
    c. Mortar Joint Thickness: 3/8 inch.

4. Establish lines, levels, and coursing indicated. Protect from displacement
5. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
6. Do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.
7. Bond and interlock each course of each wythe at corners.
8. Tooth-in new masonry work with existing, unless otherwise indicated on Drawings.

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.

**3.4 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.

## 3.5 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.

2. Where masonry walls are indicated to receive air barriers coordinate with air barrier manufacturer and tool joints slightly concave or cut flush as recommended by air barrier manufacturer. Refer to Section 07 2700 - Fluid-Applied Membrane Air Barriers.

## 3.6 SETTING CAST STONE UNITS WITH MORTAR

A. Refer to Section 04 7200 – Cast Stone, for cast stone installation.

## 3.7 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.

## 3.8 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., embeded in mortar joints

## 3.9 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. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.
3. Place and consolidate grout fill without displacing reinforcing.

**3.10 LINTELS**

A. Install steel lintels where indicated.

B. Provide steel, concrete, 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.

**3.11 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.

**3.12 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.

**3.13 CAVITY WALL INSULATION BOARD**

A. Installing Cavity Wall Insulation: Place small dabs of adhesive, spaced approximately 12 inches o.c. both ways, on inside face of insulation boards. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as shown.

1. Install in running bond pattern.
2. Extend boards over expansion joints, unbonded to wall on one side of joint

3. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane
4. 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. Exceptions:

      1) Do not seal boards to adjacent construction and flashing at bottom of wall cavity and above openings where weep holes are located.
      2) Do not seal boards to adjacent construction at top of wall cavity and below openings.

   c. Foam sealant shall be installed continuously without breaks or gaps.
   d. When complete, board insulation installation shall be continuous without holes or air gaps, including penetrations, joints, and perimeter.

## 3.14 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete, 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 or concrete 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.

## 3.15 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.

**3.16 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.

**3.17 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.

## 3.18 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. Cast Stone: Refer to Section 04 7200 – Cast Stone.

## 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 7200 – CAST STONE

## 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. Architectural cast stone.

B. Products Furnished but not Installed under this Section:

1. Anchors and fasteners for connecting cast stone to masonry backup construction, installed by Section 04 2000 - Unit Masonry.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

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

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

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

C. Material Certificates: For the following:

1. Integral water repellent used in cast stone.

D. Samples for Verification:

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

E. Sealant Samples for Verification: For each type and color of joint sealant required.

### 1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

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

1. Provide test reports based on testing within previous six months.

### 1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least 5 years of documented experience and the following:

1. Current producer member of the Cast Stone Institute or the Architectural Precast Association
2. Plant certified by CSI or APA.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least 5 years of documented experience.

### 1.6 DELIVERY, STORAGE, AND HANDLING

A. Coordinate delivery of cast stone with unit masonry work to avoid delaying the Work.

B. Pack, handle, and ship cast stone units in suitable packs or pallets.

1. Lift with wide-belt slings; do not use wire rope or ropes that might cause staining. Move cast stone units if required, using dollies with wood supports.
2. Store cast stone units on wood skids or pallets with nonstaining, waterproof covers, securely tied. Arrange to distribute weight evenly and to prevent damage to units. Ventilate under covers to prevent condensation.

### 1.7 FIELD CONDITIONS

A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Comply with cold-weather construction requirements in TMS 602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and above and will remain so until cast stone has dried, but no fewer than seven days after completing cleaning.

B. Hot-Weather Requirements: Comply with hot-weather construction requirements in TMS 602.

C. 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.

### 1.8 COORDINATION

A. Coordinate installation of embedded flashing materials and anchors and fasteners for installing cast stone 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 cast stone Installer for anchoring and supporting cast stone. 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 cast stone to avoid extended on-site storage and to coordinate with work adjacent to cast stone.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Artstone; www.american-artstone.com.

2. Continental Cast Stone; www.continentalcaststone.com.
3. Custom Cast Stone; www.customcaststone.com.
4. Edwards Cast Stone; www.edcstone.com.
5. Midwest Cast Stone; www.midwestcaststone.com.
6. Royal Stone; www.royalstoneinc.com.
7. Superior Precast Products, Inc.; www.superiorprecast.com.

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

## 2.2 PERFORMANCE REQUIREMENTS

A. Cast Stone Physical Properties:

1. Compressive Strength: 6,500 psi minimum at 28 days; ASTM C1194.
2. Absorption: 6.0 percent, maximum at 28 days; ASTM C1195. (Without water repellent admixtures)
3. Air Entrainment: Provide sufficient air content to meet the freeze-thaw requirements for wet cast products, when the air content is tested in accordance with ASTM C173 or ASTM C231.

    a. Air entrainment is not required for Vibrant Dry Tamp (VDT) products.

4. Freeze-thaw Durability: ASTM C666 in accordance with ASTM C1364. The cumulative percent weight loss (CPWL) shall be less than 5.0 percent after 300 cycles of freezing and thawing.
5. Linear Drying Shrinkage: Comply with ASTM C426. Test and report in accordance with ASTM C1364.

B. Appearance of Cast Stone:

1. All surfaces exposed to view shall have a fine-grained texture similar to natural stone unless otherwise indicated, with no air voids in excess of 1/32 inch.

    a. The density of such voids shall be less than 3 occurrences per any 1 square inch and not obvious under direct daylight illumination at a 5 foot distance.

2. Minor chips shall not be obvious under direct daylight illumination at a 20 foot distance.
3. Cast stone shall have no crazing or efflorescence.
4. Color Variation: Permissible variation in color between units of comparable age subjected to similar weathering exposure shall comply with ASTM D2244 and as follows:

    a. Total Color Difference: Not greater than 6 units.
    b. Total Hue Difference: Not greater than 2 units.

## 2.3 CAST STONE MATERIALS

A. General: Comply with ASTM C1364.

B. Portland Cement: ASTM C150, Type I or Type III, containing not more than 0.60 percent total alkali when tested according to ASTM C114. Provide natural color or white cement as required to produce cast stone color indicated.

C. Coarse Aggregates: Granite, quartz, or limestone complying with ASTM C33; gradation and colors as needed to produce required cast stone textures and colors.

D. Fine Aggregates: Natural sand or crushed stone complying with ASTM C33, gradation and colors as needed to produce required cast stone textures and colors.

E. Color Pigment: ASTM C979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.

F. Admixtures:.

1. General:

a. Do not use admixtures that contain more than 0.1 percent water-soluble chloride ions by mass of cementitious materials.
b. Do not use admixtures containing calcium chloride.
c. Use only admixtures that are certified by manufacturer to be compatible with cement and other admixtures used.

2. Air-Entraining Admixture: ASTM C260. Add to mixes at manufacturer's prescribed rate to result in an air content of 4 to 6 percent.

a. Exception: Do not add to zero-slump concrete mixes.

3. Water-Reducing Admixture: ASTM C494, Type A.
4. Water-Reducing, Retarding Admixture: ASTM C494, Type D.
5. Water-Reducing, Accelerating Admixture: ASTM C494, Type E.
6. Water Repellent Admixture: Water-repellent admixture previously established as suitable for use in cast stone by proven field performance or through laboratory testing; approved by cast stone manufacturer for use in cast stone and certified not to adversely affect cast stone performance requirements.

G. Reinforcement:

1. Deformed steel bars complying with ASTM A615, Grade 40. Use galvanized or epoxy-coated reinforcement when covered with less than 1-1/2 inches of cast stone material.

a. Epoxy Coating: ASTM A775.
b. Galvanized Coating: ASTM A767.

2. Galvanized-Steel, Welded-Wire Reinforcement: ASTM A1064, plain, fabricated from galvanized-steel wire into flat sheets.

H. Embedded Anchors and Other Inserts: Fabricated from stainless steel complying with ASTM A240, ASTM A276, or ASTM A666, Type 304.

## 2.4 CAST STONE UNITS

A. Cast Stone Units: Comply with ASTM C1364.

1. Units shall be manufactured using the manufacturer's selected method, vibrant dry tamp (VDT) or wet cast.
2. Water Repellent Admixture: Add to mixes for units exposed to the exterior.
3. Air-Entraining Admixture: Add to mixes for units exposed to the exterior.

a. Exception: Do not add to zero-slump concrete mixes.

4. Shapes, Sizes, and Profiles: As indicated on Drawings.
5. Colors and Textures: Custom color and texture to match 45 Grey as manufactured by Royal Stone.

B. Fabricate units with sharp arris and accurately reproduced details, with indicated texture on all exposed surfaces unless otherwise indicated.

1. Slope exposed horizontal surfaces 1:12 to drain unless otherwise indicated.
2. Provide raised fillets at backs of sills and at ends indicated to be built into jambs.
3. Provide drips on projecting elements unless otherwise indicated.

C. Fabrication Tolerances:

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

D. Cure Units as Follows:

1. Cure units in enclosed, moist curing room at 95 percent relative humidity and temperature of 100 deg F for 12 hours or 70 deg F for 16 hours.
2. Keep units damp and continue curing to comply with one of the following:

a. No fewer than five days at mean daily temperature of 70 deg F or above.
b. No fewer than seven days at mean daily temperature of 50 deg F or above.

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

## 2.5 MORTAR MATERIALS AND MIXES

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

1. Provide mortar with a water repellent admixture for units exposed to the exterior:
2. Use Type N mortar.

## 2.6 ANCHORS AND FASTENERS

A. Anchors: Type and size indicated, fabricated from Type 304 stainless steel complying with ASTM A240, ASTM A276, or ASTM A666.

B. Dowels: 1/2-inch diameter round bars, fabricated from Type 304 stainless steel complying with ASTM A240/, ASTM A276, or ASTM A666.

## 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, flexible fabric flashings, factory-fabricated drip plates, termination bars, weep inserts, and cavity drainage materials.

## 2.8 ACCESSORIES

A. Setting Buttons: Resilient plastic buttons, nonstaining to cast stone, sized to suit joint thicknesses and bed depths of cast stone units without intruding into required depths of pointing materials.

B. Sealants for Joints in Cast Stone: Silicone complying with Section 07 9200 - Joint Sealants, and as follows:

1. Sealants shall not stain cast stone.

C. Nonacidic Cleaner: Manufacturer's proprietary standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cast stone manufacturer and expressly approved by cleaner manufacturer for use on cast stone and adjacent masonry materials.

1. Basis-of-Design: Subject to compliance with requirements, provide PROSOCO, Inc.; www.prosoco.com: Enviro Klean Safety Klean or a comparable product by one of the following:

a. Diedrich Technologies, Inc.; www.diedrichtechnologies.com.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine substrate to verify that inserts, veneer anchors, and other items installed in backup substrates and required for or extending into cast stone are correctly installed

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of cast stone.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 SETTING CAST STONE IN MORTAR**

A. Set cast stone as indicated in TMS 604.

B. Set cast stone as indicated on Drawings. Set units accurately in locations indicated, with edges and faces aligned according to established relationships and indicated tolerances

1. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure units in place.
2. Install veneer anchors and joint reinforcement in coordination with adjacent unit masonry.

a. Comply with Section 04 4200 – Unit Masonry, for installing veneer anchors and joint reinforcement.

3. Coordinate installation of cast stone with installation of flashing.

a. Comply with Section 04 4200 – Unit Masonry, for installing embedded flashing materials and miscellaneous masonry accessories.

4. Wet joint surfaces thoroughly before applying mortar or setting in mortar.
5. Set units in full bed of mortar with full head joints unless otherwise indicated.

a. Mortar Joint Thickness: 3/8 inch.
b. Build anchors and ties into mortar joints as units are set.
c. Fill dowel holes and anchor slots with mortar.
d. Build concealed flashing into mortar joints as units are set.

6. Isolate cast stone units from clay masonry with bond breaker material (felt) or similar method of providing a continuous bond break/slip plane.

7. 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 cast stone units a distance at least equal to width of joint, but not less than depth of pointing materials.
8. Do not set heavy units or projecting courses until mortar in courses below has hardened enough to resist being squeezed out of joint.
9. Support and brace projecting cast stone units until wall above is in place and mortar has set.
10. Embed ends of sills and wall caps in mortar.

C. Joint Pointing - General: Point joints with mortar or sealant as specified.

D. 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 cast 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 cast 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.

E. 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 cast 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 cast stone surfaces to receive sealant.
2) Install compressible backer rod in joints before applying sealant unless otherwise indicated.

## 3.3 INSTALLATION TOLERANCES

A. Variation from Plumb: Do not exceed 1/4 inch in 10 ft., or 1/2 inch maximum.

B. Variation from Level: Do not exceed 1/4 inch in 10 ft., or 1/2 inch maximum.

C. Variation in Joint Width: Do not vary joint thickness more than 1/8 inch in 36 inches or one-fourth of nominal joint width, whichever is less.

D. Variation in Plane between Adjacent Surfaces (Lipping): Do not vary from flush alignment with adjacent units or adjacent surfaces indicated to be flush with units by more than 1/16 inch, except where variation is due to warpage of units within tolerances specified.

## 3.4 ADJUSTING AND CLEANING

A. Remove and replace stained and otherwise damaged units and units not matching approved Samples. Cast stone may be repaired if methods and results are approved by Architect.

B. Replace units in a manner that results in cast stone matching approved Samples, complying with other requirements, and showing no evidence of replacement.

C. In-Progress Cleaning: Clean cast stone as work progresses.

1. Remove mortar fins and smears before tooling joints.
2. Remove excess sealant and smears as sealant is installed.

D. Final Cleaning: Clean cast stone no fewer than six days after completion of pointing and sealing, using nonacidic cleaner or clean water and stiff-bristle fiber brushes.

1. 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.
2. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
3. Test cleaning methods on sample area of cast stone; leave one-half of area uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of cast stone.
4. Protect adjacent surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
5. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.

**END OF SECTION 04 7200**

# SECTION 05 1200 – STRUCTURAL STEEL 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. Structural steel.
2. Base plates, shear stud connectors and related accessories.
3. Shrinkage-resistant grout.

### 1.3 DEFINITIONS

A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.

### 1.4 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

### 1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

### 1.6 ACTION SUBMITTALS

A. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment Drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
5. Identify members not to be shop primed.

B. Delegated-Design Submittal: For structural-steel connections indicated on Drawings, whether or not fully detailed, to comply with design loads, include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

### 1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator, installer, professional engineer, and testing agency.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of shop-applied primers certifying material compatibility with field-applied primers and finish (top) coats.

D. Mill test reports for structural-steel materials, including chemical and physical properties.

E. Product Test Reports: For the following:

1. Bolts, nuts, and washers, including mechanical properties and chemical analysis.
2. Direct-tension indicators.
3. Tension-control, high-strength, bolt-nut-washer assemblies.
4. Shear stud connectors.

F. Field quality-control reports.

**1.8 QUALITY ASSURANCE**

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU or is accredited by the IAS Fabricator Inspection Program for Structural Steel (Acceptance Criteria 172).

1. 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. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1.

**1.9 DELIVERY, STORAGE, AND HANDLING**

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
2. Clean and relubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125, Grade F1852 bolt assemblies and for retesting bolt assemblies after lubrication.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

A. Comply with applicable provisions of the following specifications and documents:

1. ANSI 360.
2. ANSI Manual of Steel Construction: Load and Resistance Factor Design (LRFD).
3. ANSI 303.
4. RCSC's "Specification for Structural Joints Using High-Strength Bolts."

### 2.2 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A992.

B. Channels, Angles: ASTM A36.

C. Plate and Bar: ASTM A36.

D. Cold-Formed Hollow Structural Sections: ASTM A500, Grade B structural tubing.

E. Steel Pipe: ASTM A53, Type E or Type S, Grade B.

1. Finish: Black.

F. Steel Castings: ASTM A216, Grade WCB, with supplementary requirement S11.

G. Steel Forgings: ASTM A668.

H. Welding Electrodes: Comply with AWS requirements.

### 2.3 BOLTS AND CONNECTORS

A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436, Type 1, hardened carbon-steel washers; all with plain finish.

1. Direct-Tension Indicators: ASTM F959, Type 325-1, compressible-washer type with plain finish.

B. High-Strength A490 Bolts, Nuts, and Washers: ASTM F3125, Grade A490, Type 1, heavy-hex steel structural bolts or Grade F2280 tension-control, bolt-nut-washer assemblies with splined ends; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436, Type 1, hardened carbon-steel washers; all with plain finish.

1. Direct-Tension Indicators: ASTM F959, Type 490-1, compressible-washer type with plain finish.

C. Shear Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

### 2.4 RODS

A. Unheaded Anchor Rods: ASTM F1554, Grade 36.

1. Configuration: Straight or hooked as required.
2. Nuts: ASTM A563 heavy-hex carbon steel.

3. Washers: ASTM F436, Type 1, hardened carbon steel.
4. Finish: Plain.

B. Headed Anchor Rods: ASTM F1554, Grade 36, straight.

1. Nuts: ASTM A563 heavy-hex carbon steel.
2. Washers: ASTM F436, Type 1, hardened carbon steel.
3. Finish: Plain.

C. Threaded Rods: ASTM A36.

1. Nuts: ASTM A63 heavy-hex carbon steel.
2. Washers: ASTM F436, Type 1, hardened ASTM A36 carbon steel.
3. Finish: Plain.

**2.5 SHRINKAGE-RESISTANT GROUT**

A. 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.

**2.6 FABRICATION**

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI 303 and to ANSI 360.

1. Camber structural-steel members where indicated.
2. Fabricate beams with rolling camber up.
3. Identify high-strength structural steel in accordance with ASTM A6 and maintain markings until structural-steel framing has been erected.
4. Mark and match-mark materials for field assembly.
5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.

C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted in accordance with SSPC-SP 1 – Solvent Cleaning and SSPC-SP 3 – Hand Tool Cleaning.

F. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using automatic end welding of headed-stud shear connectors in accordance with AWS D1.1 and manufacturer's written instructions.

G. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.

1. Cut, drill, or punch holes perpendicular to steel surfaces.
2. Baseplate Holes: Cut, drill, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

## 2.7 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.

B. Weld Connections: Comply with AWS D1.1 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

## 2.8 SHOP PRIMING

A. 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.
2) PPG; Fast Dry 4190: www.ppgpaints.com.
3) Sherwin Williams; Protective and Marine Coatings, Steel Spec 4012 Universal Primer, B50 Series: www.sherwin-williams.com.
4) Tnemec; Tnemec Universal Primer Series AK02: www.tnemec.com.

B. Shop prime steel surfaces, except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
2. Surfaces to be field welded.
3. Surfaces of high-strength bolted, slip-critical connections.

C. Surface Preparation of Steel: 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:

1. SSPC-SP 6 commercial blast cleaning.

D. Priming: Immediately after surface preparation, apply primer in accordance with manufacturer's written instructions. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

## 2.9 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform shop tests and inspections.

1. Allow testing agency access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
2. Bolted Connections: Inspect and test shop-bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."

3. Welded Connections: Visually inspect shop-welded connections in accordance with AWS D1.1 and the following inspection procedures, at testing agency's option:

    a. Liquid Penetrant Inspection: ASTM E165.
    b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
    c. Ultrasonic Inspection: ASTM E164.
    d. Radiographic Inspection: ASTM E94/E94M.

4. In addition to visual inspection, test and inspect shop-welded shear stud connectors in accordance with requirements in AWS D1.1 for stud welding and as follows:

    a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear stud connector.
    b. Conduct tests in accordance with requirements in AWS D1.1 on additional shear stud connectors if weld fracture occurs on shear stud connectors already tested.

5. Prepare test and inspection reports.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

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

### 3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated on Drawings.

### 3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI 303 and ANSI 360.

B. Baseplates Bearing Plates and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.

1. Set plates for structural members on wedges, shims, or setting nuts as required.
2. Weld plate washers to top of baseplate.
3. Snug-tighten or pretension anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
4. Promptly pack shrinkage-resistant grout solidly between bearing surfaces and plates, so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for grouting.

C. Maintain erection tolerances of structural steel within ANSI 303.

D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure. Slope roof framing members to slopes indicated on Drawings.
2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection.

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

**3.4 FIELD CONNECTIONS**

A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint types indicated on Drawings or developed as part of the delegated design.

B. Weld Connections: Comply with AWS D1.1 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Comply with ANSI 303 and ANSI 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI 303 for mill material.

**3.5 REPAIR**

A. Galvanized Surfaces: Repair galvanizing with galvanized repair paint according to ASTM A780.

1. Clean field welds, bolted connections, and abraded areas.
2. Clean areas where galvanizing is damaged or missing.

B. Touchup Painting:

1. Immediately after erection, clean exposed areas where primer is damaged or missing, and paint with the 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.

**3.6 FIELD QUALITY CONTROL**

A. Special Inspections: Owner will engage a special inspector to perform the following special inspections:

1. Verify structural-steel materials and inspect steel frame joint details.
2. Verify weld materials and inspect welds.
3. Verify connection materials and inspect high-strength bolted connections.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

1. Bolted Connections: Inspect and test bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1.

    a. In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1 and the following inspection procedures, at testing agency's option:

        1) Liquid Penetrant Inspection: ASTM E165.
        2) Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
        3) Ultrasonic Inspection: ASTM E164.
        4) Radiographic Inspection: ASTM E94.

3. Field-welded Shear Connectors: In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1 for stud welding and as follows:

    a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
    b. Conduct tests according to requirements in AWS D1.1 on additional shear connectors if weld fracture occurs on shear connectors already tested.

**END OF SECTION 05 1200**

# 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.
2. Cordeck, Inc: www.cordeck.com
3. James River Steel, Inc.: www.jamesriversteel.com
4. New Millennium Building Systems, LLC: www.newmill.com
5. Roof Deck, Inc.: www.roofdeckinc.com
6. Vulcraft: 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 WR, 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.

## 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. Fasten deck to all roof beams as indicated in the structural drawings. The deck should be laid out in so far as possible to align deck flutes with steel roof members. Reference the Structural Drawings for a typical detail where deck flutes do not align with the steel roof members

C. Install temporary shoring before placing deck panels if required to meet deflection limitations.

D. Locate deck bundles to prevent overloading of supporting members.

E. 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.

F. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

G. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

H. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

I. 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 steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches long, and as follows, unless otherwise indicated on Structural Drawings:

1. Weld Diameter: Minimum 5/8 inch, nominal; unless otherwise indicated or required.
2. Weld Spacing: Weld edge and interior ribs of deck units with a minimum of two welds per deck unit at each support. Space welds 12 inches apart in the field of roof and 6 inches apart in roof corners and perimeter, based on roof-area definitions in FM Loss Prevention Data Sheet 1-28; unless otherwise indicated or required.
3. Weld Washers: Install weld washers at each weld location.

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. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and weld flanges to top of deck. Space welds not more than 12 inches apart with at least one weld at each corner.

1. Install reinforcing channels or zees in ribs to span between supports and weld.

E. 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.

F. 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.

B. Repair Painting:

1. Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.

C. Touchup Painting:

1. Immediately after erection:

a. Wire brush and clean rust spots, welds, and abraded areas.
b. Clean exposed areas where primer is damaged or missing.

c. Paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1) Apply by brush or spray to provide a minimum dry film thickness recommended by primer manufacturer.

**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 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, "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.
2. Jaimes Industries Inc.: www.jaimesind.com.
3. Marino\WARE: www.marinoware.com.
4. MBA Building Supplies, Inc.: www.mbastuds.com.
5. MRI Steel Framing LLC: www.mristeelframing.com
6. Telling Industries; 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. Interior Wall Framing

        1) Horizontal deflection of L/240 of the wall height under a horizontal load of 5 lbf/sq. ft.

            a) Exception: Limit deflection of walls to receive hard tile surfaces to L/360 of the wall height.

3. 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.
4. 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.

5. 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. Wall Studs: AISI S211.
2. Headers: AISI S212.
3. 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:

    a. For Base-Metal Thickness 0.0538 inch (16 gage) and Thicker: ST50H.

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 WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0538 inch (16 gage).
2. Minimum Flange Width: 2 inches.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges, and as follows:

1. Minimum Base-Metal Thickness: Matching steel studs.
2. Minimum Flange Width: 1-1/2 inches.

C. Slotted Deflection Track: Provide galvanized sheet steel track with slotted holes in flanges for mechanical anchorage of studs that accommodate deflection; provide screws and anti-friction bushings.

1. Minimum Base-Metal Thickness: Matching steel studs.
2. Track Depth: Matching steel studs.
3. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI S100.
4. Provide at partition heads to structure connections, where indicated on Drawings, and elsewhere as required to accommodate axial deflection.
5. Shall prevent cracking of finishes applied to framing resulting from deflection of structure above

D. At Contractor's option, the following products may be used instead of traditional framing and firestopping:

1. General: Provide components UL-listed for use in head of partitions and joint systems and as indicated on drawings.
2. Slotted Deflection and Firestop Track: Galvanized sheet steel track with slotted holes in flanges for mechanical anchorage of studs that accommodate deflection; provide screws and anti-friction bushings. Includes intumescent strip factory-applied to track flanges or web that expands when exposed to heat or flames to provide a perimeter joint seal.

    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) ClarkDietrich Building Systems; BlazeFrame (DSL 2): www.clarkdietrich.com.
        2) Marino\WARE; FAS Track 1000: www.marinoware.com.

3. Firestop Track: Galvanized sheet steel track with intumescent strip factory-applied to track flanges or web that expands when exposed to heat or flames to provide a perimeter joint seal.

    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) ClarkDietrich Building Systems; BlazeFrame (DL2): www.clarkdietrich.com.

4. Preformed Top Track Firestop Seal: Pre-formed firestop device field-applied to head of top track that expands when exposed to heat or flames to provide a perimeter joint seal.

    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) Hilti, Inc; Top Track Seal CFS TTS: www.us.hilti.com.

## 2.5 SOFFIT FRAMING

A. Soffit Frame: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0538 inch (16 gage).
2. Minimum Flange Width: 2 inches.

## 2.6 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.

## 2.7 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A36, zinc coated by hot-dip process according to ASTM A123.

B. Beam Framing Clip: Steel sheet clip designed to grip beam flange providing substrate framing for sheathing materials .

1. Steel Sheet: ASTM A1003, Structural Grade, Type H, metallic coated, Grade ST33H, G60 coating.

a. Minimum Base-Steel Thickness: 0.034 inch thick (22 gage), galvanized.

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. The Steel Network, Inc; GripClip: www.SteelNetwork.com.

C. 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.

D. 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.

E. 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.

F. Welding Electrodes: Comply with AWS standards.

**2.8 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 framing members supported by shims.

**2.9 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 WALL FRAMING**

A. Load-bearing Wall 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.

3. Align studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.
4. Align floor and roof framing directly over studs according to AISI S200, Section C1. Where framing cannot be aligned, continuously reinforce track to transfer loads or add additional cold-formed metal studs in the field to ensure alignment.
5. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure.
6. Install headers over wall openings wider than stud spacing. Locate headers above openings. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.

    a. Frame wall openings with not less than a double stud at each jamb of frame. Fasten jamb members together to uniformly distribute loads.
    b. Install tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.

B. Non-load-bearing Wall Framing:

1. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.
2. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:
3. Isolate steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

    a. Install slotted deflection tracks and anchor to building structure.
    b. Connect vertical deflection clips to bypassing studs and anchor to building structure.
    c. Connect drift clips to cold-formed steel framing and anchor to building structure.

C. Space studs as follows:

1. Stud Spacing: 16 inches, unless otherwise indicated on Drawings.

D. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar configurations.

E. 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.

F. 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.

G. 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 wall-framing system.

## 3.5 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.

## 3.6 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.

## 3.7 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.

## 3.8 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 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. Loose steel lintels.

2. Bent metal wall restraints at top of interior masonry walls.

### 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.

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.

### 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. 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. 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.

B. 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.

### 2.3 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.

## 2.4 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.

## 2.5 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.

## 2.6 MISCELLANEOUS FRAMING AND SUPPORTS

A. General:

1. Provide steel framing and supports as needed to complete the Work for:

a. 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.

## 2.7 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.

## 2.8 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

## 2.9 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.

## 2.10 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.
        2) Sherwin Williams; Protective and Marine Coatings, Steel Spec 4012 Universal Primer, B50 Series: www.sherwin-williams.com.
        3) Tnemec; Tnemec Universal Primer Series AK02: 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.

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, 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.

**3.3 INSTALLATION OF LOOSE STEEL LINTELS**

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

**3.4 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.

**3.5 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. Miscellaneous panels and sheathing.
3. Glass-mat gypsum sheathing.
4. Wood blocking, furring, 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. 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. WWPA: 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.
5. Include sheathing joint-and-penetration treatment materials for glass-mat gypsum sheathing.

### 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.
2. Hoover Treated Wood Products, Inc.: www. frtw. com.
3. Koppers Performance Chemicals, Inc.: www. koppersperformancechemicals. com.
4. Viance, LLC: www. treatedwood. com.

B. Preservative Treatment by Pressure Process: AWPA 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.

a. At Contractor's option, roof nailers may be non-preservative treated.

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, furring, and similar concealed members in contact with masonry or concrete.
4. Wood framing and furring 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.
2. Hoover Treated Wood Products, Inc.: www. frtw. com.
3. Koppers Performance Chemicals, Inc.: www. koppersperformancechemicals. com.
4. Viance, LLC: 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, furring 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.

D. For furring strips for installing plywood or other paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

## 2.6 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.

## 2.7 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.
   b. Georgia-Pacific Gypsum: DensGlass Sheathing: www. gp. com.
   c. National Gypsum Company; Gold Bond Brand eXP Sheathing: www. nationalgypsum. com.
   d. United States Gypsum Co.; Securock Brand Glass-Mat Sheathing; 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.

## 2.8 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. 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.

## 2.9 MISCELLANEOUS MATERIALS

A. Sill-Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to suit width of sill members indicated.

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

a. Owens Corning Insulating Systems, LLC; ProPink ComfortSeal Sill Gasket: www. owenscorning. com.
b. Dupont/Dow; Sill Seal Foam Gasket: www. dupont. com.

B. Construction Adhesives: Adhesives complying with ASTM C557 or ASTM D3498 and approved for use indicated by adhesive manufacturer

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

a. Franklin International, Inc; Titebond GREENchoice Heavy Duty Construction Adhesive: www. titebond. com.
b. Liquid Nails, a brand of PPG Industries, Inc.; LN-903 Heavy Duty Construction Adhesive (Low VOC): www. liquidnails. com.

C. Organic Felt: Asphalt-saturated organic felts, nonperforated and complying with the following:

1. ASTM D226: Type I.

D. Sheathing Tape for Glass-Mat Gypsum Sheathing: Self-adhering glass-fiber tape, minimum 2 inches wide, 10 by 10 or 10 by 20 threads/inch, of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.

E. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.

# 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. Install sill sealer gasket to form continuous seal between sill plates and foundation walls.

E. Do not splice structural members between supports unless otherwise indicated.

F. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.

G. 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.

H. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use copper naphthenate for items not continuously protected from liquid water.

I. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous organic felt separator between wood and metal decking.

J. Where non-preservative treated roof nailers are installed adjacent to masonry or concrete, install continuous organic felt separator between wood and masonry or concrete.

K. 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.

L. 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.

**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. Coordinate wall parapet and roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

D. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

E. Coordinate sheathing installation 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.

F. 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.

### 3.3 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. Wall and Roof Sheathing:

    a. Nail to wood framing.
    b. Screw to cold-formed metal framing.
    c. Space panels 1/8 inch apart at edges and ends.

2. Subflooring:

    a. Glue and nail to wood framing.
    b. Screw to cold-formed metal framing.
    c. Space panels 1/8 inch apart at edges and ends.

3. Underlayment:

    a. Nail or staple to subflooring.
    b. Space panels 1/32 inch apart at edges and ends.
    c. Fill and sand edge joints of underlayment immediately before installing flooring.

### 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.

E. Seal sheathing joints in accordance with sheathing manufacturer's written instructions.

1. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

**END OF SECTION 06 1000**

# SECTION 06 4023 - INTERIOR ARCHITECTURAL WOODWORK

## 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. Cabinets and millwork.
    a. Plastic laminate clad cabinets and millwork.
2. Countertops.
    a. Solid surfacing countertops.
3. Window stools.
    a. Solid surfacing window stools.

### 1.3 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections, to ensure that interior architectural woodwork can be supported and installed as indicated.

### 1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

### 1.5 ACTION SUBMITTALS

A. Product Data: For each type of product, including, but not limited to, the following:

1. Cabinet hardware and other accessories.
2. Adhesives.
3. Shop finishing materials.
4. Wood-Preservative Treatment:
    a. Include data and warranty information from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.
    b. Indicate type of preservative used and net amount of preservative retained.
    c. Include chemical-treatment manufacturer's written instructions for finishing treated material and manufacturer's written warranty.
5. Fire-Retardant Treatment: Include data and warranty information from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.
6. Waterborne Treatments: For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories

1. Include the following:

a. Dimensioned plans, elevations, and sections.
b. Attachment details.

2. Show locations and sizes of furring, blocking, and hanging strips, including blocking and reinforcement concealed by construction and specified in other Sections.
3. Show locations and sizes of cutouts and holes for items installed in architectural woodwork

C. Samples for Initial Selection:

1. Where colors and finishes are not specified, submit 3 sets of color and finish selection charts or chips

D. Samples or Verification: For each exposed product and for each shop-applied color and finish specified. Provide three samples of each of the following:

1. Plastic Laminates: 12 by 12 inches, for each type, color, pattern, and surface finish.
2. Solid Surfacing: 4 by 4 inches, for each type, color, pattern, and finish.

**1.6 INFORMATIONAL SUBMITTALS**

A. Qualification Data: For fabricator.

B. Evaluation Reports: For preservative-treated and fire-retardant-treated wood materials, from ICC-ES.

**1.7 QUALITY ASSURANCE**

A. Fabricator Qualifications: Company specializing in fabricating and installing the products specified in this section with minimum five years of documented experience

1. Fabricator shall also be the installer.

B. Single Source Responsibility: Provide and install interior architectural woodwork from single fabricator.

**1.8 DELIVERY, STORAGE, AND HANDLING**

A. Comply with the Architectural Woodwork Standards, Section 2.

B. Do not deliver interior architectural woodwork until painting and similar finish operations that might damage woodwork have been completed in installation areas.

C. Store woodwork in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1. Handle and store fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions.

**1.9 FIELD CONDITIONS**

A. Environmental Limitations: Do not deliver or install interior architectural woodwork until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels designed for building occupants for the remainder of the construction period.

B. Field Measurements: Where interior architectural woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings.

1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being concealed by construction, and indicate measurements on Shop Drawings.

**PART 2 - PRODUCTS**

**2.1 ARCHITECTURAL WOODWORK, GENERAL**

A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.

1. The Contract Documents may contain requirements that are more stringent than the Architectural Woodwork Standards. Comply with Contract Documents and Architectural Woodwork Standards.

B. Wood Moisture Content: Comply with requirements of the Architectural Woodwork Standards for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas and as follows:

1. Wood Moisture Content: 5 to 10 percent.

**2.2 WOOD MATERIALS**

A. Hardwood Lumber: As indicated in this section for each item specified.

B. Hardwood Plywood (Veneer-Faced Panel Products): As indicated in this section for each item specified and as follows:

1. HPVA HP-1.
2. Made with adhesive containing no urea formaldehyde.

C. Softwood Plywood: DOC PS 1.

1. Made with adhesive containing no urea formaldehyde.

D. Medium Density Overly (MDO) Plywood: MDO-General, DOC PS 1, Exterior, Grade B-C.

1. Provide smooth resin-impregnated surface ply, approximately 1/16 inch thick, bonded to each face.

E. Particleboard (Medium Density): ANSI A208.1, Grade M-2.

1. Made with binder containing no urea formaldehyde.

F. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade 130.

1. Made with binder containing no urea formaldehyde.

**2.3 PRESERVATIVE-TREATED-WOOD 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.

2. Hoover Treated Wood Products, Inc.: www.frtw.com.
3. Koppers Performance Chemicals, Inc.: www.koppersperformancechemicals.com.
4. Viance, LLC: www.treatedwood.com.

B. Preservative-Treated-Wood Materials: Provide with water-repellent preservative treatment complying with AWPA N1 (dip, spray, flood, or vacuum-pressure treatment).

1. Preservative Chemicals: 3-iodo-2-propynyl butyl carbamate (IPBC).
2. Use chemical formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants in solution to distinguish treated material from untreated material.

C. Extent of Preservative-Treated Wood Materials: Treat interior architectural woodwork in contact with concrete or masonry.

**2.4 FIRE-RETARDANT-TREATED WOOD 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.
2. Hoover Treated Wood Products, Inc.: www.frtw.com.
3. Koppers Performance Chemicals, Inc.: www.koppersperformancechemicals.com.
4. Viance, LLC: www.treatedwood.com.

B. Fire-Retardant-Treated Wood Materials: Where fire-retardant-treated materials are indicated, use materials complying with requirements that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products according to test method indicated by a qualified testing agency.

1. Use treated materials that comply with requirements of the Architectural Woodwork Standards. Do not use materials that are warped, discolored, or otherwise defective.
2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
3. Identify fire-retardant-treated materials with appropriate classification marking of qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.

C. Fire-Retardant-Treated Lumber and Plywood: Products with a flame-spread index of 25 or less when tested according to ASTM E84, 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. Kiln-dry lumber and plywood after treatment to a maximum moisture content of 19 and 15 percent, respectively.
2. For items indicated to receive a stained, transparent, or natural finish, use organic resin chemical formulation.

D. Fire-Retardant Particleboard: Made from softwood particles and fire-retardant chemicals mixed together at time of panel manufacture, to achieve flame-spread index of 25 or less and smoke-developed index of 25 or less according to ASTM E84.

1. For panels 3/4 inch (19 mm) thick and less, comply with ANSI A208.1 for Grade M-2, except for the following minimum properties: modulus of rupture, 1600 psi; modulus of elasticity, 300,000 psi; internal bond, 80 psi; and screw-holding capacity on face and edge, 250 and 225 lbf, respectively.

E. Fire-Retardant Fiberboard: Medium-density fiberboard (MDF) panels complying with ANSI A208.2, made from softwood fibers, synthetic resins, and fire-retardant chemicals mixed together at time of panel manufacture, to achieve flame-spread index of 25 or less and smoke-developed index of 200 or less according to ASTM E84.

## 2.5 LAMINATE MATERIALS

A. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as indicated or recommended for specific applications.

1. Colors, Patterns, and Finishes: As indicated in Color Codes on Drawings

a. For semiexposed Grade CLS laminate: Color to be white.

B. Edgebanding: Rigid PVC extrusions, flat shaped, smooth texture, through color with satin finish. Width to match component thickness. Match adjacent laminate in color, pattern, and finish.

1. 0.118 inch (3 mm) thick at doors, drawer fronts and countertops.
2. 0.039 inch (1 mm) thick elsewhere, including exposed exterior cabinet members, top edges of drawer boxes, adjustable shelves, and interior panels.

## 2.6 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. Colors, Patterns, and Finishes: As indicated in Color Codes on Drawings

## 2.7 MISCELLANEOUS MATERIALS

A. Support Faming, Grounds, and Concealed Blocking: Comply with Section 06 1000 - Rough Carpentry.

B. Provide self-drilling screws for metal-framing supports, as recommended by metal-framing manufacturer.

C. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage.

1. Provide metal expansion sleeves or expansion bolts for post-installed anchors.
2. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

D. Solid Surfacing Joint Adhesive: Manufacturer’s standard one or two-part adhesive for inconspicuous, non-porous joints.

E. Adhesive for Bonding Plastic Laminate: Product recommended by fabricator for application.

1. Adhesive for Bonding Edges (edgebanding): Hot-melt adhesive.

F. Installation Adhesives: Products recommended by fabricator for each substrate for secure anchorage.

## 2.8 CABINET HARDWARE AND OTHER ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets.

B. Cabinet Hardware, General: BHMA A156.9, types as indicated for quality grade specified.

1. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated. Unless otherwise indicated, provide the following finish:

a. Satin Chrome: BHMA 626.

2. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

C. Butt Hinges: 5-knuckle butt hinge, overlay type, Grade 1, with hospital tip and non-removable pin. 0.095 inch thick, minimum. Stainless steel.

1. Provide two hinges for doors less than 48 inches high and provide three hinges for doors more than 48 inches high.
2. Provide four hinges for tall cabinet doors.

D. Drawer Slides: ANSI/BHMA A156.9, Type B05091.

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.

E. Back-Mounted Pulls: Back mounted, solid metal, wire pulls, 4 inches wide.

1. Available Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Hafele America Co.; Item No. 117.50.610, Wire Handle, Matt Stainless Steel: www.hafele.com.

2. Provide at wall cabinets and tall cabinets.

F. Catches: Magnetic catches, ANSI/BHMA A156.9, B03141.

1. Available Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Hafele America Co.; Model 246.26.702: www.hafele.com.
b. Stanley; SP46

G. Elbow Catches for Inactive Leaf of Pairs of Doors: ANSI/BHMA A156.9, B33023.

1. Available Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Ives No. 2: www.iveshinges.com.

H. Door and Drawer Silencers: ANSI/BHMA A156.16, L03011.

I. Cabinet Locks: Keyed locks, cam or bolt type, pin tumbler, steel or brass material.

1. Complying with ANSI/BHMA A156.11, Grade 1
2. Provide 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.

J. Shelf Rests - Pin Type: ANSI/BHMA A156.9, B04013; metal. Standard side-mounted system using multiple drilled holes in cabinet sides for pin supported shelf rests, satin chrome finish, for nominal 1 inch spacing adjustments

K. Grommets for Cable Passage: 2-inch OD, unless otherwise indicated, molded-plastic grommets and matching plastic caps with slot for wire passage.

1. Color: Black.
2. Available Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Doug Mockett & Company Inc.; TG Series: www.mockett.com.

L. Countertop Support Brackets:

1. Concealed Flush Mount (Inside Wall Mounted) Brackets: Fabricated from 6063-T6 extruded aluminum horizontal tee and vertical, concealed, L-shape. 2 by 2 by 1/4 inch thick tee. 2 by 2 by 1/4 inch thick L-shape.

a. Finish: Black.
b. Size: 18 by 20 inches unless otherwise indicated.
c. Maximum Weight: 300lbs per bracket.
d. Locations: Provide where concealed flush mount is indicated on Drawings.
e. Basis of Design: Subject to compliance with requirements, provide Rangine Corp.; Rakks EH-FM Series, Inside Wall Mount Counter Support Bracket: www.rakks.com, or a comparable product by one of the following:

1) A&M Hardware, Inc.; www.aandmhardware.com.

## 2.9 FABRICATION, GENERAL

A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.

B. Fabricate interior architectural woodwork to dimensions, profiles, and details indicated.

1. Ease edges to radius indicated for the following:

a. Edges of Solid-Wood (Lumber) Members: 1/16 inch unless otherwise indicated.
b. Edges of Rails and Similar Members More Than 3/4 Inch Thick: 1/8 inch.

C. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site.

1. Disassemble components only as necessary for shipment and installation.
2. Where necessary for fitting at site, provide allowance for scribing, trimming, and fitting.
3. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled.

a. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting.
b. Verify that parts fit as intended, and check measurements of assemblies against field measurements indicated on approved Shop Drawings before disassembling for shipment.

D. Provide cutouts for plumbing fixtures, inserts, appliances, outlet boxes and fixtures and fittings. Verify locations of cutouts from on-site dimensions. Seal cut edges.

1. Locate openings accurately and use templates to produce accurately sized and shaped openings

E. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs.

1. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
2. Cap exposed plastic laminate finish edges with material of same finish and pattern, unless otherwise indicated.

F. Cabinets and Millwork:

1. Assembly: Shop assemble cabinets and millwork for delivery to site in units easily handled and to permit passage through building openings.
2. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.

G. Countertops:

1. Fabricate tops in one piece, unless size dictates multiple pieces.

## 2.10 PLASTIC LAMINATE CABINETS AND MILLWORK

A. Architectural Woodwork Standards Grade: Premium.

1. Comply with AWS Section 10 - Casework and Section 6 - Millwork.

B. Casework Construction Type: Frameless.

C. Door and Drawer Style: Flush Overlay.

D. 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. Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
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.

E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by quality standard.

F. Exposed Surfaces:

1. Horizontal Surfaces: Grade HGS (0.047 inch thick).
2. Vertical Surfaces: Grade VGS (0.028 inch thick).
3. Door and Drawer Edges: PVC edge banding, 0.118 inch (3mm) thick, matching laminate in color, pattern, and finish.
4. Other Edges: PVC edge banding, 0.039 inch (1mm) thick, matching laminate in color, pattern, and finish
5. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels.

G. Semi-exposed Surfaces:

1. 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.

    a. Colors and Patterns: Same as exposed face.

2. All other semiexposed surfaces: Grade CLS, unless otherwise indicated.
3. Edges of Laminate Shelves: PVC edge banding, 0.039 inch (1mm) thick, matching laminate in color, pattern, and finish.

H. Concealed Surfaces:

1. Concealed Backs of Panels with Exposed or Semi-exposed Surfaces: Grade BKL (0.020 inch thick).

I. All cabinets and millwork shall be fabricated with balance construction.

J. Cabinet and millwork sizes, layouts, and configurations: As indicated on Drawings.

## 2.11 COUNTERTOPS

A. Quality Standard: Premium Grade, in accordance with AWS, unless noted otherwise.

1. Comply with AWS Section 11 – Countertops.

B. Solid Surface Countertops: Solid surfacing over continuous substrate.

1. Flat Sheet Thickness: 1/2 inch, minimum.
2. Substrate/Subtops: Particle board, medium density fiberboard (MDF) or plywood.

a. Thickness: 3/4 inch.
b. Provide preservative treatment for subtops at sink or other wet locations.

3. Exposed Edge Treatment: Built up to minimum 1-1/4 inch thick; eased square edge; use marine edge at sinks.
4. Back and End Splashes: Same sheet material, eased square top; minimum 4 inches high.

a. Field applied.

5. Fabricate in accordance with manufacturer's standard requirements.

## 2.12 PLASTIC LAMINATE PANELS BELOW TOILET ROOM COUNTERTOPS

A. General:

1. Removable plastic laminate access panels below toilet room countertops/sinks where concealed tee-shaped vanity brackets are used.

B. Architectural Woodwork Standards Grade: Premium.

1. Comply with AWS Section 8 – Wall/Ceiling Surfacing and Partitions.

C. Performance Requirements:

1. Fire-Retardant-Treated Paneling: Provide panels consisting of fire-retardant cores. Panels shall have flame-spread index of 25 or less and smoke-developed index of 450 or less per ASTM E 84.

D. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by quality standard.

E. Panel Construction:

1. Design: Flat panel.
2. Corner Profile in Elevation: Square; unless otherwise indicated on Drawings.
3. Panel Thickness: 3/4 inch.
4. Panel Sizes: As indicated on Drawings.
5. Panel Faces: HPDL Grade VGS (0.028 inch thick).
6. Panel Backs: HPDL Grade BKL (0.020 inch thick).
7. Panel Edges: Same as face.
8. Core: Particle board or medium density fiberboard (MDF); fire-retardant.

F. Mounting Method: Z-clips.

## 2.13 WINDOW STOOLS

A. Quality Standard: Premium Grade, in accordance with AWS, unless noted otherwise.

B. Solid Surface Window Stools: Solid surfacing over continuous substrate.

1. Flat Sheet Thickness: 1/2 inch, minimum.

2. Exposed Edge Treatment: Solid surfacing built up to minimum 1-1/4 inch thick; square edge, unless otherwise indicated on Drawings.
3. Substrate: As indicated on Drawings.

**PART 3 - EXECUTION**

**3.1 PREPARATION**

A. Before installation, condition interior architectural woodwork to humidity conditions in installation areas for not less than 72 hours prior to beginning of installation.

B. Before installing interior architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming of concealed surfaces.

**3.2 INSTALLATION**

A. Grade: Install interior architectural woodwork to comply with same grade as item to be installed.

B. Assemble interior architectural woodwork and complete fabrication at Project site to the extent that it was not completed during shop fabrication.

C. Install interior architectural woodwork level, plumb, true in line, and without distortion.

1. Shim as required with concealed shims.
2. Install level and plumb to a tolerance of 1/8 inch in 96 inches.

D. Scribe and cut interior architectural woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Complete finishing work specified in this Section to extent not completed at shop or before installation of paneling. Fill nail holes with matching filler where exposed.

1. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are shop applied.

F. Preservative-Treated Wood: Where cut or drilled in field, treat cut ends and drilled holes according to AWPA M4.

G. Fire-Retardant-Treated Wood: Install fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions, including those for adhesives used to install woodwork.

H. Anchor interior architectural woodwork to anchors or blocking built in or directly attached to substrates.

1. Secure with countersunk, concealed fasteners and blind nailing.
2. Use fine finishing nails for exposed fastening, countersunk and filled flush with interior architectural woodwork.
3. For shop-finished items, use filler matching finish of items being installed.

I. Cabinets and Millwork:

1. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch in 96 inches using concealed shims.

a. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

b. Install cabinets without distortion so doors and drawers fit openings and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
c. Maintain veneer sequence matching of cabinets with transparent finish.
d. Fasten cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head screws sized for not less than 1-1/2-inch penetration into wood framing, blocking, or hanging strips.

J. Countertops:

1. General:

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. 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 plastic laminate countertops and solid surfacing subtops by saturating with varnish.

c. Apply sealant to gaps at walls with mildew-resistant silicone sealant; comply with Section 07 9200 "Joint Sealants."

2. Solid surfacing countertops:

a. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.
b. 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.
c. 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.

d. 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.

K. Plastic Laminate Panels Below Toilet Room Countertops:

1. Using z-clips, install removable plastic laminate access panels below toilet room countertops where concealed tee-shaped vanity brackets are installed.

L. Window Stools:

1. General:

a. Install window stools 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.

2. Solid Surfacing Window Stools:

    a. Secure window stools to substrate with adhesive according to solid surface material manufacturer's written instructions.
    b. Install in one piece without seams unless unavoidable.

        1) Seams: Align adjacent surfaces and, using adhesive in color to match solid surfacing, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

## 3.3 REPAIR

A. Repair damaged and defective interior architectural woodwork, where possible, to eliminate functional and visual defects and to result in interior architectural woodwork being in compliance with requirements of Architectural Woodwork Standards for the specified grade.

B. Where not possible to repair, replace defective woodwork.

C. Shop Finish: Touch up finishing work specified in this Section after installation of interior architectural woodwork.

1. Fill nail holes with matching filler where exposed.
2. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are shop applied.

## 3.4 CLEANING

A. Clean interior architectural woodwork on exposed and semiexposed surfaces.

**END OF SECTION 06 4023**

# 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 ADMINISTRATIVE REQUIREMENTS

A. Product Coordination and Limitations: Provide materials and components that when combined with materials and components specified in other sections form exterior wall assemblies as detailed on Drawings complying with NFPA 285 testing and acceptance criteria.

### 1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

### 1.5 INFORMATIONAL SUBMITTALS

A. NFPA 285 Documentation:

1. General: For each product, submit documentation listing all possible compatible materials and components that could be used together in a wall assembly to comply with NFPA 285 testing and acceptance criteria.
2. Project Specific:

a. Provide complete list of products that will be used to form exterior wall assemblies as detailed on Drawings.

1) For each product, include product name, model number, and manufacturer.
2) Indicate which products are provided in this section.

b. Provide documentation certifying that these products when combined to form exterior wall assemblies as detailed on Drawings comply with NFPA 285 testing and acceptance criteria.

### 1.6 QUALITY ASSURANCE

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

### 1.7 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.

B. NFPA 285 Compliance:

1. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components.
2. Provide materials and components that when combined with materials and components specified in other sections form exterior wall assemblies as detailed on Drawings complying with NFPA 285 testing and acceptance criteria.

### 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.
2. BASF Corp., Master Builders Solutions; Masterseal 615: www.master-builders-solutions.basf.us.
3. The Euclid Chemical Company; Dehydratine 75: www.euclidchemical.com.
4. Henry, a Carlisle Company.; Non-Fibered Asphalt Emulsion Dampproofing 788: www.henry.com.
5. Henry, a Carlisle Company.; HE789 FIB Asphalt Emulsion Dampproofing: www.henry.com.
6. Karnak Corp.; 100 Non-fibrated Emulsion Dampproofing: www.karnakcorp.com.
7. Karnak Corp.; 220 Fibered Emulsion Dampproofing: www.karnakcorp.com.
8. W. R. Meadows, Inc.; Sealmastic Type I: www.wrmeadows.com.
9. W. R. Meadows, Inc.; Sealmastic Type II: 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 2423 - DIRECT-APPLIED FINISH 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. Direct-Applied Finish System (DAFS) for exterior and interior soffits and ceilings (synthetic plaster).

### 1.3 ABBREVIATIONS

A. DAFS: Direct-Applied Finish Systems.

### 1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

### 1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include data on system materials, product characteristics, performance criteria and system limitations.

B. Shop Drawings: For direct-applied finish systems.

1. Include plans, details, joint patterns, joint details, and molding profiles.

C. Samples for Initial Selection: For each type of finish-coat color and texture indicated.

1. Where colors and finishes are not specified, submit 3 sets of color and finish selection charts or chips

D. Samples for Verification:

1. For each type of finish-coat color and texture indicated.

a. Submit three actual samples of selected coating on specified substrate, minimum 12 inches square, illustrating project colors and textures.

### 1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.

B. Substrate Compatibility Certificates: From manufacturer of direct-applied finish system certifying that substrates are compatible with direct-applied finish system.

C. Sample Warranty: For manufacturer's warranty.

## 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: Company specializing in performing the work of this section with minimum 5 years of documented experience.

## 1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original, unopened packages with manufacturers' labels intact and clearly identifying products.

B. Store materials inside and under cover; keep them dry and protected from weather, direct sunlight, surface contamination, aging, corrosion, damaging temperatures, construction traffic, and other causes.

## 1.9 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions and ambient outdoor air, humidity, and substrate temperatures permit DAFS to be applied, dried, and cured according to manufacturers' written instructions and warranty requirements.

1. Proceed with installation of adhesives or coatings only when ambient temperatures have remained, or are forecast to remain, above 40 deg F for a minimum of 24 hours before, during, and after application. Do not apply DAFS adhesives or coatings during rainfall.

## 1.10 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace components of DAFS that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Bond integrity and weathertightness.
   b. Deterioration of DAFS finishes and other DAFS materials beyond normal weathering.

2. Warranty coverage includes the following DAFS components:

   a. DAFS finish, including base coats, finish coats, and reinforcing mesh.
   b. DAFS accessories, including trim components and flashing.

3. Warranty Period: Five years from date of Substantial Completion.

# PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

A. Source Limitations: Obtain DAFS from single source from single DAFS manufacturer and from sources approved by DAFS manufacturer as tested and compatible with DAFS components.

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

1. Dryvit Systems, Inc.; Direct Applied TAFs: www.dryvit.com.
2. Parex USA, Inc.; ACF Soffit: www.parex.com.
3. Sika.; Synergy Direct Finish Systems for Soffits and Ceilings: www.senergy-mbcc.sika.com.com.
4. Sto Corp.; Or Equal: www.stocorp.com.

## 2.2 PERFORMANCE REQUIREMENTS

A. DAFS Performance: Comply with ASTM E2568 and with the following:

1. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/450, when tested in accordance with ASTM E84.
2. Adhesion of Water-Resistive Coating to Substrate: For each combination of coating and substrate, minimum tensile bond strength of 15 psi, when tested in accordance with ASTM E2134 .
3. Water Penetration Resistance: No water penetration beyond the plane of the base coat after 15 minutes, when tested in accordance with ASTM E331 at 6.24 psf differential pressure.
4. Salt Spray Resistance: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating after 300 hours exposure in accordance with ASTM B117, using at least three samples matching intended assembly, at least 4 by 6 inches in size.
5. Freeze-Thaw Resistance: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating when viewed under 5x magnification after 10 cycles, when tested in accordance with ICC-ES AC219 or ICC-ES AC235.
6. Weathering Resistance: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating when viewed under 5x magnification after 2000 hours of accelerated weathering conducted in accordance with ASTM G153 Cycle 1 or ASTM G155 Cycles 1, 5, or 9.
7. Water Degradation Resistance: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating after 14 days exposure, when tested in accordance with ASTM D2247.
8. Mildew Resistance: No growth supported on finish coating during 28 day exposure period, when tested in accordance with ASTM D3273.
9. Abrasion Resistance of Finish: No cracking, checking or loss of film integrity when tested in accordance with ASTM D968 with 113.5 gallons of sand.

## 2.3 DAFS MATERIALS

A. Top Coat (Finish Coating): Water-based, air curing, acrylic or polymer-based finish with integral color and texture.

1. Texture: Sand/Fine.
2. Color: As selected by Architect from manufacturer's full range.

B. Base Coat: Acrylic- or polymer-modified, fiber reinforced Portland cement coating; compatible with substrate board and reinforcing mesh.

1. Portland Cement: ASTM C150/C150M, Type I or II.

C. Reinforcing Mesh: Balanced, alkali-resistant, open-weave, glass-fiber mesh treated for compatibility with other DAFS materials, made from continuous multi-end strands with retained mesh tensile strength of not less than 120 lbf/in. according to ASTM E2098/E2098M and the following:

1. Weight: Not less than 4.0 oz./sq. yd.

D. Substrate Board:

1. Exterior Locations: Refer to Section 06 1000 - Rough Carpentry, for glass-mat gypsum sheathing.

## 2.4 ACCESSORY MATERIALS

A. Primers: Primers as recommended by DAFS manufacturer for substrate and project conditions.

B. Trim Accessories:

1. General: Types and profiles as designated or required to suit conditions indicated and to comply with DAFS manufacturer's written instructions; manufactured from UV-stabilized PVC; and complying with ASTM D1784 and ASTM C1063.

C. Sealants: Silicone; compatible with DAFS materials and as specified in Section 07 9200 - Joint Sealants.

1. Color: To match DAFS top coat color.

D. Water: Potable.

**2.5 MIXING**

A. Comply with DAFS manufacturer's requirements for combining and mixing materials. Do not introduce admixtures, water, or other materials, except as recommended by DAFS manufacturer. Mix materials in clean containers. Use materials within time period specified by DAFS manufacturer or discard.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that substrate is sound and free of oil, dirt, other surface contaminants, efflorescence, loose materials, or protrusions that could interfere with DAFS installation and is of a type and construction that is acceptable to DAFS manufacturer. Do not begin work until substrate and adjacent materials are complete and thoroughly dry.

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

1. Begin coating application only after surfaces are dry.
2. Application of coating indicates acceptance of surfaces and conditions.

**3.2 PREPARATION**

A. Protect contiguous work from moisture deterioration and soiling caused by application of DAFS. Provide temporary covering and other protection needed to prevent spattering of exterior finish coats on other work.

B. Prepare and clean substrates to comply with DAFS manufacturer's written instructions.

**3.3 INSTALLATION**

A. General: Comply with ASTM C1397, ASTM E2511, and DAFS manufacturer's written instructions for installation of DAFS as applicable to each type of substrate indicated.

B. Apply primer to substrate as recommended by DAFS manufacturer for project conditions.

C. Trim: Apply trim accessories at perimeter of DAFS, at expansion joints, and elsewhere as indicated or required by DAFS manufacturer.

D. Base Coat Application:

1. Apply full coverage to exposed substrates.

a. Dry coat thickness not less than that recommended by DAFS manufacturer.

2. Reinforcing Mesh: Embed reinforcing mesh in wet base coat to produce wrinkle-free installation with mesh continuous at corners, overlapped not less than 2-1/2 inches or otherwise treated at joints to comply with ASTM C1397.

a. Do not lap reinforcing mesh within 8 inches of corners. Completely embed mesh, applying additional base-coat material if necessary, so reinforcing-mesh color and pattern are invisible.

3. Additional Reinforcing Mesh: Apply strip-reinforcing mesh around openings, extending 4 inches beyond perimeter. Apply additional 9-by-12-inch strip-reinforcing mesh diagonally at corners of openings (re-entrant corners). Apply 8-inch-wide, strip-reinforcing mesh at both inside and outside corners unless base layer of mesh is lapped not less than 4 inches on each side of corners.

a. Embed strip-reinforcing mesh in base coat before applying first layer of reinforcing mesh.

E. Finish-Coat Application

1. Primer: Apply over dry base coat as recommended by DAFS manufacturer.
2. Finish Coat: Apply full-thickness coverage over dry primed base coat, maintaining a wet edge at all times for uniform appearance, to produce a uniform finish of color and texture matching approved sample and free of cold joints, shadow lines, and texture variations.

a. Apply finish coat after base coat has dried not less than 24 hours.
b. Finish Coat Thickness: As recommended by DAFS manufacturer.

F. Seal control and expansion joints within the field of DAFS, using sealant in accordance with recommendations of sealant and DAFS manufacturers.

## 3.4 CLEANING AND PROTECTION

A. Remove temporary covering and protection of other work. Promptly remove coating materials from window and door frames and other surfaces outside areas indicated to receive DAFS coatings.

B. Clean DAFS surfaces and work areas of foreign materials resulting from DAFS operations.

C. Protect completed work from damage and soiling by subsequent work.

**END OF SECTION 07 2423**

# 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-retarding, 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 ng/(Pa s sq m) = 1 perm.

1. Vapor Retarder (Barrier): Has water vapor permeance of 0.1 perms maximum.

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 COORDINATION

A. Product Coordination and Limitations: Provide materials and components that when combined with materials and components specified in other sections form exterior wall assemblies as detailed on Drawings complying with NFPA 285 testing and acceptance criteria.

B. Where masonry walls are indicated to receive air barriers, coordinate with Section 04 2000 – Unit Masonry, and tool joints slightly concave or cut flush as recommended by air barrier manufacturer.

### 1.5 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.

### 1.6 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.

**1.7 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. NFPA 285 Documentation:

1. General: For each product, submit documentation listing all possible compatible materials and components that could be used together in a wall assembly to comply with NFPA 285 testing and acceptance criteria.
2. Project Specific:

a. Provide complete list of products that will be used to form exterior wall assemblies as detailed on Drawings.

1) For each product, include product name, model number, and manufacturer.
2) Indicate which products are provided in this section.

b. Provide documentation certifying that these products when combined to form exterior wall assemblies as detailed on Drawings comply with NFPA 285 testing and acceptance criteria.

D. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.

E. Field quality-control reports.

**1.8 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.

**1.9 PRECONSTRUCTION TESTING**

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on field mockups.

B. Mockup Testing: Air-barrier assemblies shall comply with performance requirements indicated, as evidenced by reports based on mockup testing by a qualified testing agency.

1. Provide the following tests as indicated in “Field Quality Control” Article.

a. Membrane Adhesion Test.
b. Wet Film Thickness Test.
c. Dry Film Thickness Test.
d. Air-Leakage Tests.
e. Air-Leakage-Location Tests.
f. Water Penetration.
g. Water Spray Test:

2. Notify Architect seven days in advance of the dates and times when mockups will be tested.

**1.10 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.

**1.11 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.

C. NFPA 285 Compliance:

1. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components.
2. Provide materials and components that when combined with materials and components specified in other sections form exterior wall assemblies as detailed on Drawings complying with NFPA 285 testing and acceptance criteria.

## 2.3 AIR BARRIER MATERIALS - VAPOR RETARDER AIR BARRIER (AIR/MOISTURE BARRIER)

A. Vapor Retarder Air Barrier Membrane, Fluid-Applied (Air/Moisture Barrier): 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.
b. Water Penetration: No water penetration at 6.24 psf per ASTM E331.
c. Water Vapor Permeance: 0.1 perms, maximum; ASTM E96/E96M, Method B.
d. Air Permeance: 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft.; ASTM E2178.
e. Elongation: 250 percent, minimum; ASTM D412.
f. Tensile Strength: 100 psi, minimum; ASTM D412.
g. Flame Spread Index: Less than 25, Class A; ASTM E84.
h. Smoke Developed Index: Less than 450, Class A; ASTM E84.
i. Nail Sealability: Pass, no leakage; ASTM D1970/D1970M.
j. Air barrier shall be an approved component of an NFPA 285 tested exterior wall assembly as detailed on Drawings; tested in accordance with, and complying with the acceptance criteria, of NFPA 285.

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

a. BASF; MasterSeal AWB 660 I: www.master-builders-solutions.basf.us
b. Carlisle Coatings & Waterproofing; Fire Resist Barritech NP: www.carlisleccw.com.
c. GCP Applied Technologies; Perm-a-Barrier NPL 10: www.gcpat.com.
d. Henry Company; Air-Bloc 16MR: www.henry.com.
e. Prosoco Inc.; R-Guard VB: www.prosoco.com.
f. Sto Corp.; StoGuard VaporSeal: www.stocorp.com.
g. Tremco Inc.; EXOAIR 130: www.tremcosealants.com.
h. W.R. Meadows; Air-Shield LSR: 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.

d. Transitions and flashings shall be an approved component of an NFPA 285 tested exterior wall assembly as detailed on Drawings; tested in accordance with, and complying with the acceptance criteria of NFPA 285.

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.
2) Momentive Performance Materials, Inc./GE; Elemax 5000 Liquid Flashing: www.siliconeforbuilding.com.
3) Prosoco Inc.; R-Guard FastFlash: www.prosoco.com.
4) Tremco, Inc.; Spectrem 1: 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.
2) Momentive Performance Materials, Inc./GE; UltraSpan UST/USM Pre-Cured Silicone Transition Sheet and Molded Corners: www.siliconeforbuilding.com.
3) Prosoco Inc.; R-Guard SureSpan EX: www.prosoco.com.
4) Tremco, Inc.; ProGlaze ETA and Spectrem Simple Seal: 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.
2) Momentive Performance Materials, Inc./GE; GE Elemax SS Flashing: 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:
2) Prosoco Inc.; R-Guard SS ThruWall: 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 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.

## 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 or a comparable product by one of the following:

a. AEP Span; Flush Panel www.aepspan.com.
b. Berridge Manufacturing Company; FW-12: www.berridge.com.
c. Fabral; 12-RO: www.fabral.com.
d. Metal Sales Manufacturing Corp.; Flush Face Series-12, TLC-1: www.metalsales.us.com.
e. Morin Corp., a Kingspan Group Company; Concealed A-12: www.morincorp.com.
f. Petersen Aluminum Corporation; Flush Wall Panel: 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: To match Centria Sedona, 785.

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. Extruded Aluminum Trim: Extruded aluminum; ASTM B221.

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

      a. Base extrusions, perimeters of openings and penetrations, and panel perimeters.

   2. Trim shall be finished to match panels

D. 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.

E. 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.

F. 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.
2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal wall panel manufacturer.

a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

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. Install extruded aluminum trim true to line and levels indicated to result in waterproof and weather-resistant performance without exposed fasteners.

E. 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. Provide formed trim only at areas where manufacturer does not offer extruded trim.
2. 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.
3. 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).

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 wall panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.

## 3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Water-Spray Test: After installation, test area of assembly as directed by Architect for water penetration according to AAMA 501.2.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect completed metal wall panel installation, including accessories.

D. Remove and replace metal wall panels where tests and inspections indicate that they do not comply with specified requirements.

E. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.

F. 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 5300.01 – EPDM MEMBRANE ROOFING

## 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. Cutting, patching, and repairs to an existing ethylene-propylene-diene-monomer (EPDM) roofing assembly.

B. Locations: Savage Elementary School.

### 1.3 ABBREVIATIONS

A. EPDM: Ethylene-propylene-diene-monomer.

### 1.4 DEFINITIONS

A. Roofing Terminology: Definitions in ASTM D1079 and glossary of NRCA's "The NRCA Roofing Manual: Membrane Roof Systems" apply to work of this Section.

### 1.5 PREINSTALLATION MEETINGS

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

1. Meet with Owner, Architect, Construction Manager, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing assembly manufacturer's representative, deck Installer, air barrier Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing assembly.
7. Review temporary protection requirements for roofing assembly during and after installation.
8. Review roof observation and repair procedures after roofing installation.

### 1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For insulation and roof assembly component fasteners, include copy of FM Approvals' RoofNav listing.

B. Shop Drawings: Include roof plans, sections, details, and attachments to other work, including the following:

1. Layout and thickness of insulation.
2. Base flashings and membrane terminations.
3. Flashing details at penetrations.
4. Tapered insulation, thickness, and slopes.
5. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
6. Tie-in with air barrier.
7. Walkway pad locations

C. Wind Uplift Resistance Submittal: For roofing assembly, indicating compliance with wind uplift performance requirements.

**1.7 INFORMATIONAL SUBMITTALS**

A. Qualification Data: For Installer and manufacturer.

B. Manufacturer Certificates:

1. Performance Requirement Certificate: Signed by roof membrane manufacturer, certifying that roofing assembly complies with requirements specified in "Performance Requirements" Article.

a. Submit evidence of complying with performance requirements.

C. Product Test Reports: For components of roof membrane and insulation, for tests performed by a qualified testing agency, indicating compliance with specified requirements.

D. Evaluation Reports: For components of roofing assembly, from ICC-ES.

E. Field quality-control reports.

F. Sample Warranties: For manufacturer's special warranties.

**1.8 CLOSEOUT SUBMITTALS**

A. Maintenance Data: For roofing assembly to include in maintenance manuals.

B. Certified statement from existing roof membrane manufacturer stating that existing roof warranty has not been affected by Work performed under this Section.

**1.9 QUALITY ASSURANCE**

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 5 years of documented experience.

B. Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years documented experience, and approved by manufacturer.

**1.10 DELIVERY, STORAGE, AND HANDLING**

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing assembly manufacturer. Protect stored liquid material from direct sunlight.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

### 1.11 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing assembly to be installed according to manufacturer's written instructions and warranty requirements.

### 1.12 WARRANTY

A. Existing Warranty: Modifications to existing roofing assembly:

1. Submit written verification signed by existing roof membrane manufacturer stating that the existing roof warranty has not been affected by Work performed under this Section.

B. Special Installer’s Project Warranty: Submit roofing Installer's warranty, signed by Installer, covering the Work of this Section, including all components of roofing assembly such as roof membrane, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, and walkway products, for the following warranty period:

1. Warranty Period: Two years from Date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Roof Assembly: Subject to compliance with requirements, provide roof assemblies from one of the following:

1. Carlisle SynTec Systems; www.carlislesyntec.com.
2. Holcim/Elevate (formerly Firestone Building Products); www.holcimelevate.com.
3. Johns Manville; www.jm.com.

B. Source Limitations: Obtain components for roofing assembly from one roof membrane manufacturer or manufacturers approved by roof membrane manufacturer.

### 2.2 ROOFING ASSEMBLY - GENERAL

A. Single-ply membrane roofing assembly consisting of the following:

1. EPDM single-ply roof membrane; fully adhered.
2. Cover board; fully adhered.
3. Insulation, including tappered insulation; first layer mechanically fastened, all subsequent layers fully adhered.
4. Walkway pads.

B. Design intent is to cut, patch, and repair existing roofing as needed, matching the materials and installation methods used in the initial installation and maintaining any current roofing assembly warranties.

1. Field verify the exact materials and installation methods used.

## 2.3 PERFORMANCE REQUIREMENTS

A. General Performance: Installed roofing assembly and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roofing and flashings shall remain watertight.

1. Accelerated Weathering: Roof membrane shall withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.
2. Impact Resistance: Roof membrane shall resist impact damage when tested according to ASTM D3746, ASTM D4272, or the Resistance to Foot Traffic Test in FM Approvals 4470.

B. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roof membrane manufacturer based on testing and field experience.

C. Completed roofing shall contain no wrinkles of such size as to restrict roof drainage.

D. Wind Uplift Resistance:

1. Calculate wind uplift pressures in accordance with the following:

a. Local codes and authorities having jurisdiction.
b. FM Approvals, LLC, RoofNav Ratings Calculator: www.roofnav.com.
c. Recommendations of the roofing assembly manufacturer.
d. As required for the conditions and roof configurations indicated on Drawings.

2. Design roofing assemblies to resist wind uplift pressures when tested according to FM Approvals 4474, UL 580, or UL 1897.

E. Comply with Factory Mutual (FM) Global and FM Approvals' RoofNav Listing requirements as follows:

1. Roof membrane, base flashings, and component materials shall comply with requirements in FM Approvals FM 4450 or FM Approvals FM 4470 as part of a roofing assembly, and shall be listed in FM Approvals' RoofNav for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals Certification markings.

a. Fire/Windstorm Classification: Class 1A-90.
b. Hail-Resistance Rating: SH.

2. Comply with the following Property Loss Prevention Data Sheets:

a. Data Sheet FM DS 1-28: Wind Design.
b. Data Sheet FM DS 1-29: Roof Deck Securement and Above-Deck Roof Components.
c. Data Sheet FM DS 1-49: Perimeter Flashing.

F. Minimum Insulation Requirements: Match existing number of layers, thicknesses, and R-values.

## 2.4 ETHYLENE-PROPYLENE-DIENE-MONOMER (EPDM) ROOFING

A. EPDM Sheet: ASTM D4637/D4637M, Type I or Type II to match existing, EPDM sheet.

1. Thickness: To match existing; 60 mils, nominal, unless field verification indicates otherwise.
2. Exposed Face Color: Black.

## 2.5 AUXILIARY ROOFING MATERIALS

A. General: Auxiliary materials recommended by roofing assembly manufacturer for intended use and compatible with other roofing components.

1. Adhesive and Sealants: Comply with VOC limits of authorities having jurisdiction.

B. Sheet Flashing: 60-mil-thick EPDM, partially cured or cured, according to application.

C. Bonding Adhesives: Manufacturer's standard.

D. Seaming Material: Factory-applied seam tape, width as recommended by manufacturer.

E. Lap Sealant: Manufacturer's standard, single-component sealant, colored to match membrane roofing.

F. Water Cutoff Mastic: Manufacturer's standard butyl mastic sealant.

G. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.

H. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening components to substrate, and acceptable to roofing assembly manufacturer.

I. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, molded pipe boot flashings, preformed inside and outside corner sheet flashings, reinforced EPDM securement strips, T-joint covers, in-seam sealants, termination reglets, cover strips, and other accessories.

## 2.6 ROOF INSULATION

A. General: Preformed roof insulation boards manufactured or approved by EPDM roof membrane manufacturer.

B. Match existing roof insulation; field verify the following is used in the existing roofing assembly:

1. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 1, Grade 2, glass-fiber mat facer on both major surfaces.

a. Compressive Strength: 20 psi.
b. Long Term Thermal Resistance (LTTR) R-value: At 1 inch thick; 5.7 at 75 degrees F.
c. Size: 48 by 48 inches or 48 by 96 inches.
d. Thickness: To match existing.

1) For tapered board: Slope as indicated; minimum thickness 1/2 inch.

e. Products: Subject to compliance with requirements, provide the following:

1) Carlisle SynTec Systems; InsulBase: www.carlislesyntec.com.
2) Holcim/Elevate (formerly Firestone Building Products); ISO 95+: www.holcimelevate.com.
3) Johns Manville; Enrgy 3:www.jm.com.

## 2.7 INSULATION ACCESSORIES

A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with other roofing assembly components.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing assembly manufacturer.

C. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer. Provide one of the following types:

1. Bead-applied, low-rise, one-component or multicomponent urethane adhesive.
2. Full-spread, spray-applied, low-rise, two-component urethane adhesive.

## 2.8 COVER BOARD

A. Provide one of the following types if any exist in the current roofing assembly; field verify:

1. High compressive strength polyisocyanurate cover board.
2. Glass-mat, water-resistant gypsum board

B. Cover Board: High compressive strength polyisocyanurate cover board, ASTM C1289 Type II, Class 4, Grade 1, 1/2-inch-thick polyisocyanurate, with a minimum compressive strength of 80 psi. Glass-fiber mat facer on both major surfaces.

1. Size: 48 by 48 inches or 48 by 96 inches.
2. Thickness: 1/2 inch.
3. Insulation Thermal Resistance, R-value: 2.5, nominal.
4. Products: Subject to compliance with requirements, provide one of the following:

a. Carlisle SynTec Systems; SecurShield HD Plus: www. carlislesyntec. com.
b. Holcim/Elevate (formerly Firestone Building Products); ISOGARD HD Cover Board: www.holcimelevate.com.
c. Johns Manville; Invinsa Roof Board: www. jm. com.

C. Cover Board: ASTM C1177, glass-mat, water-resistant gypsum board.

1. Thickness: 1/2 inch.
2. Surface Finish: Factory primed.
3. Products: Subject to compliance with requirements, provide one of the following:

a. Georgia-Pacific Gypsum: DensDeck Prime Roof Board: www.gp.com.
b. National Gypsum Company; DEXcell Brand FA Glass Mat Roof Board: www.nationalgypsum.com.
a. United States Gypsum Co.; USG Securock Brand UltraLight Coated Glass-Mat Roof Board; www.usg.com.

D. Adhesive: Cover board and insulation manufacturer's recommended adhesive formulated to attach cover board to roof insulation. Provide one of the following types:

1. Bead-applied, low-rise, one-component or multicomponent urethane adhesive.
2. Full-spread, spray-applied, low-rise, two-component urethane adhesive.

## 2.9 WALKWAYS

A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads.

1. Size: 30 by 30 inches.
2. Thickness: 0.30 inch, minimum.
3. Color: Black.

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

    a. Carlisle SynTec Systems; Sure-Seal EPDM Pressure-Sensitive Molded Walkway Pads: www. carlislesyntec. com.
    b. Holcim/Elevate (formerly Firestone Building Products); QuickSeam Walkway Pad: www.holcimelevate.com.
    c. Johns Manville; JM EPDM Peel & Stick Walkpads: www.jm.com.

**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 roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.

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

**3.2 PREPARATION**

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing assembly installation according to roofing assembly manufacturer's written instructions. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

**3.3 INSTALLATION OF ROOFING, GENERAL**

A. Install roofing assembly according to roofing assembly manufacturer's written instructions and FM Approvals' RoofNav assembly requirements.

B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing assembly at end of workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

C. Install roof membrane and auxiliary materials to tie-in to existing roofing to maintain weathertightness of transition and to not void warranty for existing roofing assembly.

**3.4 INSTALLATION OF INSULATION**

A. Coordinate installing roofing assembly components, so insulation is not exposed to precipitation or left exposed at end of workday.

B. Comply with roofing assembly and insulation manufacturer's written instructions for installing roof insulation.

C. Installation Over Metal Decking:

1. Base Layer of Insulation:

a. Install base layer of insulation as follows:

1) For 48 by 48 inch boards: With joints staggered not less 24 inches in adjacent rows
2) For 48 by 96 inch boards: With end joints staggered not less than 12 inches in adjacent rows and with long joints continuous at right angle to flutes of decking.

b. Locate end joints over crests of decking.
c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
d. Make joints between adjacent insulation boards not more than 1/4 inch in width.
e. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches.

1) Trim insulation so that water flow is unrestricted.

f. Fill gaps exceeding 1/4 inch with insulation.
g. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
h. Mechanically attach base layer of insulation using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to metal decks.

1) Fasten insulation according to requirements in FM Approvals' RoofNav for specified Windstorm Resistance Classification.
2) Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.

2. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches from previous layer of insulation.

a. Install upper insulation layers as follows:

1) For 48 by 48 inch boards: Staggered end joints within each layer not less than 24 inches in adjacent rows.
2) For 48 by 96 inch boards: Install with long joints continuous and with end joints staggered not less than 12 inches in adjacent rows.

b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
c. Make joints between adjacent insulation boards not more than 1/4 inch in width.
d. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches.

1) Trim insulation so that water flow is unrestricted.

e. Fill gaps exceeding 1/4 inch with insulation.
f. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
g. Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification, as follows:

1) Use one of the following methods:

a) Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.

b) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

**3.5 INSTALLATION OF COVER BOARDS**

A. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction.

1. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
2. At internal roof drains, conform to slope of drain sump.

a. Trim cover board so that water flow is unrestricted.

3. Cut and fit cover board tight to nailers, projections, and penetrations.
4. Adhere cover board to substrate using adhesive according to FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification, as follows:

a. Use one of the following methods:

1) Set cover board in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
2) Set cover board in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

**3.6 INSTALLATION OF ADHERED ROOF MEMBRANE**

A. Adhere roof membrane over area to receive roofing according to roofing assembly manufacturer's written instructions.

B. Unroll membrane roof membrane and allow to relax before installing.

C. Start installation of roofing in presence of roofing assembly manufacturer's technical personnel.

D. Accurately align roof membrane and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

E. Bonding Adhesive: Apply to substrate and underside of roof membrane at rate required by manufacturer and allow to partially dry before installing roof membrane. Do not apply to splice area of roof membrane.

F. Apply roof membrane with side laps shingled with slope of roof deck where possible.

G. Factory-Applied Seam Tape Installation: Clean and prime surface to receive tape.

1. Firmly roll side and end laps of overlapping roof membrane to ensure a watertight seam installation.
2. Apply lap sealant and seal exposed edges of roofing terminations.

H. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.

I. Spread sealant or mastic bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.

**3.7 INSTALLATION OF BASE FLASHING**

A. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to roofing assembly manufacturer's written instructions.

B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

D. Clean splice areas, apply splicing cement, and firmly roll side and end laps of overlapping sheets to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet flashing terminations.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

**3.8 INSTALLATION OF WALKWAYS**

A. Flexible Walkways: Install walkway products according to manufacturer's written instructions.

1. Install flexible walkways at the following locations:

a. Perimeter of each rooftop unit.
b. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.
c. Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.
d. Top and bottom of each roof access ladder.
e. Between each roof access ladder and each rooftop unit location or path connecting rooftop unit locations.
f. At downspout discharges located on roof assembly.
g. Locations indicated on Drawings.
h. As required by roof membrane manufacturer's warranty requirements.

2. Provide 6-inch clearance between adjoining pads.
3. Adhere walkway products to substrate with compatible adhesive according to roofing assembly manufacturer's written instructions.

**3.9 FIELD QUALITY CONTROL**

A. Require site attendance of roof assembly manufacturer daily during installation of the Work.

B. Final Roof Inspection: Arrange for roof assembly manufacturer's technical personnel to inspect roofing installation on completion, in presence of Architect, and to prepare inspection report.

C. Repair or remove and replace components of roofing assembly where inspections indicate that they do not comply with specified requirements.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements

**3.10 PROTECTING AND CLEANING**

A. Protect roofing assembly from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing assembly, inspect roofing assembly for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing assembly that does not comply with requirements, repair substrates, and repair or reinstall roofing assembly to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

**END OF SECTION 07 5300.01**

# SECTION 07 5300.02 – PVC MEMBRANE ROOFING

## 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. Cutting, patching, and repairs to an existing polyvinyl chloride (pvc) roofing assembly.

B. Locations: Tyler Elementary School.

### 1.3 ABBREVIATIONS

A. PVC: Polyvinyl chloride.

### 1.4 DEFINITIONS

A. Roofing Terminology: Definitions in ASTM D1079 and glossary of NRCA's "The NRCA Roofing Manual: Membrane Roof Systems" apply to work of this Section.

### 1.5 PREINSTALLATION MEETINGS

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

1. Meet with Owner, Architect, Construction Manager, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing assembly manufacturer's representative, deck Installer, air barrier Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing assembly.
7. Review temporary protection requirements for roofing assembly during and after installation.
8. Review roof observation and repair procedures after roofing installation.

### 1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For insulation and roof assembly component fasteners, include copy of FM Approvals' RoofNav listing.

B. Shop Drawings: Include roof plans, sections, details, and attachments to other work, including the following:

1. Layout and thickness of insulation.
2. Base flashings and membrane terminations.

3. Flashing details at penetrations.
4. Tapered insulation, thickness, and slopes.
5. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
6. Tie-in with air barrier.
7. Walkway pad locations

C. Wind Uplift Resistance Submittal: For roofing assembly, indicating compliance with wind uplift performance requirements.

**1.7 INFORMATIONAL SUBMITTALS**

A. Qualification Data: For Installer and manufacturer.

B. Manufacturer Certificates:

1. Performance Requirement Certificate: Signed by roof membrane manufacturer, certifying that roofing assembly complies with requirements specified in "Performance Requirements" Article.

a. Submit evidence of complying with performance requirements.

C. Product Test Reports: For components of roof membrane and insulation, for tests performed by a qualified testing agency, indicating compliance with specified requirements.

D. Evaluation Reports: For components of roofing assembly, from ICC-ES.

E. Field quality-control reports.

F. Sample Warranties: For manufacturer's special warranties.

**1.8 CLOSEOUT SUBMITTALS**

A. Maintenance Data: For roofing assembly to include in maintenance manuals.

B. Certified statement from existing roof membrane manufacturer stating that existing roof warranty has not been affected by Work performed under this Section.

**1.9 QUALITY ASSURANCE**

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 5 years of documented experience.

B. Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years documented experience, and approved by manufacturer.

**1.10 DELIVERY, STORAGE, AND HANDLING**

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing assembly manufacturer. Protect stored liquid material from direct sunlight.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

**1.11 FIELD CONDITIONS**

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing assembly to be installed according to manufacturer's written instructions and warranty requirements.

**1.12 WARRANTY**

A. Existing Warranty: Modifications to existing roofing assembly:

1. Submit written verification signed by existing roof membrane manufacturer stating that the existing roof warranty has not been affected by Work performed under this Section.

B. Special Installer’s Project Warranty: Submit roofing Installer's warranty, signed by Installer, covering the Work of this Section, including all components of roofing assembly such as roof membrane, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, and walkway products, for the following warranty period:

1. Warranty Period: Two years from Date of Substantial Completion.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

A. Roof Assembly: Subject to compliance with requirements, provide roof assemblies from one of the following:

1. Carlisle SynTec Systems; www.carlislesyntec.com.
1. Holcim/Elevate (formerly Firestone Building Products); www.holcimelevate.com.
2. Johns Manville; www.jm.com.
3. Sika Sarnafil; www.sarnafil.sika.com.

B. Source Limitations: Obtain components for roofing assembly from one roof membrane manufacturer or manufacturers approved by roof membrane manufacturer.

**2.2 ROOFING ASSEMBLY - GENERAL**

A. Single-ply membrane roofing assembly consisting of the following:

1. PVC single-ply roof membrane; fully adhered.
2. Cover board; fully adhered.
3. Insulation, including tappered insulation; first layer mechanically fastened, all subsequent layers fully adhered.
4. Walkway pads.

B. Design intent is to cut, patch, and repair existing roofing as needed, matching the materials and installation methods used in the initial installation and maintaining any current roofing assembly warranties.

1. Field verify the exact materials and installation methods used.

## 2.3 PERFORMANCE REQUIREMENTS

A. General Performance: Installed roofing assembly and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roofing and flashings shall remain watertight.

1. Accelerated Weathering: Roof membrane shall withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.
2. Impact Resistance: Roof membrane shall resist impact damage when tested according to ASTM D3746, ASTM D4272, or the Resistance to Foot Traffic Test in FM Approvals 4470.

B. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roof membrane manufacturer based on testing and field experience.

C. Completed roofing shall contain no wrinkles of such size as to restrict roof drainage.

D. Wind Uplift Resistance:

1. Calculate wind uplift pressures in accordance with the following:

a. Local codes and authorities having jurisdiction.
b. FM Approvals, LLC, RoofNav Ratings Calculator: www.roofnav.com.
c. Recommendations of the roofing assembly manufacturer.
d. As required for the conditions and roof configurations indicated on Drawings.

2. Design roofing assemblies to resist wind uplift pressures when tested according to FM Approvals 4474, UL 580, or UL 1897.

E. Comply with Factory Mutual (FM) Global and FM Approvals' RoofNav Listing requirements as follows:

1. Roof membrane, base flashings, and component materials shall comply with requirements in FM Approvals FM 4450 or FM Approvals FM 4470 as part of a roofing assembly, and shall be listed in FM Approvals' RoofNav for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals Certification markings.

a. Fire/Windstorm Classification: Class 1A-90.
b. Hail-Resistance Rating: SH.

2. Comply with the following Property Loss Prevention Data Sheets:

a. Data Sheet FM DS 1-28: Wind Design.
b. Data Sheet FM DS 1-29: Roof Deck Securement and Above-Deck Roof Components.
c. Data Sheet FM DS 1-49: Perimeter Flashing.

F. Minimum Insulation Requirements: Match existing number of layers, thicknesses, and R-values.

## 2.4 POLYVINYL CHLORIDE (PVC) ROOFING

A. PVC Sheet: ASTM D4434, Type III or Type IV, fabric reinforced; to match existing PVC sheet.

1. Thickness: To match existing; 60 mils, nominal, unless field verification indicates otherwise.
2. Exposed Face Color: White.

## 2.5 AUXILIARY ROOFING MATERIALS

A. General: Auxiliary materials recommended by roofing assembly manufacturer for intended use and compatible with other roofing components.

1. Adhesive and Sealants: Comply with VOC limits of authorities having jurisdiction.

B. Sheet Flashing: Manufacturer's standard sheet flashing of same material, type, reinforcement, thickness, and color as PVC sheet.

C. Prefabricated Flashings: Manufacturer's standard prefabricated sheet flashings of same material, type, reinforcement, thickness, and color as PVC sheet.

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

a. Molded pipe boot flashings.
b. Inside and outside corner sheet flashings.
c. Cone sheet flashings.

D. Bonding Adhesives: Manufacturer's standard.

E. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.

F. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening components to substrate, and acceptable to roofing assembly manufacturer.

G. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

## 2.6 ROOF INSULATION

A. General: Preformed roof insulation boards manufactured or approved by PVC roof membrane manufacturer.

B. Match existing roof insulation; field verify the following is used in the existing roofing assembly:

1. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 1, Grade 2, glass-fiber mat facer on both major surfaces.

a. Compressive Strength: 20 psi.
b. Long Term Thermal Resistance (LTTR) R-value: At 1 inch thick; 5.7 at 75 degrees F.
c. Size: 48 by 48 inches or 48 by 96 inches.
d. Thickness: To match existing.

1) For tapered board: Slope as indicated; minimum thickness 1/2 inch.

e. Products: Subject to compliance with requirements, provide the following:

1) Carlisle SynTec Systems; InsulBase: www.carlislesyntec.com.
2) Holcim/Elevate (formerly Firestone Building Products); ISO 95+: www.holcimelevate.com.
3) Johns Manville; Enrgy 3:www.jm.com.
4) Sika Sarnafil; Sarnatherm ISO: www.sarnafil.sika.com.

## 2.7 INSULATION ACCESSORIES

A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with other roofing assembly components.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing assembly manufacturer.

C. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer. Provide one of the following types:

1. Bead-applied, low-rise, one-component or multicomponent urethane adhesive.
2. Full-spread, spray-applied, low-rise, two-component urethane adhesive.

## 2.8 COVER BOARD

A. Provide one of the following types if any exist in the current roofing assembly; field verify:

1. High compressive strength polyisocyanurate cover board.
2. Glass-mat, water-resistant gypsum board.

B. Cover Board: High compressive strength polyisocyanurate cover board, ASTM C1289 Type II, Class 4, Grade 1, 1/2-inch-thick polyisocyanurate, with a minimum compressive strength of 80 psi. Glass-fiber mat facer on both major surfaces.

1. Size: 48 by 48 inches or 48 by 96 inches.
2. Thickness: 1/2 inch.
3. Insulation Thermal Resistance, R-value: 2.5, nominal.
4. Products: Subject to compliance with requirements, provide one of the following:

    a. Carlisle SynTec Systems; SecurShield HD Plus: www.carlislesyntec.com.
    b. Holcim/Elevate (formerly Firestone Building Products); ISOGARD HD Cover Board: www.holcimelevate.com.
    c. Johns Manville; Invinsa Roof Board: www.jm.com.
    d. Sika Sarnatherm Roof Board A-III: www.sarnafil.sika.com.

C. Cover Board: ASTM C1177, glass-mat, water-resistant gypsum board.

1. Thickness: 1/2 inch.
2. Surface Finish: Factory primed or unprimed.
3. Products: Subject to compliance with requirements, provide one of the following:

    a. Georgia-Pacific Gypsum: DensDeck Prime Roof Board: www.gp’com.
    b. National Gypsum Company; DEXcell Brand FA Glass Mat Roof Board: www.nationalgypsum.com.
    c. United States Gypsum Co.; USG Securock Brand UltraLight Coated Glass-Mat Roof Board; www.usg.com.

D. Adhesive: Cover board and insulation manufacturer's recommended adhesive formulated to attach cover board to roof insulation. Provide one of the following types:

1. Bead-applied, low-rise, one-component or multicomponent urethane adhesive.
2. Full-spread, spray-applied, low-rise, two-component urethane adhesive.

## 2.9 WALKWAYS

A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads or rolls.

1. Pad Size: 30 by 30 inches, minimum.
2. Roll Width: 30 inches, minimum.
3. Thickness: 0.072 inch, minimum.
4. Color: Gray.
5. Products: Subject to compliance with requirements, provide one of the following:

a. Carlisle SynTec Systems; Sure-Flex PVC Walkway Roll: www.carlislesyntec.com.
b. Holcim/Elevate (formerly Firestone Building Products); PVC Walkway Pad: www.holcimelevate.com.
c. Johns Manville JM PVC Walkpad: www.jm.com.
d. Sika Sarnafil; Sarnatred - V: usa.sarnafil.sika.com

# 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 roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.

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

## 3.2 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing assembly installation according to roofing assembly manufacturer's written instructions. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

## 3.3 INSTALLATION OF ROOFING, GENERAL

A. Install roofing assembly according to roofing assembly manufacturer's written instructions and FM Approvals' RoofNav assembly requirements.

B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing assembly at end of workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

C. Install roof membrane and auxiliary materials to tie-in to existing roofing to maintain weathertightness of transition and to not void warranty for existing roofing assembly.

## 3.4 INSTALLATION OF INSULATION

A. Coordinate installing roofing assembly components, so insulation is not exposed to precipitation or left exposed at end of workday.

B. Comply with roofing assembly and insulation manufacturer's written instructions for installing roof insulation.

C. Installation Over Metal Decking:

1. Base Layer of Insulation:

a. Install base layer of insulation as follows:

1) For 48 by 48 inch boards: With joints staggered not less 24 inches in adjacent rows
2) For 48 by 96 inch boards: With end joints staggered not less than 12 inches in adjacent rows and with long joints continuous at right angle to flutes of decking.

b. Locate end joints over crests of decking.
c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
d. Make joints between adjacent insulation boards not more than 1/4 inch in width.
e. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches.

1) Trim insulation so that water flow is unrestricted.

f. Fill gaps exceeding 1/4 inch with insulation.
g. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
h. Mechanically attach base layer of insulation using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to metal decks.

1) Fasten insulation according to requirements in FM Approvals' RoofNav for specified Windstorm Resistance Classification.
2) Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.

2. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches from previous layer of insulation.

a. Install upper insulation layers as follows:

1) For 48 by 48 inch boards: Staggered end joints within each layer not less than 24 inches in adjacent rows.
2) For 48 by 96 inch boards: Install with long joints continuous and with end joints staggered not less than 12 inches in adjacent rows.

b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
c. Make joints between adjacent insulation boards not more than 1/4 inch in width.
d. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches.

1) Trim insulation so that water flow is unrestricted.

e. Fill gaps exceeding 1/4 inch with insulation.
f. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.

g. Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification, as follows:

1) Use one of the following methods:

a) Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
b) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

## 3.5 INSTALLATION OF COVER BOARDS

A. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction.

1. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
2. At internal roof drains, conform to slope of drain sump.

a. Trim cover board so that water flow is unrestricted.

3. Cut and fit cover board tight to nailers, projections, and penetrations.
4. Adhere cover board to substrate using adhesive according to FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification, as follows:

a. Use one of the following methods:

1) Set cover board in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
2) Set cover board in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

## 3.6 INSTALLATION OF ADHERED ROOF MEMBRANE

A. Adhere roof membrane over area to receive roofing according to roofing assembly manufacturer's written instructions.

B. Unroll membrane roof membrane and allow to relax before installing.

C. Start installation of roofing in presence of roofing assembly manufacturer's technical personnel.

D. Accurately align roof membrane and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

E. Bonding Adhesive: Apply to substrate and underside of roof membrane at rate required by manufacturer and allow to partially dry before installing roof membrane. Do not apply to splice area of roof membrane.

F. In addition to adhering, mechanically fasten roof membrane securely at terminations, penetrations, and perimeter of roofing.

G. Apply roof membrane with side laps shingled with slope of roof deck where possible.

H. Seams: Clean seam areas, overlap roofing, and hot-air weld side and end laps of roof membrane and sheet flashings to ensure a watertight seam installation.

1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roof membrane and sheet flashings.
2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.

I. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.

J. Spread sealant bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.

## 3.7 INSTALLATION OF BASE FLASHING

A. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to roofing system manufacturer's written instructions.

B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

## 3.8 INSTALLATION OF WALKWAYS

A. Flexible Walkways: Install walkway products according to manufacturer's written instructions.

1. Install flexible walkways at the following locations:

a. Perimeter of each rooftop unit.
b. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.
c. Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.
d. Top and bottom of each roof access ladder.
e. Between each roof access ladder and each rooftop unit location or path connecting rooftop unit locations.
f. At downspout discharges located on roof assembly.
g. Locations indicated on Drawings.
h. As required by roof membrane manufacturer's warranty requirements.

2. Provide 6-inch clearance between adjoining pads.
3. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

## 3.9 FIELD QUALITY CONTROL

A. Require site attendance of roof assembly manufacturer daily during installation of the Work.

B. Final Roof Inspection: Arrange for roof assembly manufacturer's technical personnel to inspect roofing installation on completion, in presence of Architect, and to prepare inspection report.

C. Repair or remove and replace components of roofing assembly where inspections indicate that they do not comply with specified requirements.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements

**3.10 PROTECTING AND CLEANING**

A. Protect roofing assembly from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing assembly, inspect roofing assembly for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing assembly that does not comply with requirements, repair substrates, and repair or reinstall roofing assembly to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

**END OF SECTION 07 5300.02**

# 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. 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 edge conditions, including eaves, ridges, valleys, rakes, crickets, flashings, and counterflashings.

9. Include details of special conditions.
10. 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.

D. 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.

**2.2 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 0.050 inches (18 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.

3. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.

**2.3 MISCELLANEOUS MATERIALS**

A. Provide materials and types of fasteners, 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. 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

B. Materials: Unless otherwise indicated on Drawings, use the following materials:

1. Fabricate sheet metal flashing and trim from aluminum sheet in areas exposed to public view.

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:

1. Do not solder aluminum sheet.

## 3.3 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. Set wall flashings in a bed of butyl sealant.
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.
5. Turn wall flashing up no less than 1 inch at back of flashing and form watertight end dams at each end.

## 3.4 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.

## 3.5 CLEANING

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean off excess sealants.

## 3.6 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 (metal roof edge and fascia).

### 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.

### 1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Product Certificates: For each type of roof specialty.

C. Product Test Reports:

1. For roof-edge flashings, for tests performed by a qualified testing agency.

a. Includes SPRI ES-1 testing for each type of coping and roof edge flashing.

D. 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.

## 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 Specialties: 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: Equal to warranty period specified for related roof assembly specified in Section 07 5300 - EPDM Membrane Roofing.
2. Where roof specialties are of the same manufacturer as roof assembly or where roof specialties are a private label partner of the same manufacturer as roof assembly, roof edge specialties shall become part of the roof assembly manufacturer's "Special Manufacturer's No Dollar Limit (NDL) Warranty;" refer to Section 07 5300 - EPDM Membrane Roofing.

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 copings and roof-edge specialties 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. SPRI Wind Design Standard: Manufacture and install copings and roof-edge specialties tested according to SPRI ES-1 and capable of resisting the following design pressures:

1. Design Pressure: As indicated on Drawings.

C. 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.

### 2.3 MATERIALS

A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653 G90 coating designation.

B. Aluminum Sheet: ASTM B209, alloy as standard with manufacturer for finish required, with temper to suit forming operations and performance required.

C. Aluminum Extrusions: ASTM B221, alloy and temper recommended by manufacturer for type of use and finish indicated, finished as follows:

D. Stainless Steel Sheet: ASTM A240 or ASTM A666, Type 304.

E. EPDM Membrane: ASTM D4637, type standard with manufacturer for application.

F. Neoprene Membrane: Neoprene sheet recommended by manufacturer for resistance to hydrocarbons, non-aromatic solvents, grease, and oil; and as standard with roof-expansion-joint manufacturer for application.

G. PVC Membrane: ASTM D4434, type standard with manufacturer for application.

### 2.4 ROOF-EDGE SPECIALTIES

A. Roof-Edge Fascia (Gravel Stop): Manufactured, two-piece, roof-edge fascia consisting of snap-on metal fascia cover in section lengths not exceeding 12 feet and a continuous metal receiver with integral drip-edge cleat to engage fascia cover and secure single-ply roof membrane. Provide matching corner units.

1. Basis of Design Product: Subject to compliance with requirements, provide Hickman Edge Systems, LLC; TerminEdge Fascia: www.hickmanedgesystems.com, or a comparable product from one of the following:

a. Architectural Products Co.: www. archprod. com.

b. ATAS International, Inc.: www. atas. com.
c. Carlisle SynTec Systems: www. carlislesyntec. com.
d. Firestone Building Products: www. firestonebpco. com.
e. Johns Manville: www. jm. com.
f. Metal-Era: www. metalera. com.
g. Petersen Aluminum Corp.: www. pac-clad. com.

2. Formed Aluminum Sheet Fascia Covers: Aluminum sheet, 0.050 inch thick.
3. Fascia Extension: Fascia extenders with continuous hold-down cleats.

a. Depth: As indicated on Drawings.

4. Finish:

a. Metal Surface Texture: Smooth, flat finish.
b. Finish: Fluoropolymer.

1) Colors:

a) Color 1: To match existing adjacent finish, subject to Architect's approval.
b) Color 2: To match Centria, Sedona, 785.
c) Color 3: To match Hickman, Midnight Extra Dark Bronze.

## 2.5 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.

## 2.6 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 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 8413 - FIRESTOPPING

## 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. Firestopping of penetrations.
2. Firestopping of joints.

B. Section includes firestopping of joints and penetrations in fire resistance rated and smoke resistant assemblies, whether indicated on Drawings or not, and other openings, joints, and construction indicated.

### 1.3 DEFINITIONS

A. SFRM: Sprayed fire-resistive materials.

### 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. Product Schedule: For each penetration and joint firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular firestopping system, submit illustration, with modifications marked, approved by firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

    a. Obtain approval of authorities having jurisdiction prior to submittal.

### 1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.

B. Product Test Reports: For each penetration and joint firestopping system, for tests performed by a qualified testing agency.

### 1.7 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that penetration and joint firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

### 1.8 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: A firm that has been approved by FM Approval according to FM Approval 4991, "Approval Standard for Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements"; with minimum five years of documented experience.

### 1.9 PROJECT CONDITIONS

A. Environmental Limitations: Do not install penetration and joint firestopping systems when ambient or substrate temperatures are outside limits permitted by firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.

B. Install and cure penetration and joint firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

### 1.10 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

C. Coordinate construction of joints to ensure that joint firestopping systems can be installed according to specified firestopping system design.

D. Coordinate sizing of joints to accommodate joint firestopping systems.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. Perform penetration and joint firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
2. Test per testing standards referenced in "Penetration Firestopping Systems" Article and "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:

    a. Penetration and joint firestopping systems shall bear classification marking of a qualified testing agency.

        1) UL in its "Fire Resistance Directory."
        2) Intertek Group in its "Directory of Listed Building Products."
        3) FM Approval in its "Approval Guide."

### 2.2 MANUFACTURERS

A. Firestopping Manufacturers: Subject to compliance with requirements, provide products from one of the following:

1. 3M Fire Protection Systems; www.3m.com.
2. A/D Fire Protection Systems; www.adfire.com.

3. Hilti Firestop; www.hilti.com.
4. RectorSeal Firestop; www.rectorseal.com.
5. Specified Technologies, Inc. (STI); www.stifirestop.com.
6. Tremco Fire Protection Systems; www.tremcofirestop.com.

**2.3 FIRESTOPPING SYSTEMS - GENERAL**

A. Provide firestopping assemblies indicated, or, if not indicated, as required to comply with fire ratings indicated.

B. Fire Ratings: As indicated on Drawings.

C. Joint Firestopping:

1. Nominal Widths: As indicated on Drawings.
2. Movement Capabilities: Class 1, 50 percent compression or extension, unless otherwise indicated or required.

**2.4 PENETRATION FIRESTOPPING SYSTEMS**

A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

B. Penetrations in Fire-Resistance-Rated Walls and Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.

1. F-Rating: Not less than the fire-resistance rating of constructions penetrated

a. At least one hour at horizontal assemblies.

2. Where indicated or required, provide the following:

a. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.

1) Required at horizontal assemblies,

b. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.

C. Penetrations in Smoke Barriers and Partitions: Penetration firestopping systems with ratings determined per UL 1479, based on testing at a positive pressure differential of 0.30-inch wg.

1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at and no more than 50-cfm cumulative total for any 100 sq. ft. at both ambient and elevated temperatures.

D. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E84.

**2.5 JOINT FIRESTOPPING SYSTEMS**

A. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are

installed. Joint firestopping systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.

B. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E1966 or UL 2079.

1. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.
2. Where indicated or required, provide the following:

a. T-Rating: At least one hour, but not less than the fire-resistance rating of adjacent construction.
b. W-Rating: Provide firestopping systems showing no evidence of water leakage when tested according to UL 1479.

C. Joints in Smoke Barriers: Provide joint firestopping systems with ratings determined per UL 2079 based on testing at a positive pressure differential of 0.30-inch wg.

1. L-Rating: Not exceeding 5.0 cfm/ft. of joint at both ambient and elevated temperatures.

D. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E84.

## 2.6 ACCESSORIES

A. General: For each firestopping system, provide all primers, forming/damming/backing materials, collars, sleeves, and related materials for a complete installation

B. Penetration Firestopping Systems: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.

1. Permanent forming/damming/backing materials.
2. Substrate primers.
3. Collars.
4. Steel sleeves.

C. Joint Firestopping Systems: Provide components of joint firestopping systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

## 2.7 FILL MATERIALS

A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete and consisting of an outer sleeve lined with an intumescent strip, a flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.

B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.

C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.

E. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.

F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

H. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.

I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

J. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.

**2.8 MIXING**

A. Firestopping Materials: For those products requiring mixing before application, comply with firestopping system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, opening configurations, penetrating items, substrates, 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: Before installing penetration and joint firestopping systems, clean out joints and openings immediately to comply with manufacturer's written instructions and with the following requirements:

1. Remove from surfaces of joints substrates and opening substrates and from penetrating items foreign materials that could interfere with adhesion of firestopping materials or compromise fire-resistive rating.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
3. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with elastomeric fill materials. Remove loose particles remaining from cleaning operation.
4. Remove laitance and form-release agents from concrete.

B. Prime substrates where recommended in writing by firestopping system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

## 3.3 INSTALLATION

A. General: Install penetration and joint firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.

B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.

C. Install fill materials by proven techniques to produce the following results:

1. Penetrations:

a. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
b. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.

2. Joints:

a. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
b. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.

3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

## 3.4 IDENTIFICATION

A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches high and with minimum 0.375-inch strokes.

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

a. In occupied areas without ceilings do not apply labels.

B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing and inspecting agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

C. Joint Identification: Identify joint firestopping systems with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of joint edge so labels are visible to anyone seeking to remove or joint firestopping system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Joint Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

## 3.5 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E2174.

B. Where deficiencies are found or penetration and joint firestopping system is damaged or removed because of testing, repair or replace firestopping system to comply with requirements.

C. Proceed with enclosing penetration and joint firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

## 3.6 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings and joints as the Work progresses by methods and with cleaning materials that are approved in writing by firestopping system manufacturers and that do not damage materials in which openings and joint occur.

B. Provide final protection and maintain conditions during and after installation that ensure that penetration and joint firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration and joint firestopping material and install new materials to produce systems complying with specified requirements.

**END OF SECTION 07 8413**

# 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.

### 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. 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 or Dowsil 790 Silicone Building Sealant: www.dow.com.
    b. Momentive Performance Materials, Inc./GE; SCS9000 SilPruf NB: www.siliconeforbuilding.com.
    c. Pecora Corporation; 890NST: www.pecora.com.
    d. Sika Corporation; Sikasil WS-295 FPS: www.usa.sika.com.
    e. Tremco, Inc.; Spectrem 3: www.tremcosealants.com.

B. Silicone, Self-Leveling – JS2:

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.
    b. Pecora Corporation; 310SL: www.pecora.com.
    c. Sika Corporation; Sikasil-728 SL: www.usa.sika.com.
    d. Tremco, Inc.; Spectrem 900SL: www.tremcosealants.com.

C. Silicone, Mildew-Resistant – JS3:

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.
    b. Momentive Performance Materials, Inc./GE; SCS1700 Sanitary: www.siliconeforbuilding.com.

c. Pecora Corporation; 898NST: www.pecora.com.
d. Sika Corporation; Sikasil - GP: www.usa.sika.com.
e. Tremco, Inc.; Tremsil 200 with fungicide: www.tremcosealants.com.

## 2.4 LATEX JOINT SEALANTS

A. Acrylic Latex – JS4:

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.
b. Franklin International Inc; Titebond Painter's Plus Caulk: www.titebond.com.
c. Pecora Corporation; AC-20 +Silicone: www.pecora.com.
d. Sherwin Williams; 950A Siliconized Acrylic Latex Caulk: www.sherwin-williams.com.
e. Tremco, Inc.; Tremflex 834: www.tremcosealants.com.

B. Acrylic Latex, Acoustical Sealant – JS5:

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.
b. PPG Architectural Coatings; Liquid Nails AS-825 Acoustical Sound Sealant: www.liquidnails.com.
c. Pecora Corporation; AC-20 FTR: www.pecora.com.
d. Pecora Corporation; AIS-919: www.pecora.com.
e. United States Gypsum Co.; USG Sheetrock Brand Firecode Smoke-Sound Sealant: www.usg.com.
f. United States Gypsum Co.; USG Sheetrock Brand Acoustical Sealant: 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.

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 – JS4.

1) Joint Locations: All locations except as follows:

a) Tile joints; refer to Section 09 3000 Tiling, for nontraffic tile sealant.
b) Locations where silicone, nonstaining sealants are specified.
c) Locations where mildew-resistant silicone sealants are specified.
d) Locations where acoustic sealants are specified.

b. Silicone Joint Sealant: Silicone, Nonstaining – JS1.

1) Joint Locations:

a) Perimeter joints at aluminum door frames and storefront framing.
b) Other joints as indicated on Drawings.

c. Mildew-Resistant Joint Sealant: : Silicone, Mildew-Resistant – JS3

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 – JS5

1) Joint Locations:

a) Gypsum board assemblies; refer to Section 09 2900 Gypsum Board.
b) Acoustical panel ceilings; ; refer to Section 09 5113 Acoustical Panel Ceilings.
c) 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 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, fire-resistance ratings, temperature-rise ratings, and finishes.

B. Shop Drawings: Include the following:

1. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
2. Locations of reinforcement and preparations for hardware.
3. Details of each different wall opening condition.
4. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
5. Details of anchorages, joints, field splices, and connections.
6. Details of accessories.
7. Details of moldings, removable stops, and glazing.

C. Product Schedule: For hollow-metal 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.

B. Product Test Reports: For each type of fire-rated hollow-metal frame assembly and fire-rated borrowed-lite assembly, for tests performed by a qualified testing agency indicating compliance with performance requirements.

C. Oversize Construction Certification: For assemblies required to be fire-rated and exceeding limitations of labeled assemblies.

### 1.8 CLOSEOUT SUBMITTALS

A. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

### 1.9 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.

### 1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal 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 jambs and mullions.

C. Store hollow-metal frames vertically under cover at Project site with head up. Place on minimum 4-inch-high wood blocking.

## 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.
2. Curries, an Assa Abloy Group company: www.curries.com.
3. Pioneer Industries, an Assa Abloy Group company: www.pioneerindustries.com.
4. Republic Doors, an Allegion brand: www.republicdoor.com.
5. Steelcraft, an Allegion brand: www.allegion.com.

## 2.2 PERFORMANCE REQUIREMENTS

A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings and temperature-rise limits indicated on Drawings, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.
2. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
3. Temperature-Rise Limit: Where indicated on Drawings and at vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F above ambient after 30 minutes of standard fire-test exposure.

B. Fire-Rated, Borrowed-Lite Assemblies: Assemblies complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

## 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" and Section 08 8813 “Fire-Rated Glazing.”

F. Filler: Two-component, non-shrinking resin, autobody filler.

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. 3M/Bondo; Professional Gold Body Filler: www.bondo.com.

G. Grout for Frames:

1. At masonry and concrete walls: ASTM C476, Portland cement-lime, with a slump of not more than 4 inches as measured according to ASTM C143; for hand troweling; thinner pumpable grout is prohibited.

H. Corrosion Resistant Back-Coating: Automotive undercoating, asphalt emulsion, or other high-build, water-resistant, resilient coating.

## 2.4 INTERIOR STANDARD STEEL FRAMES

A. Construct hollow-metal frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Where indicated on Drawings interior frames shall comply with performance requirements of Fire-Rated Door Assemblies.

C. Heavy-Duty Frames: ANSI/SDI A250.8, Level 2; ANSI/SDI A250.4, Level B.

1. 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.

2. Exposed Finish: Prime.

## 2.5 BORROWED LITES

A. Fabricate of uncoated steel sheet, minimum thickness of 0.053 inch (16 gage).

B. Where indicated on Drawings borrowed lites shall comply with performance requirements of Fire-Rated, Borrowed-Lite Assemblies.

C. Construction: Full profile welded.

D. Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as metal as frames.

E. Provide countersunk machine screws and bolts for exposed fasteners unless otherwise indicated.

## 2.6 FRAME ANCHORS

A. Jamb Anchors:

1. Type: Anchors of minimum size and type required by applicable 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. 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. Sidelite and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by welding.
2. Provide countersunk exposed screws and bolts for exposed fasteners unless otherwise indicated.
3. 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.

B. Hardware Preparation: Factory prepare hollow-metal 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 frames to receive nontemplated, mortised, and surface-mounted door hardware.
2. Comply with BHMA A156.115 for preparing hollow-metal frames for hardware.

C. 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 and Section 08 8813 – Fire Rated 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 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 frames to receive nontemplated, mortised, and surface-mounted door hardware.

## 3.3 INSTALLATION

A. Install hollow-metal 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. Back-Coating of Non-Rated Frames: Field-apply corrosion resistant back-coatings to frames that are to be grouted solid.

    a. Do not back-coat fire-rated frames.

2. Frame Fill:

    a. Solidly pack mineral-fiber insulation inside frames, unless otherwise indicated.

        1) Do not fill frames that are to be grouted solid.

            a) Do not grout frames in gypsum board construction.

    b. At Masonry Walls and Concrete Construction: Where grouting is indicated, coordinate installation of frames to allow for solidly filling frames with grout using hand trowel methods. Insure that frames are not deformed by grout installation.

        1) Install silencers prior to grouting frames.
        2) Do not grout fire-rated frames; instead solidly pack with mineral-fiber insulation.

3. 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.

4. Fire-Rated Openings: Install frames according to NFPA 80.
5. Floor Anchors: Secure with postinstalled expansion anchors.
6. 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.
7. 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. Glazing: Comply with installation requirements in Section 088000 - Glazing, Section 08 8813 – Fire Rated 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. Clean grout and other bonding material off hollow metal frames immediately after installation.

B. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

**END OF SECTION 08 1113**

# SECTION 08 1416 – FLUSH WOOD 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. Flush wood doors.

### 1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

### 1.4 ACTION SUBMITTALS

A. Product Data: For each type of product, including the following:

1. Door core materials and construction.
2. Door edge construction
3. Door face type and characteristics.
4. Factory-machining criteria.
5. Factory- finishing specifications.

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each type of door; construction details not covered in Product Data; and the following:

1. Door schedule indicating door location, type, size, fire protection rating, and swing.
2. Door elevations, dimension and locations of hardware, lite cutouts, and glazing thicknesses.
3. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
4. Dimensions and locations of blocking for hardware attachment.
5. Dimensions and locations of mortises and holes for hardware.
6. Clearances and undercuts.
7. Requirements for veneer matching.
8. Doors to be factory finished and application requirements.

C. Samples for Verification:

1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches for each material and finish. For each wood species and transparent finish, provide set of three Samples showing typical range of color and grain to be expected in finished Work.

    a. Include corner sections of doors, with door faces and edges representing actual materials to be used.

### 1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Sample Warranty: For special warranty.

### 1.6 CLOSEOUT SUBMITTALS

A. Special warranties.

B. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

### 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 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package doors individually in plastic bags or cardboard cartons.

C. Mark each door on bottom rail with opening number used on Shop Drawings.

### 1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until building is enclosed and weathertight, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during remainder of construction period.

### 1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Delamination of veneer.
   b. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
   c. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.

2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
3. Warranty Period for Solid-Core Interior Doors: Life of installation.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eggers Industries, acquired by VT Industries, Inc. : www.eggersindustries.com.
2. Five Lakes Manufacturing: www.fivelakesmfg.com
3. Graham Wood Doors; Masonite Architectural: www.graham-maiman.masonite.com.
4. Marshfield-Algoma, Masonite Architectural: https://architectural.masonite.com.
5. Mohawk Doors, Masonite Architectural: https://architectural.masonite.com.

6. Oshkosh Door Company: www.oshkoshdoor.com.
7. VT Industries, Inc: www.vtindustries.com.

B. Source Limitations: Obtain flush wood doors from single manufacturer.

**2.2 PERFORMANCE REQUIREMENTS**

A. Fire-Rated Wood Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings and temperature-rise limits indicated on Drawings, based on testing at positive pressure in accordance with UL 10C or NFPA 252.

1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
2. Temperature-Rise Limit: Where indicated on Drawings and at vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F above ambient after 30 minutes of standard fire-test exposure.

B. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing in accordance with UL 1784 and installed in compliance with NFPA 105.

**2.3 FLUSH WOOD DOORS, GENERAL**

A. Quality Standard: In addition to requirements specified, comply with AWI/AWMAC/WI's "Architectural Woodwork Standards" or ANSI/WDMA I.S. 1A.

1. Where the Contract Documents contain requirements that are more stringent than the referenced quality standard. Comply with the Contract Documents in addition to those of the referenced quality standard.

**2.4 SOLID-CORE FIVE-PLY FLUSH WOOD VENEER-FACED DOORS FOR TRANSPARENT FINISH**

A. Interior Doors, Solid-Core Five-Ply Veneer-Faced:

1. Performance Grade: Comply with the following:

   a. Architectural Woodwork Standards Grade: Premium.
   b. ANSI/WDMA I.S. 1A Extra Heavy Duty Heavy Duty; Premium grade.

2. Faces: Single-ply wood veneer not less than 1/50 inch thick.

   a. Species: White Oak.
   b. Cut: Plain sliced (flat sliced).
   c. Match between Veneer Leaves: Slip match.
   d. Assembly of Veneer Leaves on Door Faces: Center-balance match.
   e. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.

3. Exposed Vertical and Top Edges: Applied wood edges of same species as faces and covering edges of crossbands - Architectural Woodwork Standards edge Type D.

   a. Vertical Edge Bevel: Hinged edge square, and lock edge beveled 1/8 inch in 2 inches.
   b. Fire-Rated Single Doors: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed vertical edges.

c. Fire-Rated Pairs of Doors: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.
d. Mineral-Core Doors: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.

1) Screw-Holding Capability: 550 lbf in accordance with WDMA T.M. 10.

4. Core for Non-Fire-Rated Doors:

a. ANSI A208.1, Grade LD-2 particleboard.

1) Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware and as follows:

a) 5-inch top-rail blocking, in doors indicated to have closers.
b) 5-inch bottom-rail blocking, in indicated to have protection plates.

b. Provide doors with glued-wood-stave or WDMA I.S. 10 structural-composite-lumber cores instead of particleboard cores for doors scheduled to receive exit devices in Section 08 7100 - Door Hardware, and as required to comply with stile and rail widths and light opening sizes indicated on Drawings.

1) For structural-composite-lumber cores:

a) Screw Withdrawal, Door Face: 550 lbf.
b) Screw Withdrawal, Vertical Door Edge: 550 lbf.

5. Core for Fire-Rated Doors: As required to achieve fire-protection rating indicated on Drawings.

a. Blocking for Mineral-Core Doors: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated on Drawings as needed to eliminate through-bolting hardware and as follows:

1) 5-inch top-rail blocking.
2) 5-inch bottom-rail blocking, in doors indicated to have protection plates.
3) 5-inch midrail blocking, in doors indicated to have exit devices or armor plates.

6. Construction: Five plies, hot-pressed bonded (vertical and horizontal edging is bonded to core), with entire unit abrasive planed before veneering.

## 2.5 LIGHT FRAMES

A. Beads shall accommodate required glazing thicknesses; coordinate with Section 08 8000 – Glazing and Section 08 8813 – Fire Rated Glazing.

B. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads unless otherwise indicated.

1. Wood Species: Same species as door faces.
2. Profile: Flush rectangular beads, recessed tapered beads, or lipped tapered beads.
3. At wood-core doors with 20-minute fire-protection ratings, provide wood beads and metal glazing clips approved for such use.

C. Wood-Veneered Beads for Light Openings in Fire-Rated Doors: Manufacturer's standard wood-veneered noncombustible beads matching veneer species of door faces and approved for use in doors of fire-protection rating indicated on Drawings. Include concealed metal glazing clips where required for opening size and fire-protection rating indicated.

## 2.6 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated.

1. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
2. Comply with NFPA 80 requirements for fire-rated doors.

B. Factory machine doors for hardware that is not surface applied.

1. Locate hardware to comply with DHI-WDHS-3.
2. Comply with final hardware schedules, door frame Shop Drawings, ANSI/BHMA-156.115-W, and hardware templates.
3. Coordinate with hardware mortises in metal frames, to verify dimensions and alignment before factory machining.
4. For doors scheduled to receive electrified locksets, provide factory-installed raceway and wiring to accommodate specified hardware.

C. Openings: Factory cut and trim openings through doors.

1. Light Openings: Trim openings with moldings of material and profile indicated.
2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 08 8000 – Glazing, and Section 08 8813 - Fire-Rated Glazing.

## 2.7 FACTORY FINISHING

A. Comply with referenced quality standard for factory finishing.

1. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
2. Finish faces, all four edges, edges of cutouts, and mortises.
3. Stains and fillers may be omitted on bottom edges, edges of cutouts, and mortises.

B. Factory finish doors with transparent finishes.

C. Transparent Finish:

1. Architectural Woodwork Standards or ANSI/WDMA I.S. 1A Grade: Premium.
2. Provide one of the following systems:

    a. Conversion Varnish: Architectural Woodwork Standards System-5, Varnish, Conversion or ANSI/WDMA I.S. 1A TR-4 Conversion Varnish
    b. UV Cured Acrylated Epoxy, Polyester or Urethane: Architectural Woodwork Standards System-9, UV Curable, Acrylated Epoxy, Polyester or Urethane or ANSI/WDMA I.S. 1A TR-8 UV Cured Acrylated Polyester/Urethane.
    c. UV Cured, Water Based: Architectural Woodwork Standards System-10, UV Curable, Water Based.
    d. Catalyzed Polyurethane: Architectural Woodwork Standards System-11, Polyurethane, Catalyzed or ANSI/WDMA I.S. 1A TR-6 Catalyzed Polyurethane.

3. Staining: Match Architect's sample.
4. Sheen: Satin.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

A. Examine doors and installed door frames, with Installer present, before hanging doors.

1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
2. Reject doors with defects.

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

**3.2 INSTALLATION**

A. Hardware: For installation, see Section 08 7100 - Door Hardware.

B. Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.

C. Install fire-rated doors in accordance with NFPA 80 requirements.

D. Install smoke and draft control doors in accordance with NFPA 105 requirements.

E. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

F. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

**3.3 ADJUSTING**

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

**END OF SECTION 08 1416**

# 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, fire ratings, 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 CLOSEOUT SUBMITTALS

A. Record Documents: For fire-rated doors, list of applicable room name and number in which access door is located.

### 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.

## 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.
2. Babcock-Davis; www.babcockdavis.com.
3. JL Industries/Activar Construction Products Group, Inc; www.activarcpg.com/jl-industries.

4. Karp Associates, Inc; www.karpinc.com.
5. Larsen's Manufacturing Company: www.larsenmfg.com.
6. Milcor / Hart & Cooley Inc; www.milcorinc.com.
7. MIFAB, Inc.; www.mifab.com.
8. Nystrom; www.nystrom.com.

## 2.2 PERFORMANCE REQUIREMENTS

A. Fire-Rated Access Doors and Frames: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection and temperature-rise limit ratings indicated, according to NFPA 252 or UL 10B.

## 2.3 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. Metallic-Coated Steel Sheet: ASTM A653, Commercial Steel (CS), Type B; with minimum G60 or A60 metallic coating.

C. Frame Anchors: Same material as door face.

D. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A153 or ASTM F2329.

## 2.4 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.

## 2.5 FIRE-RATED ACCESS DOORS AND FRAMES

A. Fire-Rated, Flush, Uninsulated, Access Doors with Exposed Flanges:

1. Locations: Masonry.
2. Description: Face of door flush with frame, uninsulated, with exposed flange and self-closing door.
3. Fire-Rating: Not less than that of adjacent construction.
4. Door Size: As indicated on Drawings; otherwise provide in size as required for proper access of items behind access door.
5. Door Material:

    a. Uncoated Steel Sheet for Door: Nominal 0.060 inch (16 gage), factory primed.

6. Frame Material: Same material, thickness, and finish as door.
7. Hardware: Automatic closing, self-latching, with interior latch release.

    a. Hinges: Exposed, continuous piano hinge.
    b. Latch/Lock: Cylinder lock-operated cam latch, two keys for each unit.

B. Fire-Rated, Flush, Uninsulated, Access Doors with Concealed Flanges:

1. Locations: Gypsum board.
2. Description: Face of door flush with frame, uninsulated, with concealed flange for gypsum board installation and self-closing door.
3. Fire-Rating: Not less than that of adjacent construction.
4. Door Size: As indicated on Drawings; otherwise provide in size as required for proper access of items behind access door.
5. Door Material:

    a. Uncoated Steel Sheet for Door: Nominal 0.060 inch (16 gage), factory primed.

6. Frame Material: Same material and thickness as door.
7. Hardware: Automatic closing, self-latching, with interior latch release.

    a. Hinges: Exposed, continuous piano hinge.
    b. Latch/Lock: Cylinder lock-operated cam latch, two keys for each unit.

## 2.6 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.

**2.7 FINISHES**

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical 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 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.

a. Includes: Swing doors.

### 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 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 - High Performance:

1. Basis of Design Product: Subject to compliance with requirements, provide Kawneer North American, an Arconic company; Trifab 451UT Framing System: www.kawneer.com, or one of the following comparable products:

a. EFCO Corporation, an Apogee Enterprises, Inc. company; Series 403X: www.efcocorp.com.
b. Oldcastle BuildingEnvelope; Series 3000 XT Thermal Multiplane: www.obe.com.
c. Tubelite Inc, an Apogee Enterprises, Inc. company; TU24000 Series HP Thermal Storefront: www.tubeliteinc.com.

B. Swing Door Manufacturers:

1. Any of the manufacturers specified for storefront products.

C. Source Limitations: Obtain all components of aluminum-framed storefront system, including framing, doors 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:

1) Color anodic finish, Black.

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.

D. Door Stops:

1. Height: 5/8 inch high.
2. Width: As standard with manufacturer and as follows:

a. Doors with Electric Strikes: Stop width shall be equal to or greater than surface applied electric strike.

3. Provide pressure gasket weather seals.

## 2.4 SWING DOORS

A. Swing Doors: Manufacturer’s standard glazed aluminum doors.

1. Style: Wide style.

a. Top Rail: As indicated on Drawings.
b. Vertical Stiles: As indicated on Drawings.
c. Bottom Rail: As indicated on Drawings.

2. Thickness: 1-3/4 inches.
3. Glazing Stops: Square.
4. Finish: Match adjacent aluminum-framed storefront finish.

B. Hardware:

1. For each door, include manufacturer's standard weatherstripping and sill sweep strip.

a. Weatherstripping: Wool pile, continuous and replaceable; provide on all doors.
b. Sill Sweep Strips: Resilient seal type, of neoprene; provide on all doors.

2. Other Door Hardware: As specified in Section 08 7100 – Door Hardware.

**2.5 GLAZING**

A. Glazing: Refer to Section 08 8000- Glazing.

**2.6 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.

**2.7 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.

**2.8 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. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

1. At interior and exterior doors, provide compression weather stripping at fixed stops.

G. Entrance Doors: Reinforce doors as required for installing entrance door hardware.

1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
2. At exterior doors, provide weather sweeps applied to door bottoms.

H. After fabrication, clearly mark components to identify their locations in Project in accordance with Shop Drawings.

**2.9 ALUMINUM FINISHES**

A. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, 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 ALUMINUM-FRAMED ENTRANCE DOORS**

A. Install entrance doors to produce smooth operation and tight fit at contact points.

1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.

**3.4 INSTALLATION OF DOOR HARDWARE**

A. Install door hardware as specified in Section 08 7100 – Door Hardware.

**3.5 INSTALLATION OF GLAZING**

A. Install glazing as specified in Section 08 8000 - Glazing.

**3.6 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.

**3.7 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.

    a. Perform testing prior to 10, 35, and 70 percent completion.

        1) At each stage of completion, perform a minimum of three tests in up to three areas as directed by Architect.

C. Aluminum-framed storefronts will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

**3.8 ADJUSTING**

A. Adjust doors and hardware, after installation, for proper operation.

**3.9 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 4383 - FIRE-RATED FRAMING SYSTEMS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. This Section includes the following fire-rated framing systems:

1. Interior fire-rated framed glazing assemblies.

### 1.3 DEFINITIONS

A. Fire-Rated Glazing: Fire-rated glazing, either fire-protective glazing or fire-resistive glazing as specified.

B. Fire Protective Glazing: Fire-rated glazing designed to compartmentalize smoke and flame and which does not limit the transmission of heat through the glazing.

C. Fire Resistive Glazing: Fire rated glazing designed to compartmentalize smoke and flame and which limits the transmission of heat through the glazing.

D. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

### 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 fire-rated framing systems, include plans, elevations, sections, details, and attachments to other work.

1. Include details of conduits and preparations for power, signal, and control systems.

C. Samples for Verification: For each type of exposed finish required; 6 inches square, 6 inches long for linear components.

D. Delegated-Design Submittal: For fire-rated framing systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

### 1.5 INFORMATIONAL SUBMITTALS

A. Door Hardware: Provide documentation that door hardware provided for each door is approved by fire-rated framing system manufacturer; and that it maintains and does not compromise the fire rating of the fire-rated framing system.

1. Coordinate with Section 08 7100 – Door Hardware.

B. Qualification Data: For installer and manufacturer.

C. Field Quality Control Report: Submit field report.

D. Warranty Documentation: Submit manufacturer warranty.

**1.6 CLOSEOUT SUBMITTALS**

A. Maintenance Data: For fire-rated framing systems 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 documented experience

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least 5 years documented experience and approved by manufacturer

C. Professional Engineer Qualifications: For professional engineer's experience with providing delegated-design engineering services of the type indicated, including documentation that engineer is licensed in the state in which Project is located

D. Source Limitations: Obtain fire-rated framing systems and fire-rated glazing from single source from the same manufacturer.

**1.8 DELIVERY, STORAGE, AND HANDLING**

A. Storage and Protection: Store off ground, under cover, protected from weather and construction activities and at temperature conditions recommended by manufacturer.

**1.9 PROJECT CONDITIONS**

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

**1.10 WARRANTY**

A. Provide five year manufacturer's warranty for defects in workmanship and materials.

**PART 2 - PRODUCTS**

**2.1 PERFORMANCE REQUIREMENTS**

A. Structural Performance: Fire-rated framing systems shall withstand normal thermal movement and impact loads without failure, including loss or glass breakage.

1. Uniform Load - Deflection: Static air design load of 50 psf applied in the positive and negative direction in accordance with ASTM E 330.

    a. There shall be no deflection in excess of L/175 of the span of any framing member or 3/4 inch, whichever is less, at design load.

2. Uniform Load - Structural: Static air design load of 75 psf applied in the positive and negative direction in accordance with ASTM E 330.

    a. There shall be no glass breakage or permanent set in the framing members in excess of 0.2 percent of the clear spans.

B. Fire-ratings: Provide fire-rated framing systems capable of withstanding fire-ratings indicated on Drawings.

1. General: Assemblies shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction; tested in accordance with:

a. ASTM E 119.
b. NFPA 251.
c. UL 263.

2. Window Assemblies: Shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction. Comply and test in accordance with:

a. NFPA 80 and NFPA 257.
b. UL 9.

3. Door Assemblies: Shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction. Comply and test in accordance with:

a. NFPA 80 and NFPA 252.
b. UL 10B and UL 10C.

C. Appearance: Fire-rated framing systems shall have a neat finished appearance with minimum joints.

## 2.2 INTERIOR FIRE-RATED FRAMED GLAZING ASSEMBLIES

A. Basis of Design: Provide SAFTIFIRST, a division of O'Keeffe's Inc.; GPX Architectural Series including GPX Architectural Series Fire Resistive Doors: www.safti.com, or one of the following comparable products:

1. Aluflam North America; Fire-Rated Aluminum Vision Wall and Window System with Fire-Rated Aluminum Doors: www.aluflam-usa.com.
2. Technical Glass Products (TGP); Fireframes Heat Barrier Series including Fireframes Heat Barrier Series Doors: www.fireglass.com.

B. Interior Fire-Resistive Framed Glazing Assemblies: Fire-resistive, temperature rise, framing system, including doors.

1. Frame Profile:

a. Face Width: 3-1/8 inches, maximum.
b. Frame Depth: 4-1/8 inches, maximum.

2. Door Stile Face Width: 3 to 5 inch nominal face width with 10 inch bottom rail.
3. Glazing Stops: Flush.
4. Door Stops:

a. Height: 5/8 inch high.
b. Width: As standard with manufacturer and as follows:

1) Doors with Electric Strikes: Stop width shall be equal to or greater than surface applied electric strike.

c. Provide pressure gasket weather seals.

C. Glazing: Comply with requirements of Section 08 8813 – Fire-Rated Glazing.

1. Provide fire-resistance-rated glazing with fire-rating to match fire-rating of fire-rated framing system.
2. Provide butt-glazed joints where indicated on Drawings.

D. Fabrication:

1. Fabricate framing system using one of the following methods and materials:

a. Steel tube framing with non-combustible thermally-resistive fill material and aluminum cladding.
b. Extruded aluminum framing, thermally broken, filled with cement composite material.
c. Formed steel members with non-combustible thermally-resistive fill material.
d. Formed steel members with extruded aluminum caps; doors are formed steel.

2. Fabrication: Joints and corners flush, hairline, and accurately fitted and secured; prepared to receive anchors; fasteners and attachments concealed from view; reinforced as required for imposed loads.

E. Fire-Rating: As indicated on Drawings.

## 2.3 MATERIALS

A. Steel:

1. Structural Steel Sections: ASTM A36; galvanized in accordance with requirements of ASTM A123.
2. Tube steel; ASTM A501.
3. Cold-Rolled Sheet and Strip: ASTM A1008.
4. Hot-Rolled Sheet and Strip: ASTM A1011.

B. Aluminum:

1. Extruded Aluminum: ASTM B221.
2. Sheet Aluminum: ASTM B209.

## 2.4 ACCESSORIES

A. General: Provide miscellaneous accessories as required by the fire-rated framing systems for a complete installation that are compatible with fire-rated framing system, fire rated glazing, each other, and that are approved for use with fire-rated framing systems by testing agencies that listed and labeled the fire-rated framing systems.

B. Fasteners:

1. Galvanized steel or stainless steel as recommended by manufacturer.
2. Type recommended by manufacturer; concealed

C. Glazing Accessories: Refer to Section 08 8813 – Fire-Rated Glazing.

D. Mineral Fiber Insulation: Flexible preformed batt or blanket, complying with ASTM C665; friction fit; unfaced flame spread and smoke developed indexes of 0 (zero) when tested in accordance with ASTM E84.

E. Sealants: Comply with the following:

1. General Sealants: Refer to Section 07 9200 - Joint Sealants.
2. Glazing Sealants: Refer to Section 08 8813 – Fire-Rated Glazing.

## 2.5 DOOR HARDWARE

A. Factory prepare doors and framing for field mounting of hardware.

1. Door Hardware: Comply with Section 08 7100 - Door Hardware and the following:

a. Provide door hardware approved for use with fire-rated framing systems.
b. Door hardware shall maintain fire rating of the fire-rated framing systems without compromising the assemblies.

## 2.6 FINISHES

A. Aluminum: Match finishes in Section 08 4113 “Aluminum-Framed Storefronts.”

# 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

A. Comply with fire-rated framing system manufacturer's written instructions.

B. Install framed glazing assemblies in accordance with NFPA 80 and requirements of local authorities having jurisdiction Do not install damaged components.

C. Install components plumb and true in alignment with established lines and grades.

D. Fit joints to produce hairline joints free of burrs and distortion.

E. Firmly pack mineral fiber fire stop insulation or appropriately rated intumescent sealant around frame perimeter and rough opening as recommended by fire-rated framing system manufacturer.

F. Glazing: Install glazing in compliance with requirements of fire-rated framing system manufacturer and Section 08 8813 – Fire-Rated Glazing.

G. Door Hardware:

1. Refer to Section 08 7100 for hardware installation requirements.
2. Coordinate installation of electrical connections to electrical hardware items.

## 3.3 ERECTION TOLERANCES

A. Install aluminum-framed storefronts to comply with the following maximum tolerances:

1. Plumb: 1/16 inch every 3 feet non-cumulative or 1/2 inch per 100 ft, whichever is less.
2. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.
3. Sealant Space Between Mullions and Adjacent Construction: Maximum of 3/4 inch and minimum of 1/4 inch Alignment:

**3.4 FIELD QUALITY CONTROL**

A. Provide services of manufacturer's field representative to observe installation and submit report.

**3.5 ADJUSTING**

A. Adjust doors for smooth operation.

**3.6 CLEANING AND PROTECTION**

A. Remove protective material from pre-finished surfaces.

B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.

C. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired

D. Protect installed products from damage until Date of Substantial Completion.

**END OF SECTION 08 4383**

# SECTION 08 7100 – DOOR HARDWARE

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section includes hardware for doors specified in “Hardware Sets”.

B. Related Divisions:

1. Division 03 Concrete
2. Division 06 Rough & Finish Carpentry
3. Division 07 Joint Sealants
4. Division 08 Openings
5. Division 09 Finishes
6. Division 10 Specialties
7. Division 13 Special Construction
8. Division 14 Elevators
9. Division 25 Integrated Automation
10. Division 26 Electrical
11. Division 27 Communications
12. Division 28 Electronic Safety and Security

### 1.2 REFERENCES

A. American National Standards Institute/Builders Hardware Manufacturers Association (ANSI):

1. ANSI/BHMA A156.1 Butts & Hinges (2016)
2. ANSI/BHMA A156.3 Exit Devices (2020)
3. ANSI/BHMA A156.4 Door Controls – Closers (2019)
4. ANSI/BHMA A156.5 Cylinders and Input Devices for Locks (2020)
5. ANSI/BHMA A156.6 Architectural Door Trim (2015)
6. ANSI/BHMA A156.7 Template Hinge Dimensions (2016)
7. ANSI/BHMA A156.8 Door Controls – Overhead Stops and Holders (2015)
8. ANSI/BHMA A156.13 Mortise Locks & Latches (2017)
9. ANSI/BHMA A156.15 Closer Holder Release Devices (2015)
10. ANSI/BHMA A156.16 Auxiliary Hardware (2018)
11. ANSI/BHMA A156.18 Materials & Finishes (2020)
12. ANSI/BHMA A156.19 Power Assist & Low Energy Power Operated Doors (2019)
13. ANSI/BHMA A156.21 Thresholds (2019)
14. ANSI/BHMA A156.22 Door Gasketing Systems (2017)
15. ANSI/BHMA A156.25 Electrified Locks (2018)
16. ANSI/BHMA A156.26 Continuous Hinges (2017)
17. ANSI/BHMA A156.28 Keying Systems (2018)
18. ANSI/BHMA A156.35 Power Supplies for Electronic Access Control (2020)
19. ANSI/BHMA A156.36 Auxiliary Locks (2020)

B. International Code Council/American National Standards Institute (ICC/ANSI)/ADA:
1. ICC/ANSI A117.1 Standards for Accessible and Usable Buildings and Facilities.

C. Door and Hardware Institute (DHI):

1. DHI Publication – Abbreviations and Symbols (2019).
2. DHI Publication – Installation Guide for Doors and Hardware (2020).
3. DHI Publication – Sequence and Format of Hardware Schedule (2019).

D. National Fire Protection Agency (NFPA):

1. NFPA 70 National Electrical Code.
2. NFPA 80 Standard for Fire Doors and Other Opening Protectives.
3. NFPA 105 Standard for the Installation of Smoke Door Assemblies.

**1.3 SUBMITTALS**

A. Submit in accordance with Conditions of the Contract and Division 01 Administrative Requirements and Submittal Procedures Section.

B. Shop Drawings:

1. Schedule hardware in vertical format using the DHI publication Sequence and Formatting for the Hardware Schedule.
2. Include abbreviations and symbols page to include manufacturers' abbreviations, finish code descriptions, and fastener abbreviations including descriptions according to the DHI publication Abbreviations and Symbols.
3. Detail headings referencing the Architect's heading, opening number, locations, fire rating, handing, degree of opening, and description of the opening elements. Include Voltage, amperage, and operational descriptions for openings that have electrified hardware.
4. Coordinate final door hardware schedule with doors, frames, and related work listing proper sizing of hardware, addressing door thickness, handing, function, mounting accessories, and finish of hardware.
5. List related door devices specified in other Sections for each opening.
6. Architectural Hardware Consultant (AHC), as certified by DHI, who will affix seal attesting to completeness and correctness, including the review of the hardware schedule prior to submittal.

C. Product Data:

1. Furnish manufacturers' catalog sheets on design, grade, and function of items listed in hardware schedule. Submit only relevant information and circle or highlight the technical information including: model numbers, sizing information, voltage and amperage requirements, options and accessories required, means of fastening, listings of fire-rated applications, and finishes.

D. Templates:

1. Within fourteen days of receiving approved door hardware submittals submit complete list of templates for each hardware item to the opening manufacturers and the installers. Include detailed lists of the hardware location requirements for mortised and surface applied hardware.

E. Wiring Diagrams: Detail a title block for each drawing that includes the project name, project address, architect name, architect's opening number, hardware set, date, and name of the author.

1. Elevation Riser Drawings:

a. Furnish one set of elevation drawings with each hardware schedule submittal for hardware sets that contain electrified hardware. Illustrate the openings with proportional representations of the opening and electrified hardware components and dimension their mounting locations as well as sizes of junction boxes and power supplies. Label the components, wire quantities and gauges, high voltage requirements, as well as other building interfaces. Create a legend that complements the drawings with brand names, model numbers, and include voltage and amperage requirements. Add an operational description that includes the normal state of the door, ingress, egress, and what happens in case of power loss or fire alarm activation and any special conditions.
b. Upon receipt of approved hardware correct and resubmit elevation drawings with the point-to-point and system drawings.

2. Point-to-Point and System Drawings: Upon receipt of approved hardware schedule, submit point-to-point per hardware set and a system drawing. Cross-reference all wiring diagrams and the associated drawings to each other.

    a. Point-to-Point Drawings: Draw each product in a realistic representation including each terminal including those not used, and lines representing wires from component to component, labeling wire colors and gauges.
    b. System Drawing: illustrate all equipment and building interfaces required for the entire system. Include room labels and locations, opening numbers and locations.

F. Closeout Submittals: Include the following information as well as highlight and flag fire rated openings for annual inspections:

1. Cover page with required information:

    a. Project name
    b. Hardware supplier's name and contact information.
    c. Date of substantial completion.

2. Final record hardware schedule.
3. Product Data.
4. Keying Schedule.
5. Record Wiring Diagrams.

    a. System Drawing.
    b. Elevations.
    c. Point-to-Point Drawings with all final wire colors noted as terminated. (Include network IP and/or MAC addresses of field devices).

6. Operating and Maintenance Manual.
7. Warranty Information.
8. Maintenance service agreement(s).

## 1.4 QUALITY ASSURANCE

A. Hardware supplier shall employ an Architectural Hardware Consultant (AHC) as certified by DHI and a member of the seal program who will be available at reasonable times during course of work for Project hardware consultation.

1. Electrified Door Hardware Supplier Qualifications: Experienced door hardware supplier who has completed projects with electrified door hardware similar in material, design, and extent to that is indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
2. Access and Electrified Security Supplier Qualifications: Experienced supplier who has completed projects with access and electrified security door hardware similar in material, design, and extent to that is indicated for this Project, whose work has resulted in construction with a record of successful in-service performance and be a factory authorized distributor.

B. Where openings are required to be accessible door hardware shall conform to ICC/ANSI A117.1.

C. Fire Rated Door Assemblies: Where fire-rated door assemblies are indicated, provide door hardware complying with NFPA 80 that are listed and/or labeled by a qualified testing agency for fire-protection ratings indicated.

D. Smoke and Draft Control Door Assemblies: Where smoke and draft control doors are required, provide door hardware that meets requirements of assemblies in compliance with NFPA 105.

E. Door hardware certified to ANSI/BHMA standards as noted, manufacturer must participate and be listed in BHMA Certified Products Directory.

F. Substitution requests shall be submitted in compliance with Division 01: create a comparison chart that includes the testing information as well as the warranty for both the specified product and the proposed substitution. Include the reason for requesting the substitution, clear catalog copy highlighting the proposed product and options, compliance statement, technical data, product warranty and lead time, to show how the proposed can meet or exceed established level of design, function, and quality.

1. Items listed with no substitute manufacturers have been requested by the Owner to meet existing standard and will not be reviewed for substitution unless the product is no longer available.

G. Meetings: Comply with requirements in Division 01 Section “Project Meetings.”

1. Low-voltage Coordination Meeting

a. Prior to furnishing door hardware submittals, convene a low-voltage coordination meeting. Meeting participants should include all affected trades including the following, but not limited to: Contractor, installer, supplier, electrical contractor, security consultant and installer, Owner’s IT representative, and fire alarm consultant.
b. Review sequence of operation for each opening with electrified hardware to ensure that every opening functions properly for the Owner’s use.
c. Discuss the types of electrified door hardware, inspection, and electrical roughing-in and other preparatory work performed by other trades.
d. Verify wire quantities, wire types, wire sizes, conduit sizes, and locations including if the power supplies will be centrally located or if they will be located near each opening.
e. Coordinate the door hardware, power supplies, back-up power requirements, access control components, fire alarm interfaces, elevator controls, and related building systems have all proper and necessary components to interface and operate correctly.

2. Keying Meeting

a. Within fourteen days of receiving approved door hardware submittals, contact Owner to establish a keying conference. Include keying meeting decisions into final keying schedule submittal after reviewing the following, but not limited to:

1) Function of the building, flow of traffic, individual area’s purpose, and degree of security.
2) Lock functions and operation.
3) Preliminary key system schematic diagram.
4) Verify existing keyway(s), and/or proposed keyway(s)
5) Visual key and cylinder identification
6) Quantity of keys required including master level keys, change keys, and keys per lock.
7) Review the key control system.
8) Determine the recipient and contact information for the delivery of keys and accessories.

3. Pre-installation Meeting

a. Convene meeting within fourteen days of receiving approved door hardware submittals. Participants from all affected buildings trades shall attend. Minimum participants should include: Contractor, installer, material supplier, manufacturer representatives, electrical contractor, security consultant, and fire alarm consultant.
b. Inspect and discuss preparatory work performed by other trades.
c. Include in-conference decisions regarding proper installation methods and procedures for receiving and handling hardware.
d. Review all system, elevation, and point-to-point drawings to ensure that all necessary components are provided and detailed.

e. Review and finalize construction schedule and verify availability of materials, installer's personnel, equipment, and facilities needed to make progress and avoid delays.
f. Review required testing, inspecting, and certifying procedures.

H. Installer Qualifications: Specialized in performing installation of this Section and have five years minimum documented experience.

1. Electrified Hardware Supplier Qualifications: Experienced door hardware installer who has installed projects with electrified door hardware 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.
2. Access Control and Electrified Security Supplier Qualifications: Experienced installer who has completed projects with access and electrified security door hardware 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 and be a factory authorized to install and commission the system.

## 1.5 DELIVERY, STORAGE, AND HANDLING

A. Pack each item complete with necessary parts and fasteners in manufacturer's original packaging.

B. Mark hardware that is not bulk packed with architect's opening number, hardware set number, and item number for each type of hardware. Include keyset symbols and corresponding hardware component for keyed products. Mark hardware that is bulk packed with manufacturers' part number and reference all hardware sets associated.

C. Deliver hardware to the job site according to the phasing agreed upon in the pre-installation meeting. Inventory the delivery with the supplier's assistance. Immediately note shortages and damages on the shipping receipts and bill of ladings. Coordinate replacement or repair with the supplier.

D. Deliver permanent keys, cores, access control credentials, software, and related accessories directly to Owner via registered mail or overnight package service. Establish the instructions for delivery to Owner at "Keying Conference."

E. Provide a clean, dry, and secure room for hardware delivered. Shelve hardware off the floor and with larger items of hardware stored on pallets. Arrange locksets and keyed cylinders by opening number. Organize the balance of hardware by brand, model of hardware, and hardware set number. Leave the door markings of the hardware visible for installers.

F. Waste Management and Disposal: Separate waste materials for use or recycling in accordance with Division 01.

## 1.6 WARRANTY

A. General Warranty: Comply Division 01 for Warranty requirements.

B. Special Warranty: Warranties specified in this article will not deprive Owner of other rights.

1. Ten years for manual door closers.
2. Five years for mortise, auxiliary and bored locks.
3. Five years for exit devices.
4. One year for electromechanical door hardware.
5. All access and electrified security equipment and systems will be warranted for a period of one (1) year commencing with the filing date of the Notice of Completion, provided the system has been inspected and signed off by a factory authorized installer and the factory authorized commissioning agent.

## 1.7 MAINTENANCE

A. Maintenance Tool and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, removal, and replacement of door hardware.

## PART 2 - PRODUCTS

## 2.1 MATERIALS

A. General:

1. Produce hardware units of basic metal and forming method using manufacturer's standard metal alloy, composition, temper, and hardness, but in no case of lesser (commercially recognized) quality than specified within this specification section for applicable hardware units for finish designations indicated.

B. Fasteners:

1. Furnish screws for installation with each hardware item. Use only fasteners that are furnished by the hardware manufacturer to meet the manufacturer's templating requirements, warranty and NFPA 80 requirements.
2. Provide Phillips-head screws except as otherwise indicated.
3. Finish exposed screws to match hardware finish or, if exposed in surfaces of other work, to match finish of this other work as closely as possible including "prepared for paint" surfaces to receive painted finish.
4. Use machine screws with lead expansion shields at hardware mounting to masonry walls and floors.
5. Wood screw with plastic anchors at drywall applications without reinforcement and wood screws at applications with reinforcements.
6. Provide concealed fasteners for hardware units that are exposed when door is closed except to the extent no standard units of type specified are available with concealed fasteners.

    a. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work unless their use is the only means of reinforcing the work adequately to fasten the hardware securely.
    b. Where thru-bolts are used as a means of reinforcing the work, provide sleeves for each thru-bolt or use sex nut fasteners.

7. At exterior openings furnish stainless-steel fasteners for exposed fasteners, for example thresholds and screw-applied weatherstripping.

## 2.2 CONVENTIONAL HINGES

A. Hinges, electric hinges, and self-closing hinges of one manufacturer as listed for continuity of design and consideration of warranty.

B. Standards: Products to be certified and listed by the following:

1. Butts and Hinges: ANSI/BHMA A156.1.
2. Template Hinge Dimensions: ANSI/BHMA A156.7.
3. Self-Closing Hinges: ANSI/BHMA A156.17.

C. Butt Hinges:

1. Hinge weight and size unless otherwise indicated in hardware sets:

    a. Doors up to 36" wide and up to 1-3/4" thick provide hinges with a minimum thickness of .134" and a minimum of 4-1/2" in height.

b. Doors over 36” wide up to 48” wide and up to 1-3/4” thick provide hinges with a minimum thickness of .145” and a minimum of 5” in height.
c. Doors greater than 1-3/4” thick provide hinges with a minimum thickness of .190” and a minimum of 5” in height.
d. Width of hinge is to be minimum required to clear surrounding trim.
e. Doors considered to be low to medium frequency use would require standard weight hinges and medium to high frequency use would require heavy weight hinges.

2. Base material unless otherwise indicated in hardware sets:

a. Exterior Doors: 304 Stainless Steel, Brass or Bronze material.
b. Interior Doors: Steel material.
c. Fire Rated Doors: Steel or 304 Stainless Steel materials.
d. Stainless Steel ball bearing hinges to have stainless steel ball bearings. Steel ball bearings are unacceptable.

3. Quantity of hinges per door unless otherwise stated in hardware sets:

a. Doors up to 60” in height provide 2 hinges.
b. Doors 60” up to 90” in height provide 3 hinges.
c. Doors 90” up to 120” in height provide 4 hinges.
d. Doors over 120” in height add 1 additional hinge per each additional 30” in height or fraction thereof.
e. Dutch doors provide 4 hinges up to 120” in height and 1 additional per each additional 30” in height or fraction thereof.

4. Hinge design and options unless otherwise indicated in hardware sets:

a. Hinges are to be of a square corner five-knuckle design, flat button tips and have ball bearings unless otherwise indicated in hardware sets.
b. Out-swinging lockable and access-controlled doors are required to have Non-Removable Pins (NRP) to prevent removal of pin while door is in closed position.
c. When full width of opening is required, use hinges that are designed to swing door completely from opening when door is opened to 95 degrees.

D. Acceptable Manufacturers:

1. Hager
2. Stanley
3. McKinney

**2.3 ALUMINUM GEARED CONTINUOUS HINGES**

A. Continuous hinges of one manufacturer as listed for continuity of design and consideration of warranty.

B. Standards: Products to be certified and listed by ANSI/BHMA A156.26 Grade 1.

C. Determine final model numbers and accessories required using the following criteria:

1. Door inset in relation to the frame face.
2. Door thickness and weight.
3. At fire rated openings provide hinges that carry a UL certification, up to and including 90-minute applications for wood doors and up to 3-hour applications for metal doors and provide studs as required by the manufacturer’s listings.
4. Provide heavy-duty hinges for high frequency and exterior applications.

5. When full width of opening is required, use hinges that are designed to swing door completely from opening when door is opened to 95 degrees.
6. Size length of hinge to equal the actual door height unless otherwise stated in hardware sets.

D. Material and Design:

1. Base material: Anodized aluminum manufactured from 6063-T6 material; unexposed working metal surfaces be coated with TFE dry lubricant.
2. Bearings:

   a. Continuous hinges are to have a minimum spacing between bearings of 2-9/16". Typical door from 80" to 84" in height to have a minimum of 32 bearings.

3. Options:

   a. Provide factory-cut preparations for concealed electric power transfers.

E. Acceptable Manufacturers:

1. Hager
2. National Guard Products
3. Select

**2.4 POWER TRANSFER**

A. Power transfer of one manufacturer as listed for continuity of design and consideration of warranty.

B. Products to be certified and listed by the following:

1. UL Listed Miscellaneous Fire Door Accessories.
2. UL 10C Listed for up to 3 hours on fire-rated doors and frames.
3. Classified according to Uniform Building Code (UBC) Standard 7-2, Fire Test of Door Assemblies (1997).

C. Design:

1. Stainless steel tubular wire transfer and cast housing with steel back boxes to provide weather and tamper resistance when door is open or closed.
2. Mortise door and frame installation
3. Two 18 ga wires, 5 amps @ 12/24 VAC/DC.

D. Acceptable Manufacturers:

| | 2 Conductors | 10 Conductors |
|---|---|---|
| Hager | 2-679-0621 US28 | 2-679-0623 US28 |
| SDC | PTM-2 | PTM-10 |

**2.5 FLUSH BOLTS AND COORDINATORS**

A. Flush bolts of one manufacturer as listed for continuity of design and consideration of warranty.

B. Standards: Manufacturer to be listed by the following: Auxiliary Hardware: ANSI/BHMI A156.16.

C. Labeled openings: Provide automatic or constant latching flush bolts per hardware schedule for inactive leaf of pairs of doors. Provide dust proof strikes for bottom bolt.

D. Non-Labeled openings: Provide two flush bolts for inactive leaf of pairs of doors per hardware schedule. Provide extension rods so that the center line of the top flush bolt is not more than 78" above the finish floor. Provide dust proof strike from bottom bolt.

E. Acceptable Manufacturers:

| | Manual Flush Bolt | Auto Flush Bolt | Dust Proof Strike |
|---|---|---|---|
| Hager | 282D | 292D/295W/296W | 280X |
| Rockwood | 555 | 1942 | 570 |
| Trimco | 3917 | 3815 | 3911 |

F. Coordinators: Provide for labeled pairs of doors with automatic flush bolts or with vertical rod exit device with a mortise-locking device per hardware schedule. Provide filler piece to extend full width of stop on frame. Provide mounting brackets for closers and special preparation for latches where applicable.

G. Acceptable Manufacturers:

| | Coordinator | Bracket | Bracket for stops greater than 2-1/4." |
|---|---|---|---|
| Hager | 297 | 297B | 297B |
| Rockwood | 1600 | 2601D | 2601D |
| Trimco | 3094 | 3095 | 3096 |

## 2.6 REMOVABLE MULLIONS

A. Keyed and non-keyed removable mullions of one manufacturer as listed for continuity of design and consideration of warranty.

B. Standards: Manufacturer to be listed by the following: UL/cUL/Warnock Hersey for fire-rated pairs of doors up to 8 feet tall x 8 feet wide opening.

C. Material and Design:

1. For use with rim exit devices on non-rated and fire rated pairs of doors. Mullion 2" x 3" x 11 gage steel tube.
2. Top Fitting:

    a. Mullion locked in place without use of a key.
    b. Deadlock on fire-rated device

D. Acceptable manufacturers for keyed removable mullions:

| | Keyed Fire-Rated | Keyed Non-Fire-Rated |
|---|---|---|
| Hager | 4900TF | 4900T |
| Von Duprin | KR9954 | KR4954 |
| Sargent | 12-L980 | L980S |

E. Acceptable manufacturers for removable mullions:

| | Fire-Rated | Non-Fire-Rated |
|---|---|---|
| Hager | 4900UF | 4900U |
| Von Duprin | 9954 | 4954 |
| Sargent | 12-980 | 980S |

## 2.7 HEAVY DUTY MORTISE LOCKS AND LATCHES

A. Locks and latches of one manufacturer as listed for continuity of design and consideration of warranty.

B. Standards: Product to be certified and listed by following:

1. ANSI/BHMA A156.13 Series 1000 Certified to Grade 1 for Operational and Security.
2. UL/cUL Labeled and listed up to 3 hours for single doors up to 48” in width and up to 96” in height.
3. UL10C/UBC 7-2 Positive Pressure Rated.
4. ICC/ANSI A117.1.

C. Lock and latch function numbers and descriptions of manufacturer’s series as listed in hardware sets.

D. Material and Design:

1. Lock cases from fully wrapped, 12-gauge steel, zinc dichromate for corrosion resistance.
2. Non-handed, field reversible without opening lock case.
3. Break-away spindles to prevent unlocking during forced entry or vandalism.
4. Levers, zinc cast, forged brass or stainless steel and plated to match finish designation in hardware sets.
5. Escutcheons, of solid brass or stainless-steel material.
6. Armor fronts, self-adjusting to accommodate a square edge door or a standard 1/8” beveled edge door.

E. Latch and Strike:

1. Stainless steel latch bolt with minimum of 3/4” throw and deadlocking for keyed and exterior functions.
2. Strike is to fit a standard ANSI A115 prep measuring 1-1/4” x 4-7/8” with proper lip length to protect surrounding trim.
3. Deadbolts to be 1-3/4” total length with a minimum of a 1” throw and 3/4” internal engagement when fully extended and made of stainless-steel material.

F. Options:

1. Doors required lead line protection – provide locks with 1-16” lead applied to outside case of lock.
2. Provide knurled levers on entry side of doors that are potentially dangerous to visually impaired persons.

G. Electrified Locks

1. Fail-Safe (power lock): Outside trim is locked when power is applied and unlocked when power is removed. Lockset will unlock in the event of a power failure (EL).
2. Fail-Secure (power unlock): Outside trim is locked when there is no power and unlocked when power is applied. Lockset will be locked in the event of a power failure (EU).
3. Latch bolt monitoring: Single switch SPDT mounted inside lockset monitors full extension of latch bolt (LM).
4. Door Position Monitor: Single switch SPDT reed magnetic switch mounted inside lockset monitors whether door is fully closed (DPM).
5. Request to Exit: Monitors inside lever rotation (RX).

H. Acceptable Manufacturers:

| | |
|---|---|
| Hager | 3800 Series |
| Best | 45H Series |
| Sargent | 8200 Series |

**2.8 WIRE-FREE AND WIRELESS WIDEBODY MORTISE LOCKS:**

A. Basis of design: Where indicated in the schedule of materials provide access and security locks and latches that are from one manufacturer continuity of design and consideration of warranty.

B. Standards: Product to be certified and listed by the following standards:

1. Mortise Locks: ANSI/BHMA A156.13 certified Grade 1.
2. UL/cUL Labeled and listed for single doors up to 48” in width and up to 96” in height.
3. UL10C/UBC 7-2 Positive Pressure Rated.
4. ICC/ANSI A117.1.

C. Design:

1. Full Escutcheon design made from brass or stainless-steel material.
2. Lock cases from fully wrapped, 12-gauge steel, zinc dichromate for corrosion resistance and be non-handed, field reversible without opening lock case.
3. Levers to be made from brass or stainless-steel material that is plated to match finish designation in hardware sets and comply with ICC/ANSI A117.1.
4. Armor fronts, self-adjusting to accommodate a square edge door or a standard 1/8” beveled edge door.
5. Available with an optional privacy feature to prevent entry unless user has authorized override privileges.
6. Water resistance application lock units must have an option for outdoor and wet environments.
7. Internal lever will be free to operate and retract all latches/deadbolts, allowing free egress by way of a single action.
8. Optional mechanical key override.
9. Latch and Strike:

    a. Provide stainless steel latch bolt that has a dead latching feature or dead bolt.
    b. Strike is to fit a standard ANSI A115 prep measuring 1-1/4” x 4-7/8” with proper lip length to protect surrounding trim.

10. Electrical Features:

    a. Locks are to be wire-free with an option to be wireless and operated by standard alkaline batteries sufficient for up to 48,000 transactions. No proprietary or rechargeable battery packs will be accepted.
    b. Low battery status will be recorded on the user’s credential and transferred to the management system when the credential is presented at an online wall reader.
    c. In the event of a battery failure, the door will be able to be opened with a small portable handheld device in conjunction with a valid credential.
    d. Integral request to exit switch.
    e. An audit trail of the last 1,000 events will be stored on the locks memory for collection for collection using the portable handheld device at any time and without access to the inside component of the door lock.
    f. The current date and time will be synchronized with the server with a portable handheld device.
    g. Have typical access control features and be able to mimic traditional door hardware functions. The following is a minimum of the required door operational features:

        1) Office
        2) Automatic Changes
        3) Automatic Opening
        4) Automatic Opening plus Office
        5) Automatic Opening plus Toggle
        6) Times Office
        7) Timed Toggle
        8) Toggle Only

    h. Be able to be programmed to remain unlocked during certain hours and days, automatically changing to a locked down mode outside of these times i.e.- go into office, card only, card plus PIN mode, etc. Each lock will have a minimum of 8 different automatic locking and unlock

schedules. This feature can be manipulated by day of the week and by system holidays for each door lock.

i. Automatically adjust for daylight saving time. This feature will be flexible enough to provide changeable dates from year to year. This feature will not require a visit to the lock with a programming device.

j. Length of time that can open the door after a valid credential is presented will be a variable and managed by the software, allowing for users with physical disabilities additional time when needed to access the opening.

k. Optional Automatic Locking (lockdown mode), locks will be able to lock down from the inside in an emergency. While the lock is in lockdown mode, one designated token will be able to enter the locked down door unit. Once the unit is returned to normal programming mode, it will operate as previously programmed. Activation and resetting of the lockdown mode (AMOK) will be done with a card holders token. This privilege will be given to the desired card holder on a person-by-person basis.

l. Operation of the optional key override will be recorded in the lock unit audit trail memory to provide increased security and to track key usage.

D. Manufacturers:

1. Hager Companies HS4
2. Approved Equal

**2.9 WIRE-FREE AND WIRELESS EXIT DEVICE TRIM**

A. Standards: Product to be certified and listed by the following standards:

1. Exit Device Trim: ANSI/BHMA A156.3 certified Grade 1.
2. UL/cUL Labeled and listed for single doors up to 48” in width and up to 96” in height.
3. UL10C/UBC 7-2 Positive Pressure Rated.
4. ICC/ANSI A117.1.

B. Design:

1. Full Escutcheon design made from brass or stainless-steel material.
2. Levers to be made from brass or stainless-steel material that is plated to match finish designation in hardware sets and comply with ICC/ANSI A117.1.
3. Water resistance application lock units, must have an option for outdoor and wet environments.
4. Optional mechanical key override.

C. Electrical Features

1. Exit device trims are to be wire-free with an option to be wireless and operated by standard alkaline batteries sufficient for up to 48,000 transactions. No proprietary or rechargeable battery packs will be accepted.
2. Low battery status will be recorded on the user’s credential and transferred to the management system when the credential is presented at an online wall reader.
3. In the event of a battery failure, the door will be able to be opened with a small portable handheld device in conjunction with a valid credential.
4. Request to exit terminal for an external request to exit switch.
5. An audit trail of the last 1,000 events will be stored on the locks memory for collection for collection using the portable handheld device at any time and without access to the inside component of the door lock.
6. The current date and time will be synchronized with the server with a portable handheld device.
7. Have typical access control features and be able to mimic traditional door hardware functions. The following is a minimum of the required door operational features:

a. Easy Office
b. Automatic Changes

c. Automatic Opening
d. Automatic Opening plus Easy Office
e. Automatic Opening plus Toggle
f. Times Office
g. Timed Toggle
h. Toggle Only

8. Be able to be programmed to remain unlocked during certain hours and days, automatically changing to a locked down mode outside of these times i.e.- go into easy office, timed easy office, card only, etc. Each exit device trim will have a minimum of 8 different automatic locking and unlock schedules. This feature can be scheduled by day of the week and by system holidays for each door lock.
9. Automatically adjust for daylight saving time. This feature will be flexible enough to provide changeable dates from year to year. This feature will not require a visit to the lock with a programming device.
10. Length of time that can open the door after a valid credential is presented will be a variable and managed by the software, allowing for users with physical disabilities additional time when needed to access the opening.
11. Operation of the optional key override will be recorded in the lock unit audit trail memory to provide increased security and to track key usage.

D. Manufacturers:

1. Hager Companies HS4
2. Approved Equal

**2.10 EXIT DEVICES**

A. Exit Devices of one manufacturer as listed for continuity of design and consideration of warranty. Touchpad type finish to match balance of door hardware.

B. Standards: Manufacturer to be certified and/or listed by the following:

1. BHMA Certified ANSI A156.3 Grade 1.
2. UL/cUL Listed for up to 3 hours for “A” labeled doors.
3. UL10C/UBC 7-2 Positive Pressure Rated.
4. UL10B Neutral Pressure Rated.
5. UL 305 Listed for Panic Hardware.

C. Material and Design:

1. Provide exit devices with actuators that extend a minimum of one-half of door width.
2. Where trim is indicated in hardware sets provide the lever design to match design of lock levers.
3. Exit device to mount flush with door.
4. Latch bolts:

a. Rim device – 3/4” throw, Pullman type with automatic dead-latching, stainless steel
b. Surface vertical rod device – Top 1/2” throw, Pullman type with automatic dead-latching, stainless steel. Bottom 1/2” throw, Pullman type, held retracted during door swing, stainless steel.

5. Fasteners: Wood screws, machine screws, and thru bolts.

D. Lock and Latch Functions: Function numbers and descriptions of manufacturer’s series and lever styles indicated in door hardware sets.

E. Acceptable Manufactures:

| | Wide Stile | Narrow Stile |
|---|---|---|
| Hager | 4500 Series | 4600 Series |
| Von Duprin | 99 Series | 33 Series |
| Sargent | 80 Series | 8500 Series |

F. Electric Modifications:

1. Motorized Latch Retraction (MLR): An electric motor retracts the latch bolt for momentary or maintained periods of time.
2. Provide Request to Exit (REX) switches as scheduled.
3. Electrified Trim: Outside trim locked (EL) or unlocked (EU) by electric current.
4. Delayed Egress with Wall Mounted Controller (Hager Model 2-679-0630) (DE).

**2.11 CYLINDERS AND KEYING**

A. Cylinders of one manufacturer as listed for continuity of design and consideration of warranty.

B. Products to be certified and listed by the following:

1. Auxiliary Locks: ANSI/BHMA A156.5

C. Cylinders:

1. Provide cylinders matched to the types required for hardware that has a locking function and for keyed electronic functions. Furnish with appropriate collars, cams, and tailpieces to fit and operate associated hardware. Stacking collars is not acceptable, a single collar of proper size is required.
2. Manufacturer's seven-pin small format interchangeable core (SFIC).
3. Provide concealed key control (CKC) at cylinder by stamping or permanently marking the keyset symbol in a location on the cylinder that is concealed when installed.

D. Keying:

1. Key into Owner's existing key system.
2. Provide a bitting list to Owner of combinations as established and expand to twenty-five percent for future use or as directed by Owner.

    a. Include all the keysets and bittings of the original key system creating one clean version of the entire key system.

3. Keys to be shipped directly to the Owner's Representative as established during the keying conference.

    a. Package the keys in individual envelopes, grouped by keyset symbol, and label envelopes with project name, factory registry number, and keyset symbol.

4. Stamp large bow key blanks with visual key control (keyset symbol) and "Do Not Duplicate".
5. Provide interchangeable cores with construction cores as required per the keying meeting.

E. Acceptable Manufacturers:

Kaba Peaks
Owner Approved Equal

## 2.12 PUSH/PULL PLATES AND BARS

A. Push/Pull plates and bars of one manufacturer as listed for continuity of design and consideration of warranty.

B. Standards: Manufacturer to be certified by the following:

1. Architectural Door Trim: ANSI/BHMA A156.6.
2. Americans with Disabilities Act Accessibility Guidelines (ADAAG).

C. Push plates: .050" thick, square corner and beveled edges with countersunk screw holes. Width and height as stated in hardware sets.

D. Acceptable Manufacturers:

| | |
|---|---|
| Hager | 30S |
| Rockwood | 70C |
| Trimco | 1001 |

E. Pull Plates: .050" thick, square corner and beveled edges. Width and height as stated in hardware sets, 3/4" diameter pull, with clearance of 2-1/2" from face of door.

F. Acceptable Manufacturers:

| | |
|---|---|
| Hager | H34G |
| Rockwood | 110 x 70C |
| Trimco | 1018-3 |

G. Push Pull Bar Sets: 1" round bar stock with 2 –1/2" clearances from face of door. Offset 3", 90-degree standard. Center to center size should be door width less 1 stile width.

H. Acceptable Manufacturers:

| | |
|---|---|
| Hager | H159D |
| Rockwood | BF15747 |
| Trimco | 1747 |

I. Pull Bar Sets: 1" round bar stock with 2 –1/2" clearances from face of door.

J. Acceptable Manufacturers:

| | |
|---|---|
| Hager | H14J |
| Rockwood | BF157 |
| Trimco | 1194 |

## 2.13 CLOSERS

A. Closers of one manufacturer as listed for continuity of design and consideration of warranty, unless otherwise indicated on hardware schedule, comply with manufacturer's recommendations for size of closer, depending on width of door, frequency of use, atmospheric pressure, ADAAG requirement, and fire rating.

B. Standards: Manufacturer to be certified and or listed by the following:

1. BHMA Certified ANSI A156.4 Grade 1.
2. ADA Complaint ANSI A117.1.

3. UL/cUL Listed up to 3 hours.
4. UL10C Positive Pressure Rated.
5. UL10B Neutral Pressure Rated.

C. Material and Design:

1. Provide cast iron non-handed bodies with full plastic covers.
2. Closers will have separated staked adjustable valve screws for latch speed, sweep speed, and backcheck.
3. Provide Tri-Pack arms and brackets for regular arm, top jamb, and parallel arm mounting.
4. One-piece seamless steel spring tube sealed in hydraulic fluid.
5. Double heat-treated steel tempered springs.
6. Precision-machined heat-treated steel piston.
7. Triple heat-treated steel spindle.
8. Full rack and pinion operation.

D. Mounting:

1. Out-swing doors use surface parallel arm mount closers except where noted on hardware schedule.
2. In-swing doors use surface regular arm mount closers except where noted on hardware schedule.
3. Provide brackets and shoe supports for aluminum doors and frames to mount fifth screw.
4. Furnish drop plates where top rail conditions on door do not allow for mounting of closer and where backside of closer is exposed through glass.

E. Size closers in compliance with requirements for accessibility (ADAAG). Comply with following maximum opening force requirements.

1. Interior hinged openings: 5.0 lbs.
2. Fire-rated and exterior openings use minimum opening force allowable by authority having jurisdiction.

F. Fasteners: Provide self-reaming, self-tapping wood and machine screws, and sex nuts and bolts for each closer.

G. Acceptable manufacturers:

| | |
|---|---|
| Hager | 5100 Series |
| LCN | 4040XP Series |
| Sargent | 281 Series |

**2.14 LOW ENERGY POWER OPERATORS**

A. Low energy power operators of one manufacturer as listed for continuity of design and consideration of warranty.

B. Products to be certified and listed by the following:

1. Power Assist and Low Energy Power Operated Doors: ANSI/BHMA A156.19.
2. ADA Complaint ANSI A117.1.

C. Materials and Design:

1. Self-contained electrical control unit, including necessary transformers, relays, rectifiers, and other electronic components for proper operation, switching and control of door up to 350 lbs. and include time delay for normal cycle.
2. On pairs of doors, door to be opened manually without the other door opening.

3. Operates as a mechanical closer if power is disconnected. Forces consistent with ANSI A117.1 and ANSI A156.19.
4. Provide delay switches for motor activation, exit device latch retraction interfacing, and hold open times. Hold open times to be adjustable from 1 second to continuous seconds.
5. Adjustable vestibule sequencing input for operation of two or more units. Specify 2-659-0240.
6. Adjustable powered swing degree from 80 degrees to 110 degrees.
7. Integral obstruction detection for closing and opening cycle.
8. Adjustable built-in stop set from 80 degrees maximum to 180 degrees manual swing.
9. When in “blow open” operation for smoke ventilation, operator will stay in the open position when loss of power.
10. Boost to close selectable on/off switch.

D. Signage: Provide signage in according to the requirements of ANSI/BHMA A156.19.

E. Acceptable Manufacturers:

| | |
|---|---|
| Hager | 8400 Series |
| LCN | 4640 Series |
| Norton | 6000 Series |

F. Actuators:

1. Opening cycle activated by pressing switches with international symbol of accessibility and “PUSH TO OPEN” engraved on faceplate.
2. Switches installed in standard 2-gang electrical wall box and placed in a location in compliance with ANSI A117.1.
3. Wireless actuators optional.
4. Provide bollards as required where a suitable wall mount is not possible.

G. Acceptable Manufacturers:

Hager
MS Sedco
SDC

**2.15 PROTECTIVE TRIM**

A. Protective trim of one manufacturer as listed for continuity of design and consideration of warranty.

B. Size of protection plate: single doors, size two inches less door width (LDW) on push side of door, and one inch less door width on pull side of door. For pairs of doors, size one inch less door width (LDW) on push side of door, and 1/2 inch on pull side of door. Adjust sizes to accommodate accompanying hardware, such as, edge guards, astragals, and others.

1. Kick Plates 10” high or sized to door bottom rail height.
2. Mop Plates 4” high.
3. Armor Plates 36” high.

C. Products to be certified and listed by the following:

1. Architectural Door Trim: ANSI/BHMA A156.6.
2. UL.

D. Material and Design:

1. 0.050” gage stainless steel.

2. Corners square, polishing lines, or dominant direction of surface pattern so they run across door width of plate.
3. Bevel top, bottom, and sides uniformly leaving no sharp edges.
4. Countersink holes for screws. Space screw holes so they are no more than eight inches CTC, along a centerline not over 1/2" in from edge around plate. End screws maximum of 0.53" from corners.

E. UL label stamp required on protection plates when top of plate is more than 16 inches above bottom of door on fire rated openings. Verify door manufacturer's UL listing for maximum height and width of protection plate to be used.

F. Acceptable Manufacturers:

| | |
|---|---|
| Hager | 190S |
| Trimco | K0050 |
| Rockwood | K1050 |

**2.16 STOPS AND HOLDERS**

A. Stops and holders of one manufacturer as listed for continuity of design and consideration of warranty.

B. Wall Stops: Provide door stops wherever necessary to prevent door or hardware from striking an adjacent partition or obstruction. Provide wall stops when possible. Door stops and holders mounted in concrete floor or masonry walls have stainless steel machine screws and lead expansion shields.

C. Products to be certified and listed by the following:

1. Auxiliary Hardware: ANSI/BHMA A156.16.

D. Acceptable Manufacturers:

| | Wall Convex | Wall Concave | Floor Mounted |
|---|---|---|---|
| Hager | 232W | 236W | 242F / 248F / 259H / 269F |
| Rockwood | 406 | 409 | 441H / 446 / 480H / 466 |
| Trimco | 1270WX | 1270wv | 1211 / 7280 / 1214H / 1209 |

E. Overhead Stops and Holders: Provide overhead stops and holders for doors that open against equipment, casework sidelights and other objects that would make wall stops/holders and floor stops/holders inappropriate. Provide sex bolt attachments for mineral core wood door applications.

F. Products to be certified and listed by the following:

1. Overhead Stops and Holders: ANSI/BHMA A156.8 Grade 1.

G. Acceptable Manufacturers:

| | Heavy Duty Surface | Heavy Duty Concealed | Slim Line Concealed |
|---|---|---|---|
| Hager | 7000 SRF Series | 7000 CON Series | |
| Glynn Johnson | 90 SRF Series | 100 Series | |
| ABH | 1000 Series | 9000 Series | 1020 SL Series |
| Rixon | 1 Series | 9 Series | 6 Series |

**2.17 ELECTROMAGNETIC HOLDERS**

A. Electromagnetic holders of one manufacturer as listed for continuity of design and consideration of warranty.

B. Products to be certified and listed by the following:

1. ANSI A156.15 Grade 1.
2. UL/ULC Listed.
3. California State Fire Marshall listed (CSFM).
4. City of New York MEA approved.

C. Material and Design:

1. Provide electromagnetic holders where self-closing fire doors and smoke barrier doors are required to be held open. Electromagnetic holders to be fail-safe: when electrical current is interrupted, doors release to close automatically. Holding force 25-40 lbs.

D. Acceptable Manufacturers:

| | |
|---|---|
| Hager | 380 Series |
| LCN | SEM Series |
| Rixson | 980 Series |

**2.18 WALL READER / CONTROL UNIT**

A. Basis-of-Design Product: Where indicated in the hardware sets provide wall readers/control unit that are manufactured by one manufacturer for continuity of design and consideration of warranty.

1. Manufacturers:

a. Hager Companies HS4
b. Approved equal

B. Wall Readers:

1. Include support for one or two wall readers and be MiFare/DESfire capable. Secure reader to wall with a vandal resistant frame and tamper proof fixings plus a control unit.
2. Have optional keypad available for keypad only or for dual credential validation.
3. Make the connection between wall reader and control unit by a UTP CAT5e or better cable.

C. Control Unit:

1. Be 12VDC and compliant to ISO 15.93 and FCC Part 15 and certified to the following standards: CE, UL 294, FCC part 15.
2. Provide Ethernet connectivity of all on-line devices via IP4 or IP6 addressing, either hardwired or through ZigBee 16 Channel WiFi Connection (802.15.4).
3. Provide the ability to use 1 IP address and connect 4 additional controllers using RS485 (10 card readers per IP address.
4. Provide the ability to support 2 readers and 2 locking devices with on board programmable relays.
5. Support a minimum of 400 foot in cable length for each card reader and support Anti-Pass back.
6. Provide encryption between the controller and each card reader.
7. Provide a minimum of 6 auxiliary inputs for use as door position, request to exit, or for any non-door purpose required. Must support a minimum of 60 inputs per IP address without the use of an auxiliary input board or device.
8. Provide for up to 16 auxiliary output boards with a total of not less than 128 outputs available for end user programming.
9. Provide the flexibility for either online wireless or offline battery-operated locks, allowing for the two system types to be integrated into the same facility.
10. Provide two on board tamper option, input, and switch.
11. Capable of integrating with the elevator management system to control access to individual floors for individual users. Connection to the CU will be via a RS485 serial connection to Extension Relay

Boards (ERB) consisting of 8 NO/NC 12VDC dry contact relays. The Electronic Access Control (EAC) system will allow for up to 16 ERB to be connected in series to each control unit.

12. Connect directly to the Electronic Access Control (EAC) application and be capable of making changes to the individual user access profile when a credential is presented and at the same time pass the list of recently cancelled cards on to the key and upload any stored “on key” audits of attempts to access doors and any low battery warnings from the stand-alone locks.
13. During times of power failure: hold its designation and zones it belongs to, operational configuration, audit trail and a list of cancelled keys in non-volatile memory. Will connect directly to the EAC application and be capable of making changes to individual user access profile when credential is presented and at the same time pass a list of recent cancelled cards on to the key and upload any stored “on key” audits of attempts to access doors and any low battery warnings from the stand-alone locks.
14. Have the capability to operate both as an off-line stand-alone door controller or, be easily upgraded with additional hardware to function as an integrated part of the on-line EAC system.

**2.19 POWER SUPPLIES AND CONTROLLER CABINETS (10 DOOR)**

A. Basis of design: Where indicated in the schedule of materials provide power supplies that are from one manufacturer continuity of design and consideration of warranty.

B. Certifications:

1. CE approved
2. UL294 Listed – Access Control System Units

C. Design:

1. 10 door Power Supply Enclosure
2. Houses (5) HS4 controllers.
3. Wall mount for indoor use
4. Removeable mounting backplane
5. Operating Temperature: 32 to 120 degrees F
6. 16AWB powder-coated steel enclosure.
7. Single 2” center knockout on top of enclosure
8. Sixteen 2-stage knockouts for .75” or 1”
9. One Cam Lock
10. One Tamper Switch

D. Technical Characteristics:

1. 120VAC input power source
2. Dual Input Power Distribution Module

    a. Steers Power from wither two low voltage AC or DC power sources
    b. 8 fused protected outputs

3. Access Power Controller 1

    a. Converts (1) 12 to 24VAC or VDC input to (4) independently controlled fuse protected outputs.
    b. Power outputs can be converted to dry form “C” contacts.
    c. Outputs operate in both fail-safe or fail secure modes.
    d. FACP interface
    e. Option for shared or separate power sources for board operation and locking devices.

4. Access Power Controller 2

    a. Converts (1) 12 to 24VAC or VDC input to (4) independently controlled fuse protected outputs.

b. Power outputs can be converted to dry form “C” contacts.
c. Outputs operate in both fail-safe or fail secure modes.
d. FACP interface
e. Option for shared or separate power sources for board operation and locking devices.

E. Manufacturers:

1. Hager Companies HS4
2. Approved Equal

**2.20 POWER SUPPLIES AND CONTROLLER CABINETS (4 DOOR)**

A. Basis of design: Where indicated in the schedule of materials provide power supplies that are from one manufacturer continuity of design and consideration of warranty.

B. Certifications:

1. CE approved
2. UL294 Listed – Access Control System Units

C. Design:

1. 4 door Power Supply Enclosure
2. Houses (2) HS4 controllers.
3. Wall mount for indoor use
4. Removeable mounting backplane
5. Operating Temperature: 32 to 120 degrees F
6. 16AWB powder-coated steel enclosure.
7. Single 2” center knockout on top of enclosure
8. Sixteen 2-stage knockouts for .75” or 1”
9. One Cam Lock
10. One Tamper Switch

D. Technical Characteristics:

1. 120VAC input power source
2. Voltage regulator

a. Converts 24VDC input into a regulated 5VDC or 12VDC output at up to 6A supply current.

3. Dual Input Power Distribution Module

a. Steers Power from either two low voltage AC or DC power sources
b. 8 fused protected outputs

4. Access Power Controller

a. Converts (1) 12 to 24VAC or VDC input to (4) independently controlled fuse protected outputs.
b. Power outputs can be converted to dry form “C” contacts.
c. Outputs operate in both fail-safe or fail secure modes.
d. FACP interface
e. Option for shared or separate power sources for board operation and locking devices.

E. Manufacturers:

1. Hager Companies HS4
2. Approved Equal

## 2.21 THRESHOLDS

A. Thresholds of one manufacturer as listed for continuity of design and consideration of warranty.

B. Set thresholds for exterior and acoustical openings in full bed of sealant with lead expansion shields and stainless-steel machine screws complying with requirements specified in Division 07 Section “Joint Sealants: Notched in field to fit frame by hardware installer. Refer to Drawings for special details.

C. Standards: Manufacturer to be certified by the following:

1. Thresholds: ANSI/BHMA A156.21.
2. American with Disabilities Act Accessibility Guidelines (ADAAG).

D. Acceptable Manufacturers:

| | |
|---|---|
| Hager | 412S / 413S / 520S |
| Pemko | 171 / 271 / 2005 |
| National Guard Products | 425 / 513 / 896 |

## 2.22 DOOR GASKETING AND WEATHERSTRIP

A. Door gasketing and weatherstrip of one manufacturer as listed for continuity of design and consideration of warranty.

B. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing where indicated on hardware schedule. Provide noncorrosive fasteners for exterior applications.

1. Perimeter gasketing: Apply to head and jamb, forming seal between door and frame.
2. Meeting stile gasketing: Fasten to meeting stiles, forming seal when doors are in closed position.
3. Door bottoms: Apply to bottom of door, forming seal with threshold or floor when door is in closed position.
4. Sound Gasketing: Cutting or notching for stop mounted hardware not permitted.
5. Drip Guard: Apply to exterior face of frame header. Lip length to extend 4” beyond width of door.

C. Products to be certified and listed by the following:

1. Door Gasketing and Edge Seal Systems: ANSI/BHMA A156.22.
2. BHMA certified for door sweeps, automatic door bottoms, and adhesive applied gasketing.

D. Smoke-Labeled Gasketing: Comply with NFPA 105 listed, labeled, and acceptable to Authorities Having Jurisdiction, for smoke control indicated.

1. Provide smoke-labeled gasketing on 20-minute rated doors and on smoke rated doors.

E. Fire-Rated Gasketing: Comply with NFPA 80 listed, labeled, and acceptable to Authorities Having Jurisdiction, for fire ratings indicated.

F. Refer to Section 08 1416 Wood Doors for Category A or Category B. Comply with UBC 7-2 and UL10C positive pressure where frame applied intumescent seals are required.

G. Acceptable Manufacturers:

1. Perimeter Gasketing:

| | Stop Applied | Stop Applied | Adhesive Applied |
|---|---|---|---|
| Hager | 881S | 891S | 726 |
| Pemko | 700S | 303 | 5050 |
| National Guard Products | 290 | 160 | S88 |

2. Sound Seal:

| | |
|---|---|
| Hager | 864S |
| Pemko | 379 |
| National Guard Products | 107 |

3. Meeting Stile Weatherstrip:

| | |
|---|---|
| Hager | 872S N |
| Pemko | 305_N |
| National Guard Products | 9125 |

4. Overlapping Astragal:

| | |
|---|---|
| Hager | 835S / 874SN |
| Pemko | 357 / 375_R |
| National Guard | 139 / 122N |

5. Door Bottom Sweeps:

| | |
|---|---|
| Hager | 750S |
| Pemko | 200N |
| National Guard | 305_N |

6. Automatic Door Bottoms:

| | |
|---|---|
| Hager | 742S / 743S |
| Pemko | 420 / 434 |
| National Guard | 320 / 422 |

7. Overhead Drip Guard

| | |
|---|---|
| Hager | 810S |
| Pemko | 346 |
| National Guard | 17 |

**2.23 WIRELESS DOOR POSITION SWITCHES**

A. Basis of design: Where indicated in the schedule of materials provide wireless communicating door position switches for each wireless access and security lock and exit device that are from one manufacturer continuity of design and consideration of warranty

B. Manufacturers:

1. Hager Companies HS4.
2. Approved equal

**2.24 GATEWAYS AND NODES**

A. Basis of design: Where indicated in the schedule of materials provide gateways and nodes for online communication with the wireless locking devices that are from one manufacturer continuity of design and consideration of warranty

B. Gateways

1. Establishes the communication link between the PC and the wireless network.
2. Managed through the ProAccess Space software.
3. Sends and collects all information through the nodes to and from the the wireless locking devices.
4. Technical Characteristics:

a. Frequency Range: 2400-2483.5 Mhz.
b. RF Standard: Bluetooth
c. Indoor Radio Range: 10/15m..
d. Maximum output power: 8dBm
e. AES 128 bit encryption
f. LAN Network connection: 10Base-T / 100Base-T
g. One internal node included.
h. Manages up to six additional nodes.
i. IP addressing through web explorer available,
j. Firmware updates vis software through an ethernet connection.
k. PoE supported IEEE802.3af
l. Optional 12VDC power adaptor
m. Cable Requirements: UTP CAT5e
n. Built in tamper switch

C. Nodes

1. Bridge between the gateway and the wireless locking devices.
2. Technical Characteristics:

a. RF Standard: Bluetooth
b. Indoor Radio Range: 10/15m.
c. BUS485 connection to the gateway.
d. AES 128 bit encryption
e. Manages up to 16 wireless locking devices.
f. Firmware updates vis software through an ethernet connection.

D. Manufacturers:

1. Hager Companies HS4.
2. Approved equal

**2.25 MANAGEMENT TOOLS:**

A. Ncoder

1. Assigns and deletes keycards into and out of the software
2. Reads keycards
3. OTA dongle for mobile credentials

B. Technical Characteristics:

1. Communications protected by standard cryptography (DTLSv.2-AES128).
2. Built-in Ethernet and USB interfaces

3. DHCP IP Addressing
4. Standards-compliant reader/encoder with SAM data are not stored in the device.
5. Power Consumption 5V

C. Platforms:

1. SVN Data-on-card
2. JustIn Mobile Bluetooth SMART (BLE)
3. JustIn Mobile: NFC:

D. ID Technologies:

1. MiFare (DESFire EV2, Plus, Ultralight C, Classic-ISO/IEC 14443)
2. HID iCLASS
3. Bluetooth SMART (BLE)
4. NFC

E. Portable Programming Device:

1. Function:

a. Initialize wireless locking devices
b. Collect audit trail
c. Update locks
d. Diagnostics of wireless locking devices
e. Emergency opening
f. Firmware update

2. Technical Data:

a. 3-pin connection to wire-free and wireless locking devices
b. Contactless NFC connection to wire-free and wireless locking devices
c. PC connection: USB, RS232
d. Power requirements: Alkaline battery powered

F. Manufacturers:

1. Hager Companies HS4.
2. Approved equal

**2.26 SILENCERS**

A. Where smoke, light, or weather seal are not required, provide three silencers per single door frame, two per double door frame and four per Dutch door frame.

B. Products to be certified and listed by the following:

1. Auxiliary Hardware: ANSI/BHMA A156.16

C. Acceptable Manufacturers:

| | Hollow Metal Frame | Wood Frame |
|---|---|---|
| Hager | 307D | 308D |
| Rockwood | 608 | 607 |
| Trimco | 1229A | 1229B |

## 2.27 ACCESS AND SECURITY MANAGEMENT SYSTEM

A. Basis-of-Design: Subject to compliance with requirements, provide a web-based access control data-on-card software platform fully integrated that integrates all physical security requirements through networked, wired, stand-alone and battery-operated locks.

B. System requirements

1. Provide central management of users' rights, access policies and credentialing.
2. Application will be capable of implementing access policies through the assignment of entry permission based on door groupings and time schedules.
3. Allow for schedules to be applied at doors, governing their remaining open or locked condition.
4. Allow for creation and editing of cardholder credentials, including system wide card formats.
5. Permit flexible assignment of user rights and privileges.
6. Provide views of events and alarms throughout the installation and be capable of triggering hardware and communicative actions-based system configuration.
7. Capable of generating standard and custom reports and provide a detailed log of all system events as defined by the system operator.
8. Capable of real time door access monitoring with on-line capability.
9. System will support a combination of wireless (wire–free) and online (hardwired) wall readers to secure perimeter doors as well as battery powered electronic locks to secure all interior doors, manufactured in the and supported by the same manufacturer.
10. Read/write capability is mandatory; any system that does not use a two-way encrypted Smart Card (RFID) communication format will be considered unacceptable.
11. Card readers and electronic locks shell be compatible with a wide range of smart card (RFID) Technologies, operating on the industry standard frequency of 13.56MHz.

    a. HID iClass: Memory capacity: 32K bit with 2 application area configurations. The HID-IClass credential will have a minimum of 16 kb, 32kb preferred of available memory and allow the possibility for use with multiple vendors across multiple applications.
    b. MIFARE: 4k Bytes
    c. DESFire: 4k Bytes
    d. DESfire EVI: 4k Bytes
    e. Sony FeliCa: 4k Bytes
    f. Legic: 4k Bytes
    g. Pico Pass: 4k Bytes
    h. BLE: Blue Tooth Low Energy
    i. NFC: Near Field Communication at 13.56MHz

C. Software

1. Incorporate 128-bit AES encrypted data.
2. Supported operating systems will be Microsoft Windows, Windows 7 SP1, Windows 8.1, 10, Windows Server 2008 R2 or Server 2012 R2, 2016. Both 32-bit and 64-bit versions.
3. Support a web-based interface as part of the same software package. Loading or licenses for a separate application or having to download software will be unacceptable: acceptable browsers are Internet Explorer, Firefox, Chrome, and Safari.
4. Database engine will be SQL Server 2005, 2008 R2, 2012, 2014, 2016, 2017 and LocalDB. All editions support "Express" included.
5. Operating temperature of 0°C to 50°C, ambient, a storage temperature of -40°C to +85°C, ambient, a relative humidity ability of 0% to 95% (non-condensing) at 50°C, and a MTBF of > 100,000 hours.
6. The system-radiated emissions will be compliant with FCC Part 15, Class A, and EN55022 specifications.
7. The system must be capable of managing 4 million users, 64,000 doors, 256 calendars, 1024 zones, and 256 time zones, 1024 time periods, both with 8 intervals each.
8. Support integration with other software systems through dynamic database synchronization.
9. Be able to store all historical data on the system server without having to individually use a handheld device to download audit trail data from individual locks.

10. Be capable of being expanded throughout the site. Support database partitioning such that each area (department) will be able to manage their own doors and users without a chance of accidentally interfering with other areas (departments).
11. Capable of dynamic master-keying: each credential can change access privileges transparently “on the fly” without the need to visit the access control administrator to reprogram keycards and without the need to reprogram the electronic locks with a handheld programmer.
12. No predefined profiles will be necessary to issue keycards. Each keycard can be individually enabled to access any combination of doors.
13. Lost keycard cancellation: Contactless smart cards be capable of conveying lists of cancelled keys to avoid having to reprogram locks with a handheld device any time a keycard is lost.
14. No third-party WI-FI or Radio infrastructure will be required for Operation.
15. The software will be supplied ready to support any number and configuration of off-line and on-line stand-alone locks and wall readers, with the capacity to manage multiple or single sites.
16. A Portable Programming Device (PPD) for transferring information to and from the database for all off-line locks and wall readers will also be included.
17. Operator Groups will be defined hierarchically and be password protected to allow only authorized staff to make amendments to sections of the database for which they have responsibility.
18. Have a proven Application Programming Interface (API) for interfacing with existing and well-established traditional access control systems.
19. Support an “Out of Site” feature which will work in conjunction with IN and OUT on-line readers to disable user access when leaving a facility and enabling user access when entering it.
20. Support a “Limited User Access” feature which can be set to allow a maximum number of users assigned to a door.
21. Support a “Limited User Occupancy” monitor which can be set to disallow access after the desired number is reached in an area.
22. Support setting encryption type for DESfire cards.
23. Incorporate an activation date and time setting for user cards.
24. Allow multiple operator groups to be created with software features able to be individually allowed or denied to the group.
25. The system software will support the following optional features:

    a. Visitor Management
    b. Badging
    c. Partitions
    d. Third party access system interface
    e. Software to software API with other wired access control systems
    f. Graphical mapping

26. As a standard feature in all software versions, database import and export utilizing “flat files” will be supported.
27. In the event of an emergency the System Administrator will have the ability to either lock down or unlock all or some doors/locks connected via the Salto Wireless Network (SVN). These doors will then remain locked or unlocked until the emergency is designated as over by the System Administrator.
28. Synchronize the server clock with the on-line CU approximately every 30 seconds.

D. Manufacturer:

1. Hager Companies HS4 ProAccess Space
2. Approved Equal

**2.28 CREDENTIALS**

A. Basis-of-Design: Provide a secured contactless smartcard technology that provides high-speed, reliable communication with data integrity.

B. Technology

1. 13.56 MHz Smart Credentials
2. AES 128-bit encryption
3. Reusable, contactless RFID smart credentials in the available in the following:

    a. MiFare 1K
    b. MiFare 4K
    c. DESfire 4K
    d. Dual Technology (MiFare and mag stripe)
    e. JustIn Mobile
    f. NFC Mobile

4. Access profile for the individual user, encoded on the card, be encrypted and in such a format as to negate the potential for cloning.
5. Standard 16 kb or 32kb preferred memory on each credential is required to be secured with a unique set of Keys- A&B for the Electronic Access Control (EAC) system and capable of being enabled when required via the collection and transfer of information but not limited to audit trails, lost and stolen cards.
6. Credentials will be available in multiple form factors. They include but are not limited to the following: standard ID card format, printable ID card format, key fob format, wristwatch format, rubber wrist band format, RFID stickers, BLE mobile and NFC tokens. All devices are required to work at the same level.
7. Reusable, contactless RFID smart credentials in the available in the following technologies:

    a. MiFare 1K
    b. MiFare 4K
    c. DESfire 4K
    d. Dual Technology (MiFare and mag stripe)

C. Manufacturers:

1. Hager Companies HS4
2. Approved Equal

**2.29 FINISHES**

A. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if within range of approved samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within range of approved samples.

B. Comply with base material and finish requirements indicated by ANSI/BHMA A156.18 designations in hardware schedule.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

A. Examine doors and frames, with installers present, for compliance with requirements for installation tolerances, labeled fire-rated construction, wall and floor construction, and other conditions affecting performance.

B. Where hardware will be installed directly on walls inspect applications for blocking material of sufficient type and size for hardware.

C. Examine roughing-in and cabling for electrical power systems to verify actual locations of wiring connections and wiring supplied matches the requirements as described in the wiring diagrams before electrified door hardware installation.

D. Perform a site survey to determine proper mounting locations for all wirelessly communicating devices. Verify that the surrounding construction and equipment will not interfere with the communication between components.

E. Where existing products will be reused, examine existing door and frame sizes, preps, swings, ratings, and compare to the specified hardware for compatibility and functionality. The hardware set specified should act as guide for design and function. Provide filler plates as needed to fill and repair existing materials. Test any existing to remain hardware for functionality and visually inspect for damage. Note any defective or damaged products as well as noting any code deficiencies and submit issues and estimated costs for direction of how to proceed with repair or replacement.

F. Notify Architect via a prepared written report and endorsed by installer of any discrepancies between the door schedule, door types, drawings, and scheduled hardware. List conditions detrimental to application, to the proper and timely completion of the work and performance of the hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

**3.2 INSTALLATION**

A. Install hardware using manufacturers' recommended fasteners and installation instructions, at height locations and clearance tolerances that comply with:

1. NFPA 80
2. NFPA 105
3. ICC/ANSI A117.1
4. DHI Publication – Installation Guide for Doors and Hardware
5. Approved shop drawings
6. Approved hardware schedule

B. Install soffit mounted gaskets prior to other soffit mounted hardware ensuring a continuous seal around the perimeter of the opening without cutting or notching.

C. Locate surface mounted door closers on stairwell side of stair doors, interior side of exterior openings, or on the room side of openings, unless it is a sterile room.

D. Locate wall mounted bumper to contact the operating trim. Verify that pushbuttons of locksets do not contact the stop and inadvertently lock the door.

E. Mount armor, mop, and kick plates flush with the bottom of the door and centered horizontally on the door.

F. Notch thresholds with no larger than a 1/32-inch gap matching the frame profile. Set in a full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants" forming a tight seal between threshold and mounting surface. Caulk and seal the entire perimeter to prevent water leakage. Remove excess sealants immediately and clean the area thoroughly.

G. Do not install surface mounted items until finishes have been completed on substrates involved. Set unit level, plumb and true to line location.

H. Locate power supplies and junction boxes as directed and verified in the low-voltage coordination meeting.

I. Perform final connections of the system components to match the approved operational narratives. Use cable markers to label wires at each termination or end to match the final wiring diagrams. Terminate wiring in accordance with the manufacturer's recommendations. Where quick-connects are seated correctly. Provide wire ties and adhesive pads to secure and organize wires in enclosures. Outside of enclosures seal

terminations in waterproof connectors. Include record drawings of the point-point and the elevations in a plastic sleeve attached to the inside cover of the power supply/junction box enclosure for the Owner's use.

## 3.3 FIELD QUALITY CONTROL

A. Schedule a final walk through to inspect hardware installation ten (10) business days before final acceptance of the Owner. Visually inspect for proper fasteners and verify that doors open, close, latch properly, and that openings are installed to meet NFPA 80 and ANSI A117.1 requirements. Correct deficiencies, including missing hardware immediately. Provide a written report detailing discrepancies of each opening within five (5) business days of the walk through.

B. Prior to receiving certificate of occupancy have doors inspected by a Certified Fire and Egress Door Assembly Inspector (CFDAI), as certified by Intertek (ITS), submit a written report to the Owner and Contractor. Doors failing inspection must be adjusted, modified, or replaced to be within appropriate code requirements without delay.

C. Test the functionality of electrified openings upon completion of the installation in accordance with the description of operation and the Owner's intent under the supervision of a factory authorized representative and an Owner's representative, verify that all features of the software are working correctly, including interfaces with any associated trades. Document the result of all tests and provide these results to the Owner and correct immediately.

## 3.4 ADJUSTMENT, CLEANING, AND DEMONSTRATING

A. Prior to final adjustments, the HVAC system must be completed and balanced. Test that all openings meet ANSI A117.1 for closer opening pressure, closing speed, latching, and hardware operating forces. Replace items that cannot be adjusted to operate freely and smoothly or as intended for application.

B. Prior to final walk-through inspection, clean adjacent surfaces soiled by hardware installation. Clean finish hardware per manufacturer's instructions after final adjustments have been made. Remove all protection and replace items that cannot be cleaned to manufacturer's level of finish quality.

C. Demonstration and training will be conducted as per the following sessions. All sessions will be recorded and turned over to the Owner for future use.

1. Hardware Maintenance: Conduct a training class for building maintenance personnel demonstrating the adjustment, operation, and maintenance of mechanical and electrified hardware. Special tools for finish hardware to be turned over and demonstrated usage at the meeting.
2. Key control system: Train the Owner's designated representative on the key control system demonstrating the permanent file keys, duplicate loaner keys, key receipts, key envelopes, key change identification sheets, bitting lists, tags, and labels. When key management software is provided training will be provided for the setup and usage of the software.
3. Access control: Demonstrate the management and programming of the access control system including the following, but not limited to:

    a. System administration personnel to manage the LAN and databases including updating, maintaining, and backing up the system and database software.
    b. Instruct on all software features and programming for managing the credentials, users, access points, time zones, alarms and events, door monitoring, audit trails, and time schedules.

## 3.5 PROTECTION

A. Leave manufacturer's protective film intact and, protect exit devices, locks, and surface mounted hardware with kraft paper or bubble wrap. Cover fire labels at painted products that bear a label with magnetic or masking tape. Keep protection in place until time of final cleaning and adjustment.

## 3.6 HARDWARE SET SCHEDULE

A. Door hardware items have been placed in sets which are intended to be a guide of design, grade, quality, function, operation, and performance.

1. Review products that may require mounting accessories to meet door, frame, and swing conditions as these final details vary from manufacturer to manufacturer and provide as required.
2. Where additional items of hardware are required for completion of the Work, a written statement of such omission, error, or other discrepancy is required to be submitted to the Architect, prior to bid date for clarification via an addendum.
3. Abbreviations listed below do not appear in the manufacturer's literature, for any other abbreviations refer to manufacturer's literature.:

   a. LDW = Less than Door Width
   b. LAR = Length as Required
   c. QTY = Quantity
   d. CTC = Centerline to Centerline
   e. BTB = Back-to-Back mounting

## 3.7 HARDWARE SCHEDULE

Manufacturer List

| Code | Name |
|---|---|
| AB | ABH Manufacturing Inc. |
| BYOT | By Others |
| HA | Hager |
| HA | Hager Company |
| HO | HS4 |
| HS | HES |
| SATI | Safety Technology International |
| SECT | Securitech Group |
| SPCL | Special-Lite |

Hardware Sets

Set #01.50

Doors: 61

| | | | | |
|---|---|---|---|---|
| 2 | Continuous Hinge | 780-112HD x LAR x EPT | CLR | HA |
| 2 | Power Transfer | 2-679-0623 | ALM | HA |
| 1 | Mullion | SL-60 KR X LAR | CL | SPCL |
| 2 | Rim Exit Device | 4501 RIM MLR FEC | US26D | HA |
| 1 | Rim Cylinder | 3901 SFIC | US26D | HA |
| 1 | Mortise Cylinder | 3902 SFIC x LAR | US26D | HA |
| 2 | Construction Core | 3982-BLU | BLU | HA |
| 2 | Final Keyed Core | KABA PEAKS SFIC (Redford Lock of Novi) | US26D | HA |
| 2 | Recessed Pull | SL-86 BY THE DOOR MFGR | | BYOT |
| 1 | Automatic Operator | 8418 PUSH | ALM | HA |
| 2 | Jamb Actuator(s) | 2-659-0175 | US32D | HA |
| 1 | Closer(s) | 5100 | ALM | HA |
| 1 | Drop Plate(s) | 5110 | ALM | HA |
| 2 | Overhead Stop | 1023 SL | US32D | AB |
| 1 | Saddle Threshold | 412S x LAR | MIL | HA |
| 2 | Door Bottom | SL-301 By the Door Mfr. | | BYOT |
| 1 | Weatherstrip | By Frame MFR./Supplier | | BYOT |
| 1 | Power Supply(s) | Central Power Supply (See Misc Set) | | HA |

Set #01.50

| | | | | |
|---|---|---|---|---|
| 1 | Under Desk Push Switch | 2-679-0708 | No Finish | HA |
| 1 | Mullion Reader(s) | WRDB0M4B0 | | HO |

NOTE: Top jamb mount the door closer.

Operation:
Doors normally closed and locked.
A valid credential at the reader retracts the latches on both exit devices and activates the outside actuator.
Depressing the actuator cycles the automatic operator.
Remote unlock by push button located at the reception desk retracts the latches on the exit devices and activates the outside actuator.
Free egress at all time by depressing the exit device rail or by the inside actuator retracts the latches on the exit devices and cycles the automatic operator.

Set #02.00

Doors: 62

| | | | | |
|---|---|---|---|---|
| 1 | Continuous Hinge | 780-112HD x LAR x EPT | CLR | HA |
| 1 | Power Transfer | 2-679-0623 | ALM | HA |
| 1 | Rim Exit Device | 4501 RIM MLR FEC | US26D | HA |
| 1 | Rim Cylinder | 3901 SFIC | US26D | HA |
| 1 | Construction Core | 3982-BLU | BLU | HA |
| 1 | Final Keyed Core | KABA PEAKS SFIC (Redford Lock of Novi) | US26D | HA |
| 1 | Recessed Pull | SL-86 BY THE DOOR MFGR | | BYOT |
| 1 | Automatic Operator | 8418 PUSH | ALM | HA |
| 2 | Jamb Actuator(s) | 2-659-0175 | US32D | HA |
| 1 | Overhead Stop | 1023 SL | US32D | AB |
| 1 | Door Bottom | SL-301 By the Door Mfr. | | BYOT |
| 1 | Weatherstrip | By Frame MFR./Supplier | | BYOT |
| 1 | Power Supply(s) | Central Power Supply (See Misc Set) | | HA |
| 1 | Under Desk Push Switch | 2-679-0708 | No Finish | HA |
| 1 | Mullion Reader(s) | WRDB0M4B0 | | HO |

NOTE: Operation:
Door normally closed and locked.
A valid credential at the reader retracts the latch and activates the outside actuator.
A remote push button location at the Reception Desk retracts the latches and activates the outside actuator.
Depressing the actuator cycles the automatic operator.
Free egress at all time by depressing the exit device rail or by the inside actuator retracts the latch on the exit device and cycles the automatic operator.

Set #02.50

Doors: 61.1

| | | | | |
|---|---|---|---|---|
| 2 | Continuous Hinge | 780-112HD x LAR x EPT | CLR | HA |
| 2 | Power Transfer | 2-679-0623 | ALM | HA |
| 1 | Mullion | SL-60 KR X LAR | CL | SPCL |
| 2 | Rim Exit Device | 4501 RIM MLR FEC | US26D | HA |
| 1 | Rim Cylinder | 3901 SFIC | US26D | HA |
| 1 | Mortise Cylinder | 3902 SFIC x LAR | US26D | HA |
| 2 | Construction Core | 3982-BLU | BLU | HA |
| 2 | Final Keyed Core | KABA PEAKS SFIC (Redford Lock of Novi) | US26D | HA |
| 2 | Recessed Pull | SL-86 BY THE DOOR MFGR | | BYOT |
| 1 | Automatic Operator | 8418 PUSH | ALM | HA |

Set #02.50

| | | | | |
|---|---|---|---|---|
| 1 | Actuator(s) | 2-659-0172 | US32D | HA |
| 1 | Jamb Actuator(s) | 2-659-0175 | US32D | HA |
| 1 | Closer(s) | 5100 | ALM | HA |
| 1 | Drop Plate(s) | 5110 | ALM | HA |
| 2 | Overhead Stop | 1023 SL | US32D | AB |
| 2 | Door Bottom | SL-301 By the Door Mfr. | | BYOT |
| 1 | Weatherstrip | By Frame MFR./Supplier | | BYOT |
| 1 | Power Supply(s) | Central Power Supply (See Misc Set) | | HA |
| 1 | Wall Reader | WRDB0A4B0 | | HO |

NOTE: Top jamb mount the door closer.

Operation:
Doors normally closed and locked.
A valid credential at the reader retracts the latched on both exit devices and activates the outside actuator.
Depressing the actuator cycles the automatic operator.
Free egress at all time by depressing the exit device rail or by the inside actuator retracts the latches on the exit devices and cycles the automatic operator.

Set #03.00

Doors: 62.1

| | | | | |
|---|---|---|---|---|
| 1 | Continuous Hinge | 780-112HD x LAR x EPT | CLR | HA |
| 1 | Power Transfer | 2-679-0623 | ALM | HA |
| 1 | Rachie Elec. Lock | RLA-G10-DR | 630 | SECT |
| 2 | Mortise Cylinder | 3902 SFIC x LAR | US26D | HA |
| 2 | Construction Core | 3982-BLU | BLU | HA |
| 2 | Final Keyed Core | KABA PEAKS SFIC (Redford Lock of Novi) | US26D | HA |
| 1 | Electric Strike | 4500C | 630 | HS |
| 1 | Automatic Operator | 8418 PUSH | ALM | HA |
| 2 | Jamb Actuator(s) | 2-659-0175 | US32D | HA |
| 1 | Overhead Stop(s) | 1020 SL Series (Size as Req'd) | US32D | AB |
| 1 | Weatherstrip | By Frame MFR./Supplier | | BYOT |
| 1 | Power Supply(s) | Central Power Supply (See Misc Set) | | HA |
| 2 | Mullion Reader(s) | WRDB0M4B0 | | HO |

NOTE: Operation:
Corridor 79 side of door is Fail Secure with a Fail Secure electric strike.
Door is normally closed and locked.
A valid credential at the reader unlocks the lever for entry and activates the outside actuator.
Depressing the actuator releases the electric strike and cycles the automatic operator.

Main Office 62 side of door is Fail-Safe with a Fail Secure electric strike.
Door is closed and locked at all time with a fail-safe lock.
A valid credential at the reader unlocks the lever for egress and activates the inside actuator.
Remote push button located at the Reception Desk unlocks the lever for egress and activates the inside actuator.
Depressing the actuator releases the electric strike and cycles the automatic operator.
Must be tied an approved fire alarm system.
Activation of the fire alarm or signal from fire command shunts power to the Main Office 62 side of the lock.
Lever unlocks.

Set #04.00

Doors: 63

| | | | | |
|---|---|---|---|---|
| 3 | Hinge(s) | BB1168 5 X 4 1/2 | US26D | HA |
| 1 | Power Transfer | 2-679-0623 | ALM | HA |
| 1 | Rachie Elec. Lock | RLA-G10-DR | 630 | SECT |
| 2 | Mortise Cylinder | 3902 SFIC x LAR | US26D | HA |
| 2 | Construction Core | 3982-BLU | BLU | HA |
| 2 | Final Keyed Core | KABA PEAKS SFIC (Redford Lock of Novi) | US26D | HA |
| 1 | Closer | 5100 | ALM | HA |
| 1 | Kick Plate | 190S 10" x 2" LDW CSK | US32D | HA |
| 1 | Wall Stop(s) | 232W/236W (as required) | US32D | HA |
| 1 | Weatherstrip | 726 x LAR | S | HA |
| 1 | Power Supply(s) | Central Power Supply (See Misc Set) | | HA |
| 2 | Wall Reader | WRDB0A4B0 | | HO |

NOTE: Operation:
Corridor 102 side of door is Fail Secure.
Door is normally closed and locked.
A valid credential at the reader unlocks the lever for entry.

Workroom 63 side of door is Fail-Safe.
Door is closed and locked at all time with a fail-safe lock.
A valid credential at the reader unlocks the lever for egress.
Door status monitored.
Must be tied an approved fire alarm system.
Activation of the fire alarm or signal from fire command shunts power to the Workroom 63 side of the lock.
Lever unlocks.

Set #05.00

Doors: 63.1

| | | | | |
|---|---|---|---|---|
| 3 | Hinge(s) | BB1279 4 1/2 X 4 1/2 | US26D | HA |
| 1 | Wide Body Mortise Lock | HE38MBBW23M | US32D | HO |
| 1 | Overhead Stop | 7016 SRF | US32D | HA |
| 3 | Silencers | 307D | GREY | HA |

NOTE: Operation:
Wirefree offline access control lock.
A valid credential at the reader unlocks the outside lever for entry.
Free egress at all time.

Set #06.00

Doors: 64, 65.1, 66

| | | | | |
|---|---|---|---|---|
| 3 | Hinge(s) | BB1279 4 1/2 X 4 1/2 | US26D | HA |
| 1 | Wide Body Mortise Lock | HT38MBBW23M | US32D | HO |
| 1 | Wall Stop(s) | 232W/236W (as required) | US32D | HA |
| 3 | Silencers | 307D | GREY | HA |

NOTE: Operation:
Wirefree offline access control lock.
A valid credential at the reader unlocks the outside lever for entry.
Free egress at all time.
Privacy thumb turn throws the deadbolt, locks outside lever and blocks the reader for local lockdown.
Privacy override by emergency credential

Set #06.01

Doors: 69

| | | | | |
|---|---|---|---|---|
| 3 | Hinge(s) | BB1279 4 1/2 X 4 1/2 | US26D | HA |
| 1 | Wide Body Mortise Lock | HT38MBBW23M | US32D | HO |
| 1 | Closer(s) | 5100 | ALM | HA |
| 1 | Kick Plate | 190S 10" x 2" LDW CSK | US32D | HA |
| 1 | Wall Stop(s) | 232W/236W (as required) | US32D | HA |
| 1 | Weatherstrip | 726 x LAR | S | HA |

NOTE: Operation:
Wirefree offline access control lock.
A valid credential at the reader unlocks the outside lever for entry.
Free egress at all time.
Privacy thumb turn throws the deadbolt, locks outside lever and blocks the reader for local lockdown.
Privacy override by emergency credential

Set #07.00

Doors: 66.1

| | | | | |
|---|---|---|---|---|
| 3 | Hinge(s) | BB1279 4 1/2 X 4 1/2 | US26D | HA |
| 1 | Privacy Set w/ Indicator | 3896 ESC WTN | US26D | HA |
| 1 | Wall Stop(s) | 232W/236W (as required) | US32D | HA |
| 1 | Weatherstrip | 726 x LAR | S | HA |

Set #07.01

Doors: 67, 68

| | | | | |
|---|---|---|---|---|
| 3 | Hinge(s) | BB1279 4 1/2 X 4 1/2 | US26D | HA |
| 1 | Privacy Set w/ Indicator | 3896 ESC WTN | US26D | HA |
| 1 | Closer(s) | 5100 | ALM | HA |
| 1 | Kick Plate | 190S 10" x 2" LDW CSK | US32D | HA |
| 1 | Wall Stop(s) | 232W/236W (as required) | US32D | HA |
| 1 | Weatherstrip | 726 x LAR | S | HA |

Set #08.00

Doors: 65

| | | | | |
|---|---|---|---|---|
| 3 | Hinge(s) | BB1279 4 1/2 X 4 1/2 | US26D | HA |
| 1 | Passage Set | 3810 ESC WTN | US26D | HA |
| 1 | Wall Stop(s) | 232W/236W (as required) | US32D | HA |
| 3 | Silencers | 307D | GREY | HA |

Set #09.00

Doors: MISC

| | | | | |
|---|---|---|---|---|
| 1 | Power Supply | 29T4/29TX (Type & Qty as Req'd) | BLK | HO |
| 3 | Battery Backup | 2-679-1002 | | HO |
| 1 | Control Unit | CU42E0GUS | | HO |
| 3 | Control Unit | CU4200GUS | | HO |
| 2 | Lockdown Push Button | SS2025LD-EN | | SATI |
| 2 | Smart Cards | PCM04KB-50 | | HO |
| 6 | Construction Card(s) | PCM01KC00 | | HO |

**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.
5. Insulated infill panels.

### 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.

2. Insulated Infill Panels: Submit three samples for each color and finish, not less than 6 inches square.

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.

**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.
2. Pilkington North America Inc: www.pilkington.com.
3. Viracon, Inc: www.viracon.com.
4. Vitro Architectural Glass (formerly PPG Industries, Inc.): 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 SECURITY GLASS

A. Security Glass: Laminated glass with proprietary security interlayer.

1. Construction: Float glass laminated with a proprietary security interlayer to comply with interlayer manufacturer's written instructions.
2. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation
3. Laminating Process: Fabricate laminated glass to produce glass free of foreign substances and air pockets.
4. Tint: None, clear.
5. Forced Entry: Comply with ASTM F1233, Class 1.3 or 5-aa1 rated for 6 minutes.
6. Comply with Safety Glazing, 16 CFR 1201, Category II.
7. Product: Subject to compliance with requirements, provide one of the following:

a. LTI Smart Glass, Inc.; School Guard Glass SG4: www.ltisg.com.
b. Global Security Glazing; Childgard Security Glazing: www. security-glazing.com.

## 2.6 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.

## 2.7 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. Argon: Mix of 90 percent argon; 10 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: Duel-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.

      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.

      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.

      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.

      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.

      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.

**2.8 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.
   b. Dow Corning Corporation; 899 Silicone Glazing Sealant: www.dowcorning.com.
   c. GE/Momentive Performance Materials, Inc: SCS2800 SilGlaz II: www.siliconeforbuilding.com
   d. Pecora Corporation: 896: www.pecora.com.
   e. Tremco, Inc.: Spectrem 2: www.tremcosealants.com.

2. Color: Black.

## 2.9 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.

## 2.10 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.

## 2.11 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.

## 2.12 INSULATED INFILL PANELS

A. Insulated Infill Panels:

1. Laminated, metal-faced flat panels with no deviations in plane exceeding 0.8 percent of panel dimension in width or length.

a. Overall Panel Thickness: 1 inch.
b. Exterior Skin: Aluminum.

1) Thickness: 0.32 inches.
2) Finish: To match adjacent framing system specified in Section 08 4113 – Aluminum-framed Storefronts.
3) Texture: Smooth.
4) Backing Sheet: 0.125-inch-thick, corrugated, high-density polyethylene.

c. Interior Skin: Aluminum.

1) Thickness: 0.32 inches.
2) Finish: To match adjacent framing system specified in Section 08 4113 – Aluminum-framed Storefronts.
3) Texture: Smooth.
4) Backing Sheet: 0.125-inch-thick, corrugated, high-density polyethylene.

d. Thermal Insulation Core: Manufacturer's standard extruded-polystyrene board.

1) R-Value: 4.

e. 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: 25 or less.
2) Smoke-Developed Index: 50 or less.

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

1) Citadel Architectural Products; GlazeGuard 1000 WR+; www.citadelap.com.
2) Laminators, Inc.; Thermolite; www.laminatorsinc.com.
3) Mapes Industries Inc.; Mapes-R: www.mapespanels.com.

## 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 at all locations as required by local building code and authorities having jurisdiction.
b. Provide fire-rated glazing where indicated and as required by local building code and authorities having jurisdiction; refer to Section 08 8813 – Fire-Rated Glazing for fire-rated glazing.

3. Exterior doors at vestibule entrances 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 INSULATED INFILL PANEL INSTALLATION**

A. Insulated Infill Panel Installation:

1. Install in accordance with manufacturer's instructions using one or more of the specified glazing methods as recommended by fabricator and installer, and as required to comply with performance requirements.

**3.8 GLAZING FILM INSTALLATION**

A. Plastic Film Installation:

1. Install in accordance with manufacturer's instructions and as follows:

a. Clean glazing; remove all dust, dirt, grease, markings, and other debris from glazing surface.
b. Place without air bubbles, creases or visible distortion.

c. Terminate glazing film tightly to glass framing, with no more than a 1/16 inch gap between the glazing film and glazing sealant or gasket.
d. Neatly cut film edges in straight lines without tears or ragged edges.
e. Inspect film installation after 30 days.

1) If moisture dimples, air bubbles, creases or visible distortion is detected when viewed under normal viewing conditions, remove and replace film.

2. If installed as an exterior application, verify with the manufacturer as to whether edge sealing is required. Install edge sealants in accordance with manufacturer's recommendations and instructions.

**3.9 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.

**3.10 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: Argon.

4. Indoor Lite: Clear annealed float glass.

a. Minimum Thickness: 1/4 inch (6 mm).

5. Performance:

a. Winter Nighttime U-Factor: 0.25 maximum.
b. Visible Light Transmittance: 62 percent minimum.
c. Solar Heat Gain Coefficient: 0.28 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: Argon.

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. GL-2: Clear non-insulated safety glass.

1. Clear laminated safety glass.
2. Minimum Overall Thickness: 1/4 inch (6 mm).
3. Safety glazing required.

D. GL-3: Insulated infill panel.

**END OF SECTION 08 8000**

# SECTION 08 8813 - FIRE-RATED 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. Fire-protection-rated glazing.
2. Fire-resistance-rated glazing.

### 1.3 DEFINITIONS

A. Fire-Rated Glazing: Fire-rated glazing, either fire-protective glazing or fire-resistive glazing as specified.

B. Fire-Protection-Rated Glazing: Fire-rated glazing designed to compartmentalize smoke and flame and which does not limit the transmission of heat through the glazing t.

C. Fire-Resistance-Rated Glazing: Fire rated glazing designed to compartmentalize smoke and flame and which limits the transmission of heat through the glazing.

D. Glass Thicknesses: Indicated by thickness designations in millimeters in accordance with ASTM C1036.

### 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.

### 1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Glass Samples: Submit three samples 12 by 12 inch in size for each glass type.

C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

### 1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For installer and manufacturer.

B. Product Certificates: For each type of glass and glazing product.

C. Warranty Documentation: Submit manufacturer warranty.

### 1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the 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 documented experience with installers certified under the NGA's Certified Glass Installer Program.

C. Source Limitations: Obtain fire-rated glazing and fire-rated framing systems from single source from the same manufacturer.

**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 PROJECT CONDITIONS**

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

**1.10 WARRANTY**

A. Provide five year manufacturer's warranty for defects in workmanship and materials.

**PART 2 - PRODUCTS**

**2.1 PERFORMANCE REQUIREMENTS**

A. General: Installed glazing systems shall withstand normal thermal movement and impact loads (where applicable) without failure, including loss or glass breakage attributable to defective manufacture, fabrication, or installation; deterioration of glazing materials; or other defects in construction.

1. Perform Work in accordance with the following:

a. GANA (GM) - GANA Glazing Manual 2008.
b. GANA (SM) - GANA Sealant Manual 2008.
c. GANA (LGRM) - Laminated Glazing Reference Manual 2009.

B. Safety Glazing: Comply with ANSI Z97.1 and 16 CFR 1201; test requirements for Class A/Category II.

1. Subject to compliance with requirements, obtain safety glazing products permanently marked with certification label of the Safety Glazing Certification Council or another certification agency acceptable to authorities having jurisdiction.

C. Fire-Rated Glazing:

1. Fire-Protection-Rated Glazing: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire protection ratings indicated; tested in accordance with NFPA 80, NFPA 252, NFPA 257, UL 9, UL 10B, and UL 10C.

a. Fire protection rated glazing with a 20 minute rating shall be exempt from the hose-stream test.

2. Fire-Resistance-Rated Glazing: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire protection ratings indicated; tested in accordance with ASTM E119, NFPA 80, NFPA 251, NFPA 252, NFPA 257, UL 9, UL 10B, UL 10C, and UL 263.

3. Labeling: Provide permanent markings on fire-rated glazing in compliance with ICC (IBC), local building code and authorities having jurisdiction.

    a. "W" Label: Meets wall assembly criteria of ASTM E119 or UL 263 fire test standards.
    b. "OH" Label: Meets fire window assembly criteria including hose stream test of NFPA 257 or UL 9 fire test standards.
    c. "D" Label: Meets fire door assembly criteria of NFPA 252, UL 10B, or UL 10C fire test standards.
    d. "H" Label: Meets fire door assembly hose stream test of NFPA 252, UL 10B, or UL 10C fire test standards.
    e. "T" Label: Meets temperature rise of not more than 450 degrees F above ambient at end of 30 minutes fire exposure in accordance with NFPA 252, UL 10B, or UL 10C fire test standards.
    f. "XXX" Label - Placeholder that represents fire protection or fire resistance rating period, in minutes.

4. Accessories:

    a. Provide glazing gaskets, glazing sealants, glazing tapes, setting blocks, spacers, edge blocks, and other glazing accessories that are compatible with fire rated glazing and each other, and that are approved for use with fire rated glazing by testing agencies that listed and labeled fire rated glazing.

D. 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.

**2.2 FIRE RATED GLASS**

A. Fire-Protection-Rated Glazing - 20 Minute: Type, thickness, and configuration of glazing that contains flame, smoke, and does not block radiant heat, as required to achieve indicated fire-rating period.

1. Glass Type: Specialty tempered clear float glass.
2. Meet safety glazing requirements indicated in performance requirements.
3. Meet fire door assembly criteria for a "D" label as indicated in the performance requirements.
4. Glazing Method: As required for fire rating.
5. Fire-Rating: 20 minutes
6. Thickness: 1/4 inch.
7. Products: Subject to compliance with requirements, provide one of the following products:

    a. SAFTIFIRST, a division of O'Keeffe's Inc; SuperLite I: www.safti.com.
    b. Technical Glass Products; Fireglass20: www.fireglass.come.
    c. Vetrotech Saint-Gobain North America; Pyroswiss 20: www.vetrotechusa.com.

B. Fire-Protection-Rated Glazing For Door Lites: Type, thickness, and configuration of glazing that contains flame, smoke, and does not block radiant heat, as required to achieve indicated fire-rating period.

1. Glass Type: Specialty tempered clear float glass.
2. Meet safety glazing requirements indicated in performance requirements.
3. Meet fire door assembly criteria for "D", and "H" labels as indicated in the performance requirements.
4. Glazing Method: As required for fire rating.
5. Fire-Rating: As indicated.
6. Thickness: 3/4 inch.
7. Products: Subject to compliance with requirements, provide one of the following products:

    a. SAFTIFIRST, a division of O'Keeffe's Inc; SuperLite X: www.safti.com.

C. Fire-Protection-Rated Glazing: Type, thickness, and configuration of glazing that contains flame, smoke, and does not block radiant heat, as required to achieve indicated fire-rating period.

1. Glass Type: Laminated ceramic glass.

a. Neutral color, free of amber tint.

2. Meet safety glazing requirements indicated in performance requirements.
3. Meet fire door assembly criteria for "D", and "H" labels as indicated in the performance requirements.
4. Meet fire window assembly criteria for "OH" labels as indicated in the performance requirements.
5. Glazing Method: As required for fire rating.
6. Fire-Rating: As indicated.
7. Thickness: 3/8 inch.
8. Products: Subject to compliance with requirements, provide one of the following products:

a. SAFTIFIRST, a division of O'Keeffe's Inc; Pyran Platinum L: www.safti.com.
b. SCHOTT North America Inc; Pyran Platinum L: www.us.schott.com.
c. Technical Glass Products; FireLite Plus: www.fireglass.com.
d. Vetrotech Saint-Gobain North America; Keralite L: www.vetrotechusa.com.

D. Fire-Resistance-Rated Glazing: Type, thickness, and configuration of glazing that contains flame, smoke, and blocks radiant heat, as required to achieve indicated fire-rating period.

1. Glass Type: Multi-laminate clear annealed glass with intumescent fire retardant interlayers.
2. Meet safety glazing requirements indicated in performance requirements.
3. Meet fire door assembly criteria for "D", and "H" labels as indicated in the performance requirements.
4. Meet fire window assembly criteria for "W" and "OH" labels as indicated in the performance requirements.
5. Meet temperature rise criteria for "T" label as indicated in the performance requirements.
6. Glazing Method: As required for fire rating.
7. Fire-Rating: As indicated.
8. Thickness: Varies with fire-rating.
9. Products: Subject to compliance with requirements, provide one of the following products:

a. SAFTIFIRST, a division of O'Keeffe's Inc; SuperLite II-XL: www.safti.com.
b. Technical Glass Products; Pilkington Pyrostop: www.fireglass.com.
c. Vetrotech Saint-Gobain North America; Contraflam: www.vetrotechusa.com

## 2.3 GLAZING ACCESSORIES

A. General: Provide glazing gaskets, glazing sealants, glazing tapes, setting blocks, spacers, edge blocks, and other glazing accessories that are compatible with glazing products and each other and are approved by testing agencies that listed and labeled the fire-rated glazing products for use in other fire rated products and applications as indicated.

B. Glazing Sealants for Fire-Rated Glazing Products: Neutral-curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 50, Use NT. Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Dow Corning Corporation; 795 Silicone Building Sealant: www.dowcorning.com.
b. Dow Corning Corporation; 899 Silicone Glazing Sealant: www.dowcorning.com.

c. GE/Momentive Performance Materials, Inc: SCS2800 SilGlaz II: www.siliconeforbuilding.com
d. Pecora Corporation: 896: www.pecora.com.
e. Tremco, Inc.: Spectrem 2: www.tremcosealants.com.

2. Colors of Exposed Glazing Sealants: Black.

**2.4 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.

**PART 3 - EXECUTION**

**3.1 GLAZING, GENERAL**

A. Installation Method:

1. Use methods approved by testing agencies that listed and labeled fire-rated glazing products.
2. Use one or more of the specified glazing methods as recommended by GANA, glass manufacturer, and installer, and as required to comply with fire-rating and performance requirements.

B. Refer to 08 8000 – Glazing, for examination, preparation, specified glazing methods and general installation requirements.

**3.2 CLEANING AND PROTECTION**

A. Refer to 08 8000 – Glazing, for cleaning and protection requirements.

**3.3 FIRE-RATED GLAZING SCHEDULE**

A. General: Use one or more of the following glazing types as required for the glazed fire ratings indicated on Drawings.

B. FRG-1: 20 minute fire-protection-rated glazing.

1. Specialty tempered float glass.
2. Thickness: 1/4 inch.
3. Fire Rating: 20 minutes.

C. FRG-2: Fire-protection-rated glazing (for Door Lites only).

1. Specialty tempered float glass.
2. Thickness: 3/4 inch.
3. Fire Rating: 60 minutes.

D. FRG-3: Fire-protection-rated glazing.

1. Laminated ceramic glass.
2. Thickness: 3/8 inch.
3. Fire Rating: 60 minutes.

E. FRG-4: Fire-resistance-rated glazing.

1. Multi-laminate tempered glass with intumescent fire retardant interlayers.
2. Thickness: 7/8 to 1-1/8 inches.
3. Fire Rating:: 60 minutes.

**END OF SECTION 08 8813**

# 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 interior partitions, ceilings, and soffits.
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.

C. Evaluation Reports: For firestop tracks, post-installed anchors, and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

### 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.
2. Jaimes Industries Inc.: www.jaimesind.com.
3. Marino\WARE: www.marinoware.com.
4. MBA Building Supplies, Inc.: www.mbastuds.com.
5. MRI Steel Framing LLC: www.mristeelframing.com
6. State Building Products; www.statebp.com.
7. Telling Industries; 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. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E119 by an independent testing agency.

E. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

F. 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.

## 2.3 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. Slotted Deflection Track: Provide galvanized sheet steel track with slotted holes in flanges for mechanical anchorage of studs that accommodate deflection; provide screws and anti-friction bushings.

1. Comply with the following:

a. Provide at partition heads to structure connections, where indicated on Drawings, and elsewhere as required to accommodate axial deflection.
b. Shall prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above
c. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI S100-12.
d. Comply with ASTM C645 and ASTM C754.
e. Protective Coating: ASTM A653/A653M, G40, hot-dip galvanized.
f. Minimum Metal Thickness: Same material thickness as studs.
g. Track Depth: Matching studs.
h. Provide components UL-listed for use in UL-listed fire-rated head of partition joint systems indicated on drawings.

D. At Contractor's option, the following products may be used instead of traditional framing and firestopping:

1. General: Provide components UL-listed for use in head of partitions and joint systems and as indicated on drawings.
2. Slotted Deflection and Firestop Track: Galvanized sheet steel track with slotted holes in flanges for mechanical anchorage of studs that accommodate deflection; provide screws and anti-friction bushings. Includes intumescent strip factory-applied to track flanges or web that expands when exposed to heat or flames to provide a perimeter joint seal.

    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) ClarkDietrich Building Systems; BlazeFrame (DSL 2): www.clarkdietrich.com.
        2) Marino\WARE; FAS Track 1000: www.marinoware.com.

3. Firestop Track: Galvanized sheet steel track with intumescent strip factory-applied to track flanges or web that expands when exposed to heat or flames to provide a perimeter joint seal.

    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) ClarkDietrich Building Systems; BlazeFrame (DL2): www.clarkdietrich.com.

4. Preformed Top Track Firestop Seal: Pre-formed firestop device field-applied to head of top track that expands when exposed to heat or flames to provide a perimeter joint seal.

    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) Hilti, Inc; Top Track Seal CFS TTS: www.us.hilti.com.

E. 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.

F. Hat-Shaped, Rigid Furring Channels: Galvanized steel sheet members.

1. Minimum Base-Steel Thickness: 0.030 inch (20 gage).
2. Depth: 7/8 inch, unless otherwise indicated on Drawings.

G. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Minimum Base-Steel Thickness: 0.054 inch thick (16 gage), galvanized.
2. At Contractor's option, the following products may be used instead of traditional flat strap and backing plates:

a. Flexible Wood Backing: Fire-retardant treated wood with sheet steel connectors.

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) ClarkDietrich Building Systems; Danback Flexible Wood Backing System: www.clarkdietrich.com.
b) The Steel Network, Inc; BackIt: www.SteelNetwork.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.
2) CertainTeed/Saint-Gobain; Quickspan Locking Drywall Grid System: www.certainteed.com.
3) Rockfon, Part of the Rockwool Group; Chicago Metallic Drywall Grid: www.rockfon.com.
4) USG Corporation: Drywall Suspension System: 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.

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.

## 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. Where stud tracks are installed directly against overhead decking, install closure strip between track and decking.

D. Install studs so flanges within framing system point in same direction.

E. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.

1. Slotted Deflection Tracks: Where framing extends to overhead structural supports, install slotted deflection tracks to produce joints at tops of framing systems that prevent axial loading of finished assemblies.

2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.

    a. Install two studs at each jamb unless otherwise indicated.
    b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
    c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
6. Curved Partitions:

    a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
    b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 6 inches o.c.

F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

## 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. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

E. Lateral/Seismic Bracing: Sway-brace suspension systems with hangers used for support.

F. 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.

G. 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. Tile backing panels.
3. Finishing materials.
4. Trim accessories.
5. 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.

### 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.
b. Georgia-Pacific Gypsum; ToughRock Fireguard X: www.gp.com.
c. National Gypsum Company; Gold Bond Brand Fire-Shield Gypsum Board: www.nationalgypsum.com.
d. USG Corporation; Sheetrock Brand Firecode X Panels: www.usg.com.

### 2.4 TILE BACKING PANELS

A. Cementitious Backing Panel: ANSI A118.9 and ASTM C1288 or ASTM C1325, with manufacturer's standard edges.

1. Thickness: 5/8 inch.
2. Flame Spread/Smoke Developed: 0/0 per ASTM E84.

3. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
4. Locations: Wet areas and elsewhere as indicated on Drawings; including, but not limited to, the following:

    a. Showers.
    b. Natatorium areas.

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

    a. National Gypsum Company; PermaBase Brand Cement Board: www.nationalgypsum.com.
    b. USG Corporation; Durock Brand Cement Board: www.usg.com.

B. Glass-Mat Backing Panel: Coated glass mat water-resistant gypsum backing panel; ASTM C1178/C1178M.

1. Thickness: 5/8 inch.
2. Type: Fire resistance rated Type X, UL or WH listed.
3. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
4. Locations: Non-wet areas and elsewhere as indicated on Drawings; including, but not limited to, the following:

    a. Kitchens.
    b. Laundry areas.
    c. Locker rooms.
    d. Toilet rooms.

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

    a. CertainTeed Corp.; GlasRoc Diamondback Tile Backer: www.certainteed.com.
    b. Georgia-Pacific Gypsum; DensShield Tile Backer: www.gp.com.
    c. National Gypsum Company; Gold Bond Brand eXP Tile Backer: www.nationalgypsum.com.
    d. USG Corporation; Durock Brand Glass-Mat Tile Backerboard: www.usg.com.

## 2.5 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.
    b. Marino\WARE: www.marinoware.com.
    c. Telling Industries; www.buildstrong.com.
    d. Phillips Manufacturing Co: www.phillipsmfg.com.
    e. USG Corporation: 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.

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.

## 2.6 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.

## 2.7 AUXILIARY MATERIALS

A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.

B. Steel Drill Screws: ASTM C1002 unless otherwise indicated.

C. 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.
b) Owens Corning; Thermafiber SAFB (Sound Attenuation Fire Batts): www.owenscorning.com.
c) Rockwool; Safe'n'Sound: 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.
b) Johns Manville; Formaldehyde-Free Fiberglass Insulation: www.jm.com.
c) Knauf Insulation; EcoBatt Insulation with ECOSE Technology: www.knaufinsulation.com.
d) Owens Corning Corporation; EcoTouch Sound Attenuation Batts: www.owenscorning.com.

D. 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.
    b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.

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. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

## 3.4 INSTALLATION OF TILE BACKING PANELS

A. Glass-Mat Backing Panels: Comply with manufacturer's written installation instructions. Install with 1/4-inch gap where panels abut other construction or penetrations.

B. Cementitious Backer Units: Comply with ANSI A108.11.

C. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

**3.5 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. Arches: Use at curved openings.

**3.6 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.

E. Glass-Mat Backing Panels: Finish according to manufacturer's written instructions.

F. Cementitious Backing Panels: Finish according to manufacturer's written instructions.

**3.7 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.

## 3.8 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 3000 – TILING

## 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. Hard tile.
2. Stone thresholds.
3. Setting materials.
4. Waterproofing and crack isolation membranes.
5. Metal trim.

### 1.3 DEFINITIONS

A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.

B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in its "Specifications for Installation of Ceramic Tile."

### 1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

### 1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

1. Include:

a. TCNA installation methods.
b. Locations of waterproofing and crack isolation membranes.
c. Locations and profiles of metal trim.

C. Samples for Initial Selection: For tile, grout, and accessories involving color selection.

D. Samples for Verification:

1. Full-size units of each type and composition of tile and for each color and finish required.

a. For sheet-mounted tile, provide full size sheet.

2. Full-size units of each type of trim and accessory for each color and finish required.
3. Thresholds in 6-inch lengths for each profile, color and finish required.
4. Metal trim in 6-inch lengths for each profile, color and finish required.

E. Product Schedule: For tile. Use same designations indicated on Drawings.

**1.6 INFORMATIONAL SUBMITTALS**

A. Qualification Data: For manufacturer and installer.

B. Product Certificates: For each type of product.

**1.7 MAINTENANCE MATERIAL SUBMITTALS**

A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Tile and Trim Units: Furnish quantity of full-size units equal to 2 percent of amount installed for each type, composition, color, pattern, and size indicated but not less than 1 box.
2. Grout: Furnish quantity of grout equal to 2 percent of amount installed for each type, composition, and color indicated.

**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, and as follows:

1. Installer employs only Ceramic Tile Education Foundation Certified Installers.
2. Installer employs at least one installer for Project that has completed the Advanced Certification for Tile Installers (ACT) certification for installation of mud floors, membranes, shower receptors, and large format tile.

**1.9 DELIVERY, STORAGE, AND HANDLING**

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

D. Store liquid materials in unopened containers and protected from freezing.

**1.10 FIELD CONDITIONS**

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Source Limitations for Tile: Obtain tile of each type and color or finish from single source or producer.

1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.

B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from single manufacturer and each aggregate from single source or producer.

1. Obtain setting and grouting materials from single manufacturer.
2. Obtain waterproofing and crack isolation membrane from manufacturer of setting and grouting materials.

C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer:

1. Thresholds.
2. Metal edge strips.

### 2.2 PERFORMANCE REQUIREMENTS

A. Floor tile and other traffic surfaces:

1. Dynamic Coefficient of Friction: Not less than 0.42 when tested in accordance with DCOF AcuTest per ANSI A137.1.

### 2.3 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.

1. Provide tile complying with Standard grade requirements.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation methods, and other requirements specified.

C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.

## 2.4 TILE PRODUCTS

A. Tile: Refer to Color Codes on Drawings. Substitutions not permitted.

1. Grout Colors: As indicated by Room Finish Schedules and Color Codes on Drawings or, if not indicated, standard colors as selected by Architect.
2. Joint Sizes: As recommended by tile manufacturer unless otherwise indicated on Drawings..

## 2.5 TILE TRIM UNITS

A. Tile Trim Units: Except as otherwise specified or indicated in Color Codes on Drawings (B Series Drawing Designation), provide trim units from same manufacturer, product line, color and finish, as each specified tile; and as follows:

1. Shapes: As selected by Architect from manufacturer's standard shapes; coordinate with adjacent tile sizes and jointing

a. Shapes include, but are not limited to, the following:

1) Bullnose units.
2) Cove base units.
3) Inside and outside corners.

2. Sizes: As selected by Architect from manufacturer's standard sizes; coordinate with adjacent tile sizes and jointing

## 2.6 THRESHOLDS

A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.

1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch above adjacent floor surface.

a. Finish bevel to match top surface of threshold.

2. Limit height of threshold to 1/2 inch or less above adjacent floor surface.

B. Marble Threshold:

1. Comply with ASTM C503.
2. Abrasion Resistance: 12, minimum according to ASTM C1353 or ASTM C241 and with honed finish.
3. Description: Uniform, fine- to medium-grained white stone with gray veining.

## 2.7 SETTING MATERIALS

A. Modified Dry-Set Mortar (Thinset): ANSI A118.4.

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

a. Bostik, Inc; Bostik PM: www.bostik.com.
b. Custom Building Products; VersaBond Flex Professional Thin-Set Mortar or Porcelain Tile Professional Thin-Set Mortar: www.custombuildingproducts.com.
c. LATICRETE International, Inc; 253 Gold or 254 Platinum: www.laticrete.com.

d. MAPEI Corp.; Ultraflex 2 or Ultraflex 3: www.mapei.com.
e. TEC, H.B. Fuller Construction Products Inc.; Full Flex Premium Thin Set Mortar or Super Flex Ultra-Premium Thin Set Mortar: www.tecspecialty.com.

2. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
3. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.

**2.8 GROUT MATERIALS**

A. Epoxy Grout - Water-Cleanable: ANSI A118.3.

1. Grout Colors: As indicated in Color Codes on Drawings.
2. Products: Subject to compliance with requirements, provide one of the following:

a. Bostik, Inc; EzPoxy EzClean: www.bostik.com.
b. Custom Building Products; CEG-Lite 100% Solids Commercial Epoxy Grout: www.custombuildingproducts.com.
c. LATICRETE International, Inc; Spectralock Pro Premium or Spectralock Pro: www.laticrete.com.
d. MAPEI Corp.; Kerapoxy or Kerapoxy CQ: www.mapei.com.
e. TEC, H.B. Fuller Construction Products Inc.; AccuColor EFX Epoxy Special Effects Grout: www.tecspecialty.com.

**2.9 WATERPROOFING AND CRACK ISOLATION MEMBRANE**

A. Waterproofing and Crack Isolation Membrane: ANSI A118.10 and ANSI A118.12.

1. System consisting of liquid-latex rubber or elastomeric polymer; with or without fabric reinforcement
2. Thickness: As recommended by membrane manufacturer.
3. Crack Resistance: No failure at 1/8 inch gap, minimum.

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

1. Without Fabric Reinforcing:

a. Custom Building Products; RedGard: www.custombuildingproducts.com.
b. LATICRETE International, Inc; Hydro Ban: www.laticrete.com.
c. MAPEI Corp.; Mapelastic AquaDefense: www.mapei.com.

2. With Fabric Reinforcing:

a. Bostik, Inc; GoldPlus: www.bostik.com.
b. Custom Building Products; 9240 Waterproofing and Anti-Fracture Membrane: www.custombuildingproducts.com.
c. LATICRETE International, Inc; Hydro Barrier: www.laticrete.com.
d. MAPEI Corp.; Mapelastic AquaDefense: www.mapei.com.
e. TEC, H.B. Fuller Construction Products Inc; HydraFlex: www.tecspecialty.com.

## 2.10 METAL TRIM

A. Metal Trim - General:

1. Except as otherwise indicated provide the following:

a. Metallic edge trim, height to match tile and setting-bed thickness, designed specifically for tiling applications; stainless steel, ASTM A276 or ASTM A666, 300 Series exposed-edge material.

1) Profiles:

a) Angle or L-shaped.
b) Other shapes as indicated on Drawings.

2) Finish: Brushed stainless steel.
3) Provide associated corner pieces, if any.
4) Applications and Locations: Unless otherwise indicated or finished with tile trim units, provide metal trim at the following locations:

a) Open edges of wall tile.
b) Open edges of floor tile.
c) Outside wall corners.
d) Transitions between hard tile and other floor finishes.
e) Tile perimeters not against a wall or other solid vertical surface.
f) Other areas as indicated on Drawings.

5) Manufacturers: Subject to compliance with requirements, provide products from one of the following:

a) Schluter-Systems: www.schluter.com.
b) Or approved equal.

## 2.11 MISCELLANEOUS MATERIALS

A. Joint Sealants

1. Tile Sealants - Traffic Grade:

a. Refer to Section 07 9200 - Joint Sealants.

1) Provide Nonsag traffic grade silicone sealant or self-leveling silicone sealant.

2. Tile Sealant - Non-traffic Grade: Gunnable siliconized acrylic; moisture and mildew resistant type.

a. Colors: To match adjacent grout colors.
b. Products: Subject to compliance with requirements, provide one of the following:

1) Bostik, Inc; Bosti-Flex Plus: www.bostik.com.
2) Custom Building Products; Polyblend Ceramic Tile Caulk: www.custombuildingproducts.com.
3) LATICRETE International, Inc; Premium Acrylic Caulk: www.laticrete.com.
4) MAPEI Corp.; Keracaulk S (sanded) and Keracaulk U (unsanded): www.mapei.com.
5) TEC, H.B. Fuller Construction Products Inc; AccuColor Sanded/Unsanded Siliconized Acrylic Caulk: www.tecspecialty.com.

B. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

C. Trowelable Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

**2.12 MIXING MORTARS AND GROUT**

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. Add materials, water, and additives in accurate proportions.

C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.

    a. Flatness tolerances shall also comply with requirements of specified TCNA installation methods.

2. Verify that concrete substrates for tile floors installed with thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.

    a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
    b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.

3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

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

**3.2 PREPARATION**

A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thinset mortar with trowelable patching compound specifically recommended by tile-setting material manufacturer.

B. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.3 INSTALLATION OF TILE**

A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation methods.

B. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in specified TCNA installation methods.

C. Tile shall have 80 percent mortar coverage except as follows:

1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:

a. Tile floors consisting of tiles 8 by 8 inches or larger.
b. Tile floors consisting of rib-backed tiles.

D. Bond Coats:

1. Use latex-portland cement thin-set mortar, unless otherwise indicated.

a. Bond Coat Color: White or gray.

E. Grout:

1. Use epoxy grout.

F. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

G. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

H. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges except where metal trim is indicated.

I. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.

J. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.

K. Joint Widths: Install tiles with joint widths indicated, if not indicated install in widths as directed by Architect in writing.

L. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

M. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.

N. Thresholds: Install thresholds in same type of setting bed as adjacent floor unless otherwise indicated.

O. Metal Edge Strips: Install in same type of setting bed as adjacent tile unless otherwise indicated.

**3.4 INSTALLATION OF WATERPROOF MEMBRANE**

A. Install waterproofing and crack isolation membrane to comply with ANSI A108.13, ANSI A108.17 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.

B. Allow waterproofing and crack isolation membrane to cure and verify by testing that it is watertight before installing tile or setting materials over it.

C. Locations: Install waterproofing and crack isolation membrane at the following locations:

1. All floor and traffic areas.
2. Other areas as indicated on Drawings.

**3.5 ADJUSTING AND CLEANING**

A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.

B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

1. Remove grout residue from tile as soon as possible.
2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

**3.6 PROTECTION**

A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.

B. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

## 3.7 INTERIOR FLOOR TILE - INSTALLATION METHODS

A. Interior Floor Tile Installations:

1. Concrete Substrates - Thinset Installation: Install in accordance with TCNA F122 or F122A as appropriate for substrate conditions.

    a. Provide waterproofing and crack isolation membrane.
    a. Bond Coat: Thinset mortar.
    b. Grout: Epoxy grout.

## 3.8 INTERIOR WALL TILE - INSTALLATION METHODS

A. Interior Wall Tile Installations:

1. Concrete and Masonry Substrates – Thinset Installation: Install in accordance with TCNA W202I.

    a. Provide waterproofing and crack isolation membrane at specified locations and as indicated on Drawings.
    a. Bond Coat: Thinset mortar.
    b. Grout: Epoxy grout.

2. Cementitious Backing Panel Substrates - Thinset Installation: Install in accordance with TCNA W244C.

    a. Provide waterproofing and crack isolation membrane at specified locations and as indicated on Drawings.
    b. Bond Coat: Thinset mortar.
    c. Grout: Epoxy grout.

3. Glass-Mat Backing Panel Substrates - Thinset Installation: Install in accordance with TCNA W245.

    a. Provide waterproofing and crack isolation membrane at specified locations and as indicated on Drawings.
    a. Bond Coat: Thinset mortar.
    b. Grout: Epoxy grout.

4. Gypsum Board Substrates - Thinset Installation: Install in accordance with TCNA W243.

    a. Provide waterproofing and crack isolation membrane at specified locations and as indicated on Drawings.
    a. Bond Coat: Thinset mortar.
    b. Grout: Epoxy grout.

**END OF SECTION 09 3000**

# 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 products as manufactured by the following:

1. USG Corporation: www.usg.com.
2. Substitutions not permitted.

B. Metal Suspension Systems: The design for each metal suspension system specified is based on the product named. Subject to compliance with requirements, provide products as manufactured by the following:

1. USG Corporation: www.usg.com.
2. Substitutions not permitted.

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.

## 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. Product USG Corporation; USG Donn Brand DX: www.usg.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. For reveal-edged panels on suspension-system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension-system surfaces and panel faces flush with bottom face of runners.
4. 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.

## 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.
2. Resilient molding accessories.

### 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.
2. Resilient Molding Accessories: 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.

### 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. 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.
    b. Mannington Mills, Inc./Burke Flooring: www.manningtoncommercial.com.
    c. Johnsonite, a Tarkett Company: www.johnsonite.com.
    d. Nora Systems, Inc.: www.nora.com
    e. Roppe Corp: www.roppe.com.
    f. Tarkett Company: commercial.tarkett.com.

2. 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.

3. Thickness: 0.125 inch.
4. Height: 4 inches.
5. Lengths: Coils in manufacturer's standard length.
6. Outside Corners: Job formed.
7. Inside Corners: Job formed.
8. Colors: Equal to colors indicated in Color Codes on Drawings.

### 2.2 RESILIENT MOLDING ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Armstrong Flooring Inc.: www.armstrongflooring.com.
2. Mannington Mills, Inc./Burke Flooring: www.manningtoncommercial.com.

3. Johnsonite, a Tarkett Company: www.johnsonite.com.
4. Nora Systems, Inc.: www.nora.com
5. Roppe Corp: www.roppe.com.
6. Tarkett Company: commercial.tarkett.com.

B. Resilient edge and transition strips for changes in flooring materials.

1. Material: Rubber.
2. Profile and Dimensions: As standard with manufacturer and as follows:

   a. As appropriate for floor finishes.
   b. As indicated on Drawings.

3. Provide floor moldings at the following locations unless otherwise indicated:

   a. Open perimeters of resilient flooring; reducer strips.
   b. Open perimeters of carpeting; edge guards.
   c. Changes in floor finishes from resilient flooring to carpeting; transition strips.
   d. Changes in elevation: Tapered substrate transition strips; provide for smooth flooring transitions.
   e. Other areas as indicated on Drawings or required for complete floor finish installations.

4. Colors and Patterns: Equal to colors indicated in Color Codes on Drawings or, if not indicated, standard colors as selected by Architect.

## 2.3 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 RESILIENT ACCESSORY INSTALLATION**

A. Comply with manufacturer's written instructions for installing resilient accessories.

B. Install floor moldings in one piece for full width of installation, where possible

1. Where joints are unavoidable, fit tightly together and align adjacent molding profiles

C. Butt to adjacent materials and tightly adhere to substrates throughout length of each piece.

**3.5 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 mars, 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 6543 – LINOLEUM FLOORING

## 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. Linoleum floor tile.
2. Metal trim.

### 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. Shop Drawings: For each type of linoleum flooring.

1. Include flooring layouts, locations of seams, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
2. Show details of special patterns.

C. Samples for Initial Selection: For each type of linoleum flooring, in manufacturer's standard size, but not less than 6 by 9 inches.

D. Samples for Verification: For each type of linoleum flooring, in manufacturer's standard size, but not less than 6-by-9-inch sections of each different color and pattern required.

1. Heat-Welding Bead: Include manufacturer's standard-size Samples, but not less than 9 inches long, of each color required.
2. Metal Trim: Include 6-inch lengths for each profile, color and finish required.

E. Product Schedule: For linoleum flooring. Use same designations indicated on Drawings.

### 1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Sample Warranty: For special warranty.

### 1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of linoleum flooring 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. Floor Tile: Furnish one box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

## 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, and as follows:

1. Engage an installer who employs workers for this Project who are approved, trained or certified by linoleum flooring manufacturer for installation techniques required.

## 1.9 DELIVERY, STORAGE, AND HANDLING

A. Store flooring and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 65 deg F or more than 90 deg F.

1. Floor Tile: Store on flat surfaces.

## 1.10 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 flooring during the following periods:

1. 72 hours before installation.
2. During installation.
3. 72 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. Close spaces to traffic during flooring installation.

D. Close spaces to traffic for 72 hours after flooring installation.

E. Install flooring after other finishing operations, including painting, have been completed.

## 1.11 WARRANTY

A. Special Warranty for Linoleum Floor Tiles: Manufacturer agrees to repair or replace components of linoleum flooring installation that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Thirty years from date of Substantial Completion except as follows:

a. Adhesives, warranty period is fifteen years from date of Substantial Completion.
b. Additionally, application of a floor finish shall not be required, under normal use, for a period of 10 years from the date of substantial completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For linoleum flooring, as determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

### 2.2 LINOLEUM FLOOR TILE

A. Linoleum Floor Tile: Refer to Color Codes on Drawings. Substitutions not permitted.

1. Tile Standard: ASTM F2195.
2. Colors and Patterns:

a. Colors: As indicated in Color Codes on Drawings.
b. Patterns: As indicated on Drawings.

### 2.3 METAL TRIM

A. Metal Trim - General:

1. Metallic edge trim, height to match linoleum thickness; stainless steel, ASTM A276 or ASTM A666, 300 Series exposed-edge material.

a. Profile: Angle or L-shaped.
b. Finish: Brushed stainless steel.
c. Applications and Locations: Unless otherwise indicated, provide metal trim at the following locations:

1) Transitions between linoleum flooring and other floor finishes.
2) Other areas as indicated on Drawings.

d. Basis of Design Product: Subject to compliance with requirements, provide Schluter-Systems; SCHIENE: www.schluter.com, or a comparable product from one of the following:

1) Or approved equal.

### 2.4 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by linoleum flooring manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by flooring and adhesive manufacturers to suit 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 flooring.

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

### 3.2 PREPARATION

A. Prepare substrates according to linoleum flooring manufacturer's written instructions to ensure adhesion of flooring.

B. Concrete Substrates: Prepare according to ASTM F710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with flooring adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by linoleum flooring manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by linoleum flooring manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
4. 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.
    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.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install flooring until materials are the same temperature as space where they are to be installed.

1. At least 72 hours in advance of installation, move flooring and installation materials into spaces where they will be installed.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by flooring.

### 3.3 INSTALLATION, GENERAL

A. Comply with manufacturer's written instructions for installing flooring.

B. Scribe and cut flooring to butt neatly and tightly to vertical surfaces and permanent fixtures, including built-in furniture, cabinets, pipes, outlets, edgings, thresholds, door frames, and nosings.

C. Extend flooring into toe spaces, door reveals, closets, and similar openings.

D. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on flooring as marked on substrates. Use chalk or other nonpermanent marking device.

E. Install flooring on covers for telephone and electrical ducts and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of flooring installed on covers and adjoining flooring. Tightly adhere flooring edges to substrates that abut covers and to cover perimeters.

F. Adhere flooring to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

G. Metal Trim: Adhere securely to substrate prior to installing linoleum flooring.

## 3.4 LINOLEUM FLOOR TILE INSTALLATION

A. Lay out linoleum floor tiles from center marks established with principal walls, discounting minor offsets, so floor tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

1. Lay floor tiles in patterns indicated on Drawings.

B. Match linoleum floor tiles for color and pattern by selecting tiles from cartons in same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed floor tiles.

1. Lay floor tiles in patterns of colors and sizes indicated on Drawings.

## 3.5 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting linoleum flooring.

B. Perform the following operations immediately after completing linoleum flooring installation:

1. Remove adhesive and other blemishes from surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect linoleum flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. After allowing drying room film (yellow film caused by linseed oil oxidation) to disappear, cover linoleum flooring until Substantial Completion.

**END OF SECTION 09 6543**

# SECTION 09 6623 – RESINOUS MATRIX TERRAZZO 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. Thin-set, epoxy-resin terrazzo flooring.

### 1.3 DEFINITIONS

A. NMTA: National Terrazzo and Mosaic Association.

### 1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to terrazzo including, but not limited to, the following:

a. Inspect and discuss condition of substrate and other preparatory work performed by other trades.
b. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
c. Review special terrazzo designs and patterns.

### 1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include terrazzo installation requirements. Include plans, sections, component details, and relationship to other work. Show layout of the following:

1. Divider strips.
2. Control-joint strips.
3. Expansion-joint strips.
4. Accessory strips.
5. Terrazzo patterns.

C. Samples for Initial Selection: Where colors and finishes are not specified, provide NTMA's "Terrazzo Color Palette" showing the full range of colors and patterns available for each terrazzo type.

D. Samples for Verification: For each type, material, color, and pattern of terrazzo and accessory required showing the full range of color, texture, and pattern variations expected. Label each terrazzo Sample to identify manufacturer's matrix color and aggregate types, sizes, and proportions. Prepare Samples of same thickness and from same material to be used for the Work, in sizes indicated below:

1. Terrazzo: 6-inch-square Samples.
2. Accessories: 6-inch-long Samples of each exposed strip item required.

### 1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Material Certificates: For each type of terrazzo material or product.

C. Installer Certificates: Signed by manufacturers certifying that installers comply with requirements.

D. Preinstallation moisture-testing reports.

### 1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For terrazzo to include in maintenance manuals.

### 1.8 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified with at least 5 years of documented experience and complying with the following:

1. An installer who is a contractor member of NTMA
2. Engage an installer who is certified in writing by terrazzo manufacturer as qualified to install manufacturer's products.

### 1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in supplier's original wrappings and containers, labeled with source's or manufacturer's name, material or product brand name, and lot number if any.

B. Store materials in their original, undamaged packages and containers, inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

### 1.10 FIELD CONDITIONS

A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting terrazzo installation.

B. Provide permanent interior lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during terrazzo installation.

C. Close spaces to traffic during terrazzo installation and for not less than 24 hours after installation unless manufacturer recommends a longer period.

D. Control and collect water and dust produced by epoxy-resin terrazzo grinding operations. Protect adjacent construction from detrimental effects of grinding operations.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Crossfield Products Corp./Dex-o-tex: www.dex-o-tex.com.
2. Key Resin Company: www.keyresin.com.
3. Master Terrazzo Inc.: www.masterterrazzo.com.
4. Sherwin-Williams Company: General Polymers Brand: www.generalpolymers.com.
5. Sika Corporation: www.sikafloorusa.com.
6. Terrazzo & Marble Supply Companies: www.tmsupply.com

B. Source Limitations for Aggregates: Obtain each color, grade, type, and variety of granular materials from single source with resources to provide materials of consistent quality in appearance and physical properties.

## 2.2 PERFORMANCE REQUIREMENTS

A. NTMA Standards: Comply with NTMA's written recommendations for terrazzo type indicated unless more stringent requirements are specified.

## 2.3 EPOXY-RESIN TERRAZZO

A. Epoxy-Resin Terrazzo: Comply with manufacturer's written instructions for matrix and aggregate proportions and mixing.

1. Mix Color and Pattern: Match existing unless otherwise indicated in Color Codes on Drawings.
2. Thickness: 3/8 inch, nominal, unless otherwise indicated on Drawings or recommended by terrazzo manufacturer.

B. Materials:

1. Substrate-Crack-Suppression Membrane: Product of terrazzo-resin manufacturer, having minimum 120 percent elongation potential according to ASTM D412.

    a. Reinforcement: Fiberglass scrim as recommended by membrane manufacturer.

2. Primer: Manufacturer's product recommended for substrate and use indicated.
3. Epoxy-Resin Matrix: Manufacturer's standard recommended for use indicated and in color required for mix indicated.

    a. Physical Properties without Aggregates:

        1) Hardness: 60 to 85 per ASTM D2240, Shore D.
        2) Minimum Tensile Strength: 3000 psi per ASTM D638 for a 2-inch specimen made using a "C" die per ASTM D412.
        3) Minimum Compressive Strength: 10,000 psi per ASTM D695, Specimen B cylinder.
        4) Chemical Resistance: No deleterious effects by contaminants listed below after seven-day immersion at room temperature per ASTM D1308.

            a) Distilled water.
            b) Mineral water.
            c) Isopropanol.
            d) Ethanol.
            e) 0.025 percent detergent solution.
            f) 1.0 percent soap solution.
            g) 5 percent acetic acid.
            h) 10 percent sodium hydroxide.
            i) 10 percent hydrochloric acid.
            j) 30 percent sulfuric acid.

4. Aggregates: Comply with NTMA gradation standards for mix indicated and contain no deleterious or foreign matter.

    a. Aggregate Type: Marble, granite, quartz, mother-of-pearl, glass, synthetic, and other materials as required to match specified mix and color pattern.
    b. Abrasion and Impact Resistance: Less than 40 percent loss per ASTM C131.
    c. 24-Hour Absorption Rate: Less than 0.75 percent.
    d. Dust Content: Less than 1.0 percent by weight.

5. Finishing Grout: Resin based.

## 2.4 STRIP MATERIALS

A. Thin-Set Divider Strips: L-type angle in depth required for topping thickness indicated.

1. Material: White-zinc alloy.
2. Top Width: 1/8 inch.

B. Control-Joint Strips: Separate, double L-type angles, positioned back to back, that match material and color of divider strips and in depth required for topping thickness indicated.

C. Accessory Strips: Match divider-strip width, material, and color unless otherwise indicated. Use the following types of accessory strips as required to provide a complete installation:

1. Edge-bead strips for exposed edges of terrazzo.

## 2.5 MISCELLANEOUS ACCESSORIES

A. Strip Adhesive: Epoxy-resin adhesive recommended by adhesive manufacturer for this use.

B. Anchoring Devices:

1. Strips: Provide mechanical anchoring devices or adhesives for strip materials as recommended by manufacturer and as required for secure attachment to substrate.

C. Patching and Fill Material: Terrazzo manufacturer's resinous product approved and recommended by manufacturer for application indicated.

D. Joint Compound: Terrazzo manufacturer's resinous product approved and recommended by manufacturer for application indicated.

E. Joint Sealants: Refer to Section 07 9200 – Joint Sealants.

F. Resinous Matrix Terrazzo Cleaner: Chemically neutral cleaner with pH factor between 7 and 10 that is biodegradable, phosphate free, and recommended by sealer manufacturer for use on terrazzo type indicated; and complies with NTMA's written recommendations for terrazzo type indicated.

G. Sealer: Slip- and stain-resistant, penetrating-type sealer that is chemically neutral; does not affect terrazzo color or physical properties; and is recommended by terrazzo manufacturer; and complies with NTMA's written recommendations for terrazzo type indicated.

1. Surface Friction: Not less than 0.6 according to ASTM D2047.
2. Acid-Base Properties: With pH factor between 7 and 10.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. Examine substrates and 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, including levelness tolerances, have been corrected.

## 3.2 PREPARATION

A. Clean substrates of substances, including oil, grease, and curing compounds, that might impair terrazzo bond. Provide clean, dry, and neutral substrate for terrazzo application.

B. Concrete Slabs:

1. Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with terrazzo.

   a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
   b. Repair damaged and deteriorated concrete according to terrazzo manufacturer's written instructions.
   c. Use patching and fill material to fill holes and depressions in substrates according to terrazzo manufacturer's written instructions.

C. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.

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.
   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.

2. Proceed with terrazzo installation only after concrete substrates pass moisture testing.

D. Substrate-Crack-Suppression Membrane: Install to isolate and suppress substrate cracks according to manufacturer's written instructions.

1. Prepare and prefill substrate cracks with membrane material.
2. Install membrane at substrate cracks in areas to receive terrazzo.
3. Reinforce membrane with fiberglass scrim as recommended by membrane manufacturer..

E. Protect other work from water and dust generated by grinding operations. Control water and dust to comply with environmental protection regulations.

1. Erect and maintain temporary enclosures and other suitable methods to limit water damage and dust migration and to ensure adequate ambient temperatures and ventilation conditions during installation.

## 3.3 EPOXY-RESIN TERRAZZO INSTALLATION

A. Comply with NTMA's written recommendations for terrazzo and accessory installation.

B. Strip Materials:

1. Divider and Control-Joint Strips:

   a. Locate divider strips as indicated on Drawings and as recommended by installer in compliance with NTMA's written recommendations; subject to Architect’s approval.
   b. Install control-joint strips back to back and directly above concrete-slab control joints.

1) Install control-joint strips with 1/4-inch gap between strips, and install sealant in gap.

c. Install strips in adhesive setting bed without voids below strips, or mechanically anchor strips as required to attach strips to substrate, as recommended by strip manufacturer.

2. Accessory Strips: Install as indicated on Drawings and as required to provide a complete installation.

C. Apply primer to terrazzo substrates according to manufacturer's written instructions.

D. Place, rough grind, grout, cure grout, fine grind, and finish terrazzo according to manufacturer's written instructions.

1. Installed Thickness: 3/8 inch nominal, unless otherwise indicated on Drawings or recommended by terrazzo manufacturer.
2. Terrazzo Finishing: Ensure that matrix components and fluids from grinding operations do not stain terrazzo by reacting with divider and control-joint strips.

a. Rough Grinding: Grind with 24-grit or finer stones or with comparable diamond abrasives. Follow initial grind with 60/80-grit stones or with comparable diamond abrasives.
b. Grouting: Before grouting, clean terrazzo with water, rinse, and allow to dry. Apply and cure epoxy grout.
c. Fine Grinding/Polishing: Delay fine grinding until heavy trade work is complete and construction traffic through area is restricted. Grind with 80-grit stones or with comparable diamond abrasives until grout is removed from surface.

3. Installation Tolerance: Limit variation in terrazzo surface from level to 1/4 inch in 10 feet; noncumulative.

## 3.4 REPAIR

A. Cut out and replace terrazzo areas that evidence lack of bond with substrate. Cut out terrazzo areas in panels defined by strips and replace to match adjacent terrazzo, or repair panels according to NTMA's written recommendations, as approved by Architect.

## 3.5 CLEANING AND PROTECTION

A. Cleaning:

1. Remove grinding dust from installation and adjacent areas.
2. Wash surfaces with cleaner according to NTMA's written recommendations and manufacturer's written instructions; rinse surfaces with water and allow them to dry thoroughly.

B. Sealing:

1. Seal surfaces according to NTMA's written recommendations.
2. Apply sealer according to sealer manufacturer's written instructions.

C. Protection: Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure that terrazzo is without damage or deterioration at time of Substantial Completion.

**END OF SECTION 09 6623**

# SECTION 09 6813 – TILE CARPETING

## 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. Carpet tile.
2. Metal trim.

### 1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to carpet tile installation including, but not limited to, the following:

a. Review delivery, storage, and handling procedures.
b. Review ambient conditions and ventilation procedures.
c. Review subfloor preparation procedures.

### 1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
2. Include manufacturer's written installation recommendations for each type of substrate.

B. Shop Drawings: For carpet tile installation, plans showing the following:

1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
2. Carpet tile type, color, and dye lot.
3. Type of subfloor.
4. Type of installation.
5. Pattern of installation.
6. Pattern type, location, and direction.
7. Pile direction.
8. Type, color, and location of insets and borders.
9. Transition details to other flooring materials.

C. Samples for Initial Selection: For each type of carpet tile.

D. Samples for Verification: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

1. Carpet Tile: Full-size Sample.
2. Metal Trim: Include 6-inch lengths for each profile, color and finish required.

E. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

**1.5 INFORMATIONAL SUBMITTALS**

A. Qualification Data: For manufacturer and installer.

B. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.

C. Sample Warranty: For special warranty.

**1.6 CLOSEOUT SUBMITTALS**

A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:

1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

**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. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd..

**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, and as follows:

1. Shall be certified by the International Certified Floorcovering Installers Association at the Commercial II certification level

C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Size: Minimum 100 sq. ft. for each type, color, and pattern 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. Comply with the Carpet and Rug Institute's CRI 104.

**1.10 FIELD CONDITIONS**

A. Comply with the Carpet and Rug Institute's CRI 104 for temperature, humidity, and ventilation limitations.

B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels planned for building occupants during the remainder of the construction period.

C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

**1.11 WARRANTY**

A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.

1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
2. Failures include, but are not limited to, the following:

a. More than 10 percent edge raveling, snags, and runs.
b. Dimensional instability.
c. Excess static discharge.
d. Loss of tuft-bind strength.
e. Loss of face fiber.
f. Delamination.

3. Warranty Period: 10 years from date of Substantial Completion.

**PART 2 - PRODUCTS**

**2.1 PERFORMANCE REQUIREMENTS**

A. Performance Characteristics:

1. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm according to NFPA 253.
2. Electrostatic Propensity: Less than 3.5 kV according to AATCC 134.

**2.2 CARPET TILE**

A. Carpet Tile: Refer to Color Codes on Drawings. Substitutions not permitted.

1. Colors and Patterns:

a. Colors: As indicated in Color Codes on Drawings.
b. Patterns: As indicated on Drawings.

2. Installation Method: As selected by Architect, unless otherwise indicated on Drawings.

**2.3 METAL TRIM**

A. Metal Trim - General:

1. Metallic edge trim, height to match carpet thickness; extruded aluminum, ASTM B221, Alloy and Temper as recommended by manufacturer.

a. Profile: Sloped transition.
b. Finish: Satin anodized.

c. Applications and Locations: Unless otherwise indicated, provide metal trim at the following locations:

1) Transitions between carpet and other floor finishes.
2) Other areas as indicated on Drawings.

d. Basis of Design Product: Subject to compliance with requirements, provide Schluter-Systems; RENO-U: www.schluter.com, or a comparable product from one of the following:

1) Or approved equal.

**2.4 INSTALLATION ACCESSORIES**

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance.

B. Examine carpet tile for type, color, pattern, and potential defects.

C. Concrete Slabs: Verify that finishes comply with requirements specified in Section 033000 "Cast-in-Place Concrete" and that surfaces are free of cracks, ridges, depressions, scale, and foreign deposits.

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.
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.
c. Perform additional moisture tests recommended in writing by adhesive and carpet tile manufacturers. Proceed with installation only after substrates pass testing.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 PREPARATION**

A. General: Comply with the Carpet and Rug Institute's CRI 104 and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider, and protrusions more than 1/32 inch (0.8 mm) unless more stringent requirements are required by manufacturer's written instructions.

C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.

D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

**3.3 INSTALLATION**

A. General: Comply with the Carpet and Rug Institute's CRI 104, Section 10, "Carpet Tile," and with carpet tile manufacturer's written installation instructions.

B. Installation Method: As recommended in writing by carpet tile manufacturer but not less than the following:

1. Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive.

C. Maintain dye-lot integrity. Do not mix dye lots in same area.

D. Maintain pile-direction patterns as indicated on Drawings and as recommended in writing by carpet tile manufacturer.

E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.

H. Metal Trim: Adhere securely to substrate prior to installing carpet tile.

**3.4 CLEANING AND PROTECTION**

A. Perform the following operations immediately after installing carpet tile:

1. Remove excess adhesive and other surface blemishes using cleaner recommended by carpet tile manufacturer.
2. Remove yarns that protrude from carpet tile surface.
3. Vacuum carpet tile using commercial machine with face-beater element.

B. Protect installed carpet tile to comply with the Carpet and Rug Institute's CRI 104, Section 13.7.

C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

**END OF SECTION 09 6813**

# 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. Interior painting.

### 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.

### 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.
2. PPG: PPG Industries, Inc., Architectural Coatings: www.ppgpaints.com.
3. Sherwin-Williams: The Sherwin-Williams Company: www: sherwin-williams.com.

C. Non-Bridging Paint Manufacturers: 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. Acoustical Surfaces, Inc: www.acousticalsurfaces.com.
2. Procoat Products, Inc.: www.procoat.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.

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 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 o3.8 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 previously painted surfaces; including concrete and masonry: 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.

e. 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.
         a) 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.
         a) 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.

### 2.4 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.
3. Portland Cement Plaster: 12 percent.

C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

D. Portland Cement Plaster Substrates: Verify that plaster is fully cured.

E. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

F. 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. Previously Painted Surfaces - General:

1. Remove all surface contamination such as oil, grease, loose paint, mill scale, dirt, foreign matter, rust, mold, mildew, mortar, and any other surface contamination.
2. Remove masking tape, labels, adhesives, and other materials that would either be deleterious to adhesion of, or show through, new paint.
3. Scrape all loose, blistered, peeling, scratched or otherwise imperfect paint down to bare substrate and sand adjacent tightly adhering paint to feather edge.
4. Spot prime all bare areas with appropriate primer before priming entire surface.

K. Repair of Existing Gypsum Board:

1. Fill hairline cracks, small holes, and imperfections with filler compound and sand smooth.

L. Repair of Existing Cementitious Plaster:

1. Fill hairline cracks, small holes, and imperfections with exterior patching plaster and make 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 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 convector and baseboard heating cabinets to match face panels.

**3.5 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.

## 3.6 IDENTIFICATION AND COLOR CODING

A. Marking Fire and Smoke Assemblies.

1. Permanently identify both sides of each fire and smoke assembly indicated on Drawings.

a. Labeling:

1) Labeling may be either painted stencils or preprinted self-adhesive stickers.
2) Lettering not less than 3 inches in height, minimum 3/8 inch stroke width, in contrasting color to wall. Example of wording as follows:

a) "2 HOUR FIRE BARRIER - PROTECT ALL OPENINGS" or similar.

3) Colors and exact wording of labels shall comply with local code(s).

b. Locations:

1) Locate labels within 15 feet of the ends of each wall and intervals not to exceed 30 feet measured horizontally along the wall. Minimum of one label per run of wall.

a) Locate approximately 12 to 24 inches below ceiling/roof deck unless otherwise required by local code(s).
b) In occupied areas without ceilings do not apply labels.

c. Where multiple ratings occur in single run of wall:

1) Apply vertical stripe 2 inches wide and approximately 12 inches high where rating change occurs; use contrasting color to wall.
2) In occupied areas without ceilings do not apply.
3) Comply with local code(s).

B. 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.

## 3.7 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.

**3.8 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 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.

### 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.
2. Carboline Company www.carboline.com.
3. PPG: PPG Industries, Inc., Architectural Coatings: www.ppgpaints.com.
4. Sherwin-Williams: The Sherwin-Williams Company: www: sherwin-williams.com.
5. Tnemec: Tnemec Company Inc.: 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.

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:

a) For Gloss Finish Top Coat: Pro Industrial Heavy Duty Block Filler B42 Series; DFT 8.0 to 10.5 mils
b) For Semigloss and Low Luster Finish Top Coats: 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 gypsum board: Two-component epoxy or acrylic/latex primer, water-based.

1) Benjamin Moore; Super Hide Zero VOC Interior Latex Primer 354; DFT 1.3 mils.
2) Carboline; Sanitile 120; DFT 1.0 to 2.0 mils.
3) PPG; Speedhide 6-2 Interior Quick-Drying Latex Sealer; DFT 1.2 mils.
4) Sherwin Williams; ProMar 200 Zero V.O.C. Interior Latex Primer B28W02600; DFT 1.0 mils.

d. Primer for previously painted surfaces; including concrete and masonry: 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.

e. 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. Structural steel, steel joists, and metal decking.
b. Exposed exterior steel lintels.

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.

c. Primer at previously painted surfaces:

1) Primer: Two-component rust inhibitive, high solids, epoxy.

a) Carboline; Carboguard 890; DFT 4.0 to 6.0 mils.
b) PPG; Amerlock 2; DFT 4.0 to 8.0 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; Probond Series 108; DFT 1.0 to 2.0 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. Previously Painted Surfaces - General:

1. Remove all surface contamination such as oil, grease, loose paint, mill scale, dirt, foreign matter, rust, mold, mildew, mortar, and any other surface contamination.
2. Remove masking tape, labels, adhesives, and other materials that would either be deleterious to adhesion of, or show through, new paint.
3. Scrape all loose, blistered, peeling, scratched or otherwise imperfect paint down to bare substrate and sand adjacent tightly adhering paint to feather edge.
4. Spot prime all bare areas with appropriate primer before priming entire surface.

K. 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 1100 – VISUAL DISPLAY UNITS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. This Section includes the following:

1. Markerboards.
2. Tackboards.

### 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, finishes, and accessories for visual display units.

B. Shop Drawings: For visual display units.

1. Include plans, elevations, sections, details, and attachment to other work.
2. Include seam locations for tackable linoleum surface.
3. Show locations of panel joints. Show locations of field-assembled joints for factory-fabricated units too large to ship in one piece.
4. Include sections of typical trim members.

C. Samples for Initial Selection: For each type of exposed finish.

D. Samples for Verification:

1. Porcelain-enamel Markerboard Finishes: Not less than 2 by 2 inches for each color and finish.
2. Plastic-Impregnated-Cork Sheet: Not less than 2 by 2 inches for each color, texture, and finish.
3. Fabrics: Not less than 8 by 10 inches for each color, texture, and finish.
4. Trim: 6-inch-long sections of each trim profile.

    a. Including chalk trays, map rails, tack strips and edge trim.

5. Accessories: Full-size Sample of each type of accessory.

E. Product Schedule: For visual display units. Use same designations indicated on Drawings.

### 1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Sample Warranties: For manufacturer's special warranties.

## 1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For visual display units 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 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.

## 1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver factory-fabricated visual display units completely assembled in one piece. If dimensions exceed maximum manufactured unit size, or if unit size is impracticable to ship in one piece, provide two or more pieces with joints in locations indicated on approved Shop Drawings.

1. Tackable Linoleum Surface: Store rolls upright.

## 1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install visual display units until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

B. Tackable linoleum surfacing.

1. Maintain ambient temperatures within range recommended by tackable linoleum surface manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive flooring during the following periods:

   a. 72 hours before installation.
   b. During installation.
   c. 72 hours after installation.

2. After tackable linoleum surface 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.

## 1.10 WARRANTY

A. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer agrees to repair or replace porcelain-enamel face sheets that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Surfaces lose original writing and erasing qualities.
   b. Surfaces exhibit crazing, cracking, or flaking.

2. Warranty Period: Life of the building.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Visual Display Board Assemblies - Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ADP Lemco, Inc.; www.adplemco.com.
2. ASI Visual Display Products, Inc., an ASI Group Company: www.asi-visualdisplayproducts.com.
3. Cig Jan Products, Ltd.: www.cig-jan.com
4. Claridge Products and Equipment, Inc: www.claridgeproducts.com/.
5. Egan Visual, Inc.; www.egan.com.
6. Ghent, a GMi company; www.ghent.com.
7. Marsh Industries, Inc., a PolyVision Corporation company; www.marsh-ind.com.
8. Platinum Visual Systems; www.pvsusa.com.
9. PolyVision Corporation: www.polyvision.com.

B. Source Limitations: Obtain visual display units 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: 25 or less.
2. Smoke-Developed Index: 450 or less.

### 2.3 MATERIALS

A. Porcelain-Enamel Face Sheet: PEI-1002, with face sheet manufacturer's standard two- or three-coat process.

1. Color and Gloss: As selected from manufacturer's full range.

B. Polyester Fabric: Nondirectional weave, 100 percent polyester; weighing not less than 15 oz./sq.yd.; with surface-burning characteristics indicated.

1. Colors: As indicated in Color Codes on Drawings.

C. Particleboard: ANSI A208.1, Grade M-1.

D. Fiberboard: ASTM C208 cellulosic fiber insulating board.

E. Extruded Aluminum: ASTM B221, Alloy 6063.

F. Mounting Hardware: Concealed. Include brackets and all related fasteners for installation on substrates indicated

G. Adhesives for Field Application: Mildew-resistant, nonstaining adhesive for use with specific type of panels, sheets, or assemblies; and for substrate application; as recommended in writing by visual display unit manufacturer.

## 2.4 MARKERBOARD PANELS

A. Porcelain-Enamel Markerboard Panels: Balanced, high-pressure, factory-laminated markerboard assembly of three-ply construction, consisting of moisture-barrier backing, core material, and porcelain-enamel face sheet with gloss finish. Laminate panels under heat and pressure with manufacturer's standard, flexible waterproof adhesive.

1. Face Sheet Thickness: 0.021 inch uncoated base metal thickness.
2. Particleboard Core: 1/2 inch thick; with 0.015-inch-thick, aluminum sheet backing.
3. Laminating Adhesive: Manufacturer's standard moisture-resistant thermoplastic type.

## 2.5 TACKBOARD PANELS

A. Tackboard Panels:

1. Facing: Fabric.
2. Core: 7/16-inch-thick fiberboard.

## 2.6 ALUMINUM FRAMES AND TRIM

A. Aluminum Frames: Fabricated from not less than 0.062-inch-thick, extruded aluminum; standard size and shape unless otherwise indicated on Drawings; no visible fasteners.

1. Aluminum Finish: Clear anodic finish.

## 2.7 VISUAL DISPLAY BOARD ASSEMBLIES

A. Markerboard Assemblies: Factory fabricated:

1. Markerboard Panel: Porcelain-enamel-faced markerboard panel on core indicated.
2. Aluminum Frames and Trim: Extruded aluminum.
3. Widths: As indicated on Drawings.
4. Heights: As indicated on Drawings.
5. Mounting Method: Direct to wall.

B. Joints: Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, balanced around center of board, as acceptable to Architect.

C. Combination Assemblies:

1. Provide manufacturer's standard hidden spline between abutting markerboard panel sections.

D. Chalktray: Manufacturer's standard; continuous. Extend across bottom edge of markerboard panels excluding tackboard panels.

1. Solid Type: Extruded aluminum with ribbed section and smoothly curved exposed ends.

E. Display (Map) Rail: Manufacturer's standard, extruded-aluminum display rail with plastic-impregnated-cork insert.

1. Size: 1 inch high by full length of visual display unit including tackboard panels.
2. End Stops: Manufacturer’s standard; provide at each end of display rail.
3. Map Hooks: Two map hooks for every 48 inches of display rail or fraction thereof.
4. Map Hooks and Clips: Two map hooks with flexible metal clips for every 96 inches of display rail or fraction thereof.
5. Flag Holder: One for each room.

## 2.8 FRAMELESS TACKBOARD ASSEMBLIES

A. Tackboard Assemblies - Frameless: Factory fabricated:

1. Tackboard Panel: Fabric on core indicated.
2. Fabric Wrapped Edge: Wrap edge of tackboard panel with fabric facing.
3. Widths: As indicated on Drawings.
4. Heights: As indicated on Drawings <Insert dimension>.
5. Mounting Method: Direct to wall.

B. Combination Assemblies:

1. Install wrapped-edge panels with butt joints between adjacent wall panels.

## 2.9 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM/NOMMA 500 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 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.

## 2.10 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.

B. Examine walls and partitions for proper preparation and backing for visual display units.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 PREPARATION

A. Comply with manufacturer's written instructions for surface preparation.

B. Clean substrates of substances, such as dirt, mold, and mildew, that could impair the performance of and affect the smooth, finished surfaces of visual display boards.

C. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, depressions, and substances that will impair bond between visual display units and wall surfaces.

D. Verify wall surfaces indicated to receive visual display units have been prime painted, at the minimum.

## 3.3 VISUAL DISPLAY BOARD ASSEMBLIES INSTALLATION

A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

B. Factory-Fabricated Visual Display Board Assemblies : Secure to walls with adhesive and mechanical fasteners.

1. Attach concealed clips, hangers, and grounds to wall surfaces and to visual display board assemblies with fasteners at not more than 16 inches o.c. Secure tops and bottoms of boards to walls.
2. Adhere to wall surfaces with egg-size adhesive gobs at 16 inches o.c., horizontally and vertically.

C. Frameless Tackboard Panels: Attach panels to wall surface with egg-size adhesive gobs at 16 inches o.c., horizontally and vertically.

D. Visual Display Board Assembly Mounting Heights: Install visual display units at mounting heights indicated on Drawings, or if not indicated, at heights indicated below.

1. Mounting Height for Grades K through 3: 24 inches above finished floor to top of chalktray.
2. Mounting Height for Grades 4 through 6: 28 inches above finished floor to top of chalktray.
3. Mounting Height for Grades 7 and Higher: 36 inches above finished floor to top of chalktray.

## 3.4 CLEANING AND PROTECTION

A. Clean visual display units in accordance with manufacturer's written instructions. Attach one removable cleaning instructions label to visual display unit in each room.

B. Touch up factory-applied finishes to restore damaged or soiled areas.

C. Cover and protect visual display units after installation and cleaning.

**END OF SECTION 10 1100**

# 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.

### 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.
b. Bobrick Washroom Equipment, Inc.: www.bobrick.com.
c. Bradley Corporation: www.bradleycorp.com.

B. Source Limitations: Obtain each type of toilet, 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. Sanitizer Dispenser: Owner furnished; Owner installed.

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.

**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 12 2413 – ROLLER WINDOW SHADES

## 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. Manually operated roller shades.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.

B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.

C. Samples for Initial Selection: For each type and color of shadeband material.

1. Include Samples of accessories involving color selection.

D. Samples for Verification: For each type of roller shade.

1. Shadeband Material: Not less than 10 inches square. Mark interior face of material if applicable.
2. Roller Shade Material: Not less than 2 by 3 inches for each color and finish.
3. Installation Accessories: Full-size unit, not less than 10 inches long.

E. Product Schedule: For roller shades. Use same designations indicated on Drawings.

### 1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Product Certificates: For each type of shadeband material.

C. Product Test Reports: For each type of shadeband material, for tests performed by manufacturer and witnessed by a qualified testing agency or a qualified testing agency.

D. Sample Warranties: For manufacturer's special warranties.

### 1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For roller shades to include in maintenance manuals.

### 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. Roller Shades: Full-size units equal to 2 percent of quantity installed for each size, color, and shadeband material indicated, but no fewer than two units.
2. Drive Chain: Quantity equal to 2 percent of total installed, but not less than 100 lineal feet.
3. Clutch Operator: Quantity equal to 2 percent of total installed, but not less than 2 units.
4. Mounting Brackets: Quantity equal to 2 percent of total installed, but not less than 2 pair.

### 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.

### 1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

### 1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

### 1.10 WARRANTY

A. Warranties: Provide manufacturers' standard warranty against defects in material and workmanship for period indicated, from Date of Substantial Completion.

1. Shade Hardware, excluding drive chains: 10 years.
2. Fabric: 10 years.
3. Aluminum and Steel Coatings: One year.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Draper, Inc: draperinc.com.
2. Hunter Douglas Architectural: hunterdouglasarchitectural.com.
3. MechoShade Systems, LLC: mechoshade.com.

B. Source Limitations: Obtain roller shades from single source from single manufacturer.

## 2.2 ROLLER SHADES, GENERAL

A. Refer to Drawings for roller shade configurations and installation methods, including:

1. Roller shade locations.
2. Shadeband materials.
3. Installation methods including front fascias and recessed shade pockets.

B. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.

1. Single Rollers:

a. Roller Drive-End Location: Right side of interior face of shade unless otherwise indicated on Drawings.
b. Direction of Shadeband Roll: Regular, from back (exterior face) of roller.

2. Shadeband-to-Roller Attachment: Adhesive strip or removable spline fitting into integral channel in tube.

C. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.

1. Provide mounting hardware as recommended by manufacturer for mounting conditions and substrates indicated on Drawings

D. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers into a multiband shade that is operated by one roller drive-end assembly.

1. Provide as indicated on Drawings or as recommended by manufacturer.

E. Shadebands:

1. Single Rollers:

a. Shadeband Material: Light-filtering fabric.

2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.

a. Type: Enclosed in sealed pocket of shadeband material or exposed with endcaps as standard with manufacturer.

F. Installation Accessories:

1. For each roller shade provide one of the following in accordance with mounting conditions and details indicated on Drawings

a. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.

1) Shape: L-shaped.
2) Height: Manufacturer's standard height required to conceal roller and shadeband assembly when shade is fully open, but not less than 4 inches.

b. Recessed Shade Pocket: Rectangular, extruded-aluminum enclosure designed for recessed ceiling installation; with front, top, and back formed as one piece, end plates, and removable bottom closure panel.

1) Height: Manufacturer's standard height required to enclose roller and shadeband assembly when shade is fully open, but not less than 4 inches.
2) At acoustical panel ceilings, provide pocket with lip at lower edge to support acoustical ceiling panel.

G. Color and Finish:

1. For metal components exposed to view provide manufacturer's standard baked enamel or powder coated finish

a. Colors Standard color as selected by Architect.

2. For plastic components exposed to view:

a. Colors Standard color as selected by Architect.

## 2.3 MANUALLY OPERATED SHADES

A. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.

1. Bead Chains: Nickel-plated metal or stainless steel.

a. Chain Break Strength: 95 pounds, minimum.
b. Loop Length: Full length of roller shade.
c. Limit Stops: Provide upper and lower ball stops.
d. Chain-Retainer Type: Chain tensioner, jamb or sill mounted.

2. Spring Lift-Assist Mechanisms: Manufacturer's standard for balancing roller shade weight and for lifting heavy roller shades.

a. Provide for shadebands that weigh more than 10 lb or for shades as recommended by manufacturer, whichever criterion is more stringent.

## 2.4 SHADEBAND MATERIALS

A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

B. Light-Filtering Fabric: Refer to Color Codes on Drawings.

1. Manufacturers: The design for each shadeband material 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. Mermet Corporation: : www.mermetusa.com.
b. Phifer, Inc.: www.phifer.com

2. Performance Requirements:

a. UV Blockage: 95 percent, minimum.
b. Fungal Resistance: No growth when tested according to ASTM G21.

3. Openness Factor: 3 percent.
4. Colors: As indicated in Color Codes and Window Shade Schedule on Drawings.

**2.5 ROLLER SHADE FABRICATION**

A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.

B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F:

1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch per side or 1/2-inch total, plus or minus 1/8 inch. Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch, plus or minus 1/8 inch.
2. Outside of Jamb Installation: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.

a. Extend shades 2 inches, plus or minus 1/8 inch, beyond jambs on each side if not otherwise indicated.
b. Extend shades 2 inches beyond sill, plus or minus 1/8 inch, if not otherwise indicated.

1) If sill extends into path of shadeband material, stop shade within 1/4 inch, plus or minus 1/8 inch, of sill

C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible, except as follows, unless otherwise indicated on Drawings:

1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.
2. Railroaded Materials: Railroad material where material roll width is less than the required width of shadeband and where indicated. Provide battens and seams as required by railroaded material to produce shadebands with full roll-width panel(s) plus, if required, one partial roll-width panel located at top of shadeband.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances and other conditions affecting performance of the Work.

B. Verify locations of connections to building electrical system for motor-operated roller shades.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 ROLLER SHADE INSTALLATION

A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.

1. Locate so shadeband material is not closer than 2 inches to interior face of glass. Allow clearances for window operation hardware.

B. Roller Shade Locations: As indicated on Drawings.

## 3.3 ADJUSTING

A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

## 3.4 CLEANING AND PROTECTION

A. Clean roller shade surfaces, after installation, according to manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.

C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

## 3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain motor-operated roller shades.

**END OF SECTION 12 2413**

# 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. 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.
2. Case Systems: www.casesystems.com.
3. Stevens Industries, Inc.: www.stevensind.com.
4. Strata Design; www.stratadesign.com
5. TMI Systems Design Corporation: 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. 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: Grade CLS, 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 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. Warranties
13. Sealing of Openings (Firestopping)
14. Examination of Existing Conditions and Temporary Services
15. Mechanical Demolition Work
16. Cutting and Patching
17. Protection of Installed Construction, Damage to Other Work and Corrections
18. Coordination with Other Trades
19. Touch-up Painting
20. Scaffolding, Rigging, Hoisting, Excavation and Backfilling
21. Accessibility and Access Panels
22. Field Quality Control, Starting, Adjusting and Commissioning
23. 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 from, 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 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 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 tile 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 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.

**3.6 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.

**3.7 SCAFFOLDING, RIGGING, HOISTING, EXCAVATION AND BACKFILLING**

A. 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.

**3.8 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. 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.

E. 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.

**3.9 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. 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.

G. Refer to related information in other sections for additional requirements.

H. 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 them over to the Owner and obtain itemized receipt. This receipt shall be attached to the "Final Application" for payment.

**3.10 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 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 ≤ 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:

| Service | Range (Degrees F) |
|---|---|
| Domestic Cold Water | 0-120 |
| Domestic Hot Water | 0-180 |
| 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 GLASS THERMOMETERS**

A. Manufacturers:

1. Industrial Glass
2. H.O. Trerice
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.

**2.3 PRESSURE GAUGES**

A. Manufacturers:

1. Dwyer
2. H. O. Trerice
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. Except where noted otherwise, select range for twice normal operating pressure:

1. Water (CW and HW): 0-100 psig
2. Compressed Air: 0-125 psig

F. Outdoor gauges shall be ultraviolet proof and specifically manufactured for outdoor use.

## 2.4 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.

## 2.5 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.

# 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 INSTALLATION OF TEST PLUGS**

A. Test Plugs: Install in piping tee where indicated, located on pipe at most readable position. Secure cap.

**3.5 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. Natural Gas
3. Heating Hot Water and Non-Potable Water
4. Refrigerant
5. Compressed Air / Lab Vacuum
6. 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 ≤ 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.

**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 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

**2.6 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

**2.7 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

**2.8 DRAIN VALVE**

A. General Service: Ball valve with 3/4-inch hose threaded end fitting and cap.

**2.9 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

## 2.10 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).

## 2.11 REFRIGERANT VALVES & SPECIALTIES

A. General: Complete valve assembly shall be and designed to conform to ARI 760.

B. Globe: 450 psig maximum operating pressure, 275 deg. F maximum operating temperature; cast bronze body, with cast bronze or forged brass wing cap and bolted bonnet; replaceable resilient seat disc; plated steel stem. Valve shall be capable of being repacked under pressure. Valve shall be straight through or angle pattern, with solder-end connections.

C. Check Valves:

1. Smaller Than 7/8 Inch: 500 psig maximum operating pressure, 300 deg. F maximum operating temperature; cast brass body, with removable piston, Teflon seat, and stainless steel spring; straight through globe design. Valve shall be straight through pattern, with solder-end connections

2. 7/8 inch and Larger: 450 psig maximum operating pressure, 300 deg. F maximum operating temperature; cast bronze body, with cast bronze or forged brass bolted bonnet; floating piston with mechanically retained Teflon seat disc. Valve shall be straight through or angle pattern, with solder-end connections.

D. Solenoid Valves: UL-listed, 250 deg. F temperature rating, 400 psig working pressure; forged brass, with Teflon valve seat, two-way straight through pattern, and solder end connections. Provide manual operator to open valve. Furnish complete with NEMA 1 solenoid enclosure with 1/2 inch conduit adapter, holding coil, voltage to meet controls requirements.

E. Thermal Expansion Valves: thermostatic adjustable, modulating type; size as required for specific evaporator requirements, and factory set for proper evaporator superheat requirements. Valves shall have copper fittings for solder end connections; complete with sensing bulb, a distributor having a side connection for hot gas bypass line, and an external equalizer line.

F. Hot Gas Bypass Valve: adjustable type, sized to provide capacity reduction beyond the last step of compressor unloading; and wrought copper fittings for solder end connections.

G. VRF refrigerant isolation valves: Compatible with R410A and PVE (polyvinyl ether oil), operating range of -40F to 300F, working pressure of 550 psi (capable of transient pressure spikes to 700 psi), full port valve with zero pressure drop, bi-directional flow, service port in valve body, brazed connections.

H. Charging and Purging Valves:

1. Manufacturer: Henry

I. Refrigeration Ball Valve:

1. Manufacturer: Henry

J. Refrigeration Piping Specialties

1. General: Complete refrigerant piping specialty assembly shall be UL-listed and designed to conform to ARI 760.
2. Strainers: 500 psig maximum working pressure; forged brass body with monel 80-mesh screen, and screwed cleanout plug; Y-pattern, with solder end connections.
3. Moisture/liquid Indicators: 500 psig maximum operation pressure, 200 deg. F maximum operating temperature; forged brass body, with replaceable polished optical viewing window, and solder end connections.
4. Filter-driers: 500 psig maximum operation pressure; steel shell, flange ring, and spring, ductile iron cover plate with steel capscrews, and wrought copper fittings for solder end connections. Furnish complete with replaceable filter-drier core kit, including gaskets, as follows:

    a. Standard capacity desiccant sieves to provide micronic filtration.
    b. High capacity desiccant sieves to provide micronic filtration and extra drying capacity.

5. Suction Line Filter-Drier: 350 psig maximum operation pressure, 225 deg. F maximum operating temperature; steel shell, and wrought copper fittings for solder end connections. Permanent filter element shall be molded felt core surrounded by a desiccant for removal of acids and moisture for refrigerant vapor.
6. Suction Line Filters: 500 psig maximum operation pressure; steel shell, flange ring, and spring, ductile iron cover plate with steel capscrews, and wrought copper fittings for solder end connections. Furnish complete with replaceable filter core kit, including gaskets, as follows:

    a. Standard capacity desiccant sieves to provide micronic filtration.
    b. High capacity desiccant sieves to provide micronic filtration and extra drying capacity.

7. Flexible Connectors: 500 psig maximum operating pressure; seamless tin bronze or stainless steel core, high tensile bronze braid covering, solder connections, and synthetic covering; dehydrated, pressure tested, minimum 7 inch in length. Manufacturer: Anaconda

**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

B. Natural Gas System:

1. Isolation through 2”: Ball Valve certified by UL or CSA for natural gas.
2. Isolation 2 1/2" and Larger: Lubricated Plug Valve

C. Heating Hot Water/Non-Potable Water Systems:

1. Isolation through 2": Ball Valve.
2. Isolation 2-1/2" and Larger: Butterfly Valve.
3. Check through 2”: Swing Check Valve
4. Check 2-1/2” and Larger: Silent Check Valve
5. Balancing: Manual Balancing Valve

D. Compressed Air/Lab Vacuum Systems:

1. Isolation through 2": Ball Valve
2. Isolation 2-1/2" and Larger: Butterfly Valve
3. Check through 2”: Swing Check Valve
4. Check 2-1/2” and Larger: Silent Check Valve

E. Valves for Mechanical Press Fit Piping Systems:

1. The mechanical press fit system manufacturer’s standard isolation ball valves through 2” shall be allowed provided they meet the ball valve specification in Section 2 above.

**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.

I. Natural Gas Valve Installation Requirements:

1. Install valves in accessible locations, protected from physical damage. Do not locate valves in plenum ceilings.
2. Install isolation valve upstream and within 6 feet of gas appliance. Install a union or flanged connection downstream from the valve to permit removal of controls.

J. Domestic Hot Water Valve Installation:

1. For general service applications: steam and condensate flanged valves shall be installed with Flexitallic gaskets, 316L stainless steel, with “Flexicarb” filler.
2. For general service applications, domestic hot water flanged valves shall be installed with 100% PTFE gaskets, Interlex SQ-S.

**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 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.

## 1.7 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. Channel Support Systems:

    a. Anvil
    b. Cooper B-Line
    c. Carpenter & Patterson, Inc.
    d. PHD Manufacturing
    e. Unistrut Corporation
    f. Powerstrut

2. Non-Penetrating Rooftop Hangers and Supports:

    a. nVent Caddy Pyramid
    b. Miro Industries, Inc.
    c. Big Foot Systems

3. Drilled Insert Anchors:

    a. Hilti
    b. Powers Fasteners

4. Powder-Actuated Fastener Systems: **NOT ALLOWED**

## 2.2 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.

## 2.3 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. 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.

D. Attachments to metal decking: **NOT ALLOWED**.

## 2.4 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. 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.

E. 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

F. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

G. 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. 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.

D. 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.

E. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

**3.3 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.

**3.4 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.

**3.5 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 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:

| | Piping System | Label I.D. | Letter and Label Color |
|---|---|---|---|
| 1. | Cold Water, Domestic | CW | White on Green |
| 2. | Compressed Air | CA | White on Blue |
| 3. | Fire Protection | FP | White on Red |
| 4. | Hot Water, Domestic | HW | White on Green |
| 5. | Hot Water Return, Domestic | HWR | White on Green |
| 6. | Natural Gas | G | Black on Yellow |
| 7. | Non-Potable Water | NPW | White on Green |
| 8. | Sanitary Vent | V | White on Green |
| 9. | Sanitary Waste | SAN | White on Green |
| 10. | Storm Sewer Water | ST | White on Green |
| 11. | Condensate Drain | COND | White on Green |
| 12. | Hot Water Heating Supply | HWHS | White on Green |
| 13. | Hot Water Heating Return | HWHR | White on Green |

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:

| | Service/Duct | Label I.D. | Letter and Label Color |
|---|---|---|---|
| 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 |

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 - CLOSED CELL ELASTOMERIC

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Armacell; AP Armaflex
2. Aeroflex; Aerocel
3. K-Flex; INSUL-TUBE

B. Flexible closed cell elastomeric pipe insulation, ASTM C534, conductivity of 0.25, water vapor permeability of 0.20, composite flame spread/ smoke density of 25/50.

## 2.4 REFRIGERANT PIPING INSULATION – EPDM CLOSED CELL ELASTOMERIC

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Armacell; AP Armaflex Black LapSeal
2. Aeroflex; Aerocell-SSPT
3. K-Flex; INSUL-LOCK DS

B. Flexible closed cell elastomeric tube insulation with self-seal, dual-tape closure. Thermal conductivity: 0.245; Water Vapor Transmission: 0.03, UV resistant, Temperature range: -40F to 250F, composite flame spread/ smoke density of 25/50.

## 2.5 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

## 2.6 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.

## 2.7 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.

## 2.8 DUCTWORK 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.

## 2.9 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)

## 2.10 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

## 2.11 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.

## 2.12 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. Insulate connection points between new and existing items.

C. Repair or replace insulation damaged during construction.

D. All systems shall be tested and approved before being insulated.

E. The insulation shall be applied over clean, dry surface.

F. 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 |
|---|---|---|---|---|---|---|
| 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 |
| Refrigerant Suction | Any | 1.0 | 1.5 | 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: Aluminum.

C. Refrigerant Piping - Outdoor:

1. Type: Closed Cell Elastomeric
2. Thickness: 1” for risers in vertical pipe chase, 3/4” for all branch piping outside pipe chase
3. Jacket: Aluminum.
4. Workmanship: It is imperative that sealing of the seams be done in a careful manner to ensure integrity of the vapor barrier. In that regard, provide adhesive taping at all seams in addition to mfr’s integral seam sealing system. Ensure no air gaps between insulation and the piping. Ensure all transverse and longitudinal seams are carefully taped. For all outdoor piping, ensure all longitudinal seams are turned down.

D. 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. Sanitary, waste and vent piping
8. Compressed air piping
9. Natural gas piping
10. Refrigerant liquid lines
11. Vertical portion of rain water conductors
12. Below-grade piping, unless otherwise indicated
13. Chrome-plated pipes and fittings, unless potential for personnel injury
14. Air Chambers

E. 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.

F. 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.

G. Wherever necessary to seal insulation and provide a complete and continuous vapor barrier, apply two coats of insulating mastic

H. For closed cell elastomeric insulation, seal all butt joints and seams by joining cut edges with adhesive as supplied by the insulation manufacturer

I. 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

J. 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 – Outdoor

1. Type: Rigid Fiberglass Insulation Board or Closed Cell Elastomeric Sheet
2. Thickness: 1-1/2”
3. Jacket: Self-Adhering Sheet Membrane

D. 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. The following spaces are normally considered conditioned areas: return air plenums above ceilings, heated penthouse, mechanical and electrical rooms

E. 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.

F. 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 HOT EQUIPMENT INSULATION APPLICATION

A. Hot Equipment Insulation

1. Type: Rigid Fiberglass Insulation Board
2. Thickness: See Below
3. Jacket: None for indoor equipment, PVC for outdoor equipment

B. Insulate all equipment with surface temperature over 100F.

C. Apply insulation in thickness as follows:

1. 1-1/2" for operating temperature up to 150F
2. 2" for operating temperature of 150F to 200F
3. 3" for operating temperature over 200F

D. Cut, score, or miter insulation to fit contour of equipment and secure with galvanized steel bands or wire, or weld pins. Stagger joints where possible and fill voids with insulating cement. Apply 1" galvanized wire mesh over entire exterior surface and finish with two coats of insulating cement troweled to a hard finish.

E. Hot Equipment Not To Be Insulated:

1. Hot water pumps
2. Steam condensate pumps
3. Boiler feedwater pumps
4. Heating hot water system chemical shot feeders
5. Domestic water or heating hot water expansion tanks

## 3.6 COLD EQUIPMENT INSULATION APPLICATION

A. Cold Equipment Insulation

1. Type: Closed Cell Elastomeric Sheet

2. Thickness: 1”
3. Jacket: None for indoor equipment, PVC for outdoor equipment

B. Insulate all equipment with surface temperature below 60F.

C. Apply elastomeric insulation sheet with contact adhesive

D. Cold Equipment Not To Be Insulated:

1. Water softener shells
2. Vacuum pumps
3. Factory insulated equipment
4. Vibration-control devices

**3.7 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. Hydronic piping systems
3. Refrigerant piping systems
4. Pipe joints
5. Mechanically formed tee connections in copper piping
6. Unions
7. Pipe sleeves
8. Dielectric fittings
9. Strainers
10. Pipe anchors
11. Piping transitions
12. 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 ≤ 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. Press Joints:

1. Limited to a maximum pipe size of 4".
2. Rated for a minimum 200 PSI working pressure from -4ºF to 250ºF.
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

G. 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 -66ºF to 272ºF. 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 “FLEXTALLIC”, 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.

H. 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.)

I. Gasket Joint Lubricant - for use with grooved and hubless joints: Provide manufacturer’s recommended gasket lubricant.

J. 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. Cold water: Sleeves are required for all piping 2” and larger penetrating walls and floors.

D. 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 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.

D. 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) 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. Tubing: Viega PEX Ultra, Type b, 1/2-inch thru 2-inch shall conform to, ASTM F876, ASTM 877, ASTM E84, ASTM E119-14, CSA 137.5, NFPA 251, NSF 61, NSF 372, UBC 7-1, and UL 263. Viega PEX Ultra tubing shall have a Standard Dimensional Ratio (SDR-9), with 100 psi at 180°F / 160 psi at 73°F pressure rating, a “5006” or CL 5 chlorine listing and a 5306, or 3 ultraviolet UV exposure listing. Tubing distribution should be made through a Viega ManaBloc / MiniBloc Home-run System and shall conform to ASTM F877, NSF Standards 14 & 61, CSA B137.5 and have a UPC Certification
2. Fittings - none, continuous piping

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

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

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

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

**3.3 HYDRONIC PIPING SYSTEMS APPLICATION**

A. Heating Hot Water

1. For piping through 4”:

a. Pipe: Type L Copper, hard drawn, ASTM B88
b. Fittings: Wrought Copper, ANSI B16.22
c. Joints: Soldered through 2”; Brazed for 2-1/2” through 4”

2. For piping 5” and larger:

a. Pipe: Black Steel, Schedule 40, ASTM A53, ERW or seamless, grade B, standard weight for 12” and above
b. Fittings: Standard weight, butt welded, black steel, ASTM A234
c. Joints: Welded. Flanged ASTM A181, 150#, forged steel at valves, and equipment.

**3.4 NATURAL GAS PIPING APPLICATION**

A. Natural Gas - Above Ground

1. For piping through 2”:

a. Pipe: Black Steel, Schedule 40, ASTM A 53, ERW or seamless, grade B
b. Fittings: Malleable iron, 150 lb ASTM A 197; unions, 250 lb ASTM A 197
c. Joints:

1) Screwed Terminal Connections: for 1/2” and less Type L Copper, annealed, ASTM B 88, 24” maximum length, flared connections.

2. For piping 2-1/2” and larger:

a. Pipe: Black Steel, Schedule 40, ASTM A 53, ERW or seamless, grade B, standard weight for 12” and above
b. Fittings: Standard weight, butt welded, black steel, ASTM A 234
c. Joints: Welded. Flanged ASTM A 181, 150#, forged steel at valves, and equipment.

**3.5 NATURAL GAS PIPING INSTALLATION REQUIREMENTS**

A. Install, inspect, test, and purge natural gas systems in accordance with NFPA 54, and local utility requirements.

B. Gas meter, pressure regulator and related valves and trim shall be furnished and installed by the Local Utility. All gas piping outside the building, upstream of the gas meter shall be provided and installed by the Local Utility. Contractor shall coordinate the installation of gas meter and related components with the Local Utility and the Owner. Expenses and fees for Local Utility Work shall be paid for by the Owner.

C. See Section 22 05 23 for valve specifications and installation requirements.

D. Gas piping in Floors: Gas piping with welded joints and protective PE wrapping may be installed in floors, subject to approval of authorities having jurisdiction. Surround piping cast in concrete slabs with minimum of 1-1/2 inches of concrete. Piping may not be in physical contact with other metallic structures such as reinforcing rods or electrically neutral conductors. Do not embed piping in concrete slabs containing quick-set additives or cinder aggregate

E. Gas piping In Partitions: Do not install concealed piping in solid partitions. Protect tubing from physical damage when installed inside hollow partitions or hollow walls

F. Gas piping In Masonry Walls: Gas piping with welded joints and protective PE wrapping may be installed in masonry walls, subject to approval of authorities having jurisdiction

G. Drips and Sediment Traps: Install a drip leg at inlet to terminal equipment, points where condensate may collect, and at the outlet of the gas meter. Do not install drips where condensate is likely to freeze. Construct drips using a tee with plugged or capped bottom outlet. Drip shall be minimum of 3 pipe diameters long, same size as pipe. Locate drips to permit cleaning and emptying.

H. Install gas line pressure regulator(s) where indicated on drawings.

I. Install a gas isolation valve upstream of each gas pressure regulator. Where two gas pressure regulators are installed in series in a single gas line, a valve is not required at the second regulator.

J. Install pressure relief or pressure limiting devices so they can be readily operated to determine if the valve is free, so they can be tested to determine the pressure at which they will operate; and examined for leakage when in the closed position.

K. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment, and elsewhere as indicated. Unions are not required on flanged devices

L. Install strainer on inlet of each line pressure regulator and automatic and electrically operated valve

M. Install pressure gage upstream and downstream from each line pressure regulator

N. Install vent line from pressure regulators to safe location outdoors. Terminate vents with turned-down, reducing-elbow fittings with corrosion-resistant insect screens in large end

O. Install containment conduits for gas piping below slabs, within building, in gastight conduits extending minimum of 4 inches outside building and vented to atmosphere. Terminate vents with turned-down, reducing-elbow fittings with corrosion-resistant insect screens in large end. Prepare and paint outside of conduits with coal-tar, epoxy-polyamide paint according to SSPC-Paint 16

P. Install above ground portions of gas piping systems, upstream from equipment shutoff valves electrically continuous and bonded to a grounding electrode in accordance with NFPA 70 - "National Electrical Code".

Q. Do not use gas piping as a grounding electrode.

R. Conform to NFPA 70 - "National Electrical Code," for electrical connections between wiring and electrically operated control devices.

## 3.6 REFRIGERANT PIPING SYSTEMS APPLICATION

A. Refrigeration Piping - Above Ground and Under Ground

1. Pipe: Type L or K Seamless Copper, Nitrogenized ACR, ASTM B 88 or ASTM B 280, annealed for 3/8” and smaller, hard drawn for 1/2” and larger. For underground piping 2” and smaller: Type K, annealed, with no fittings.
2. Fittings: ANSI B16.26 cast copper alloy refrigeration type with 45 degree flare or wrought copper ANSI B16.22 socket fittings
3. Joints: brazed, flared (above ground only).

## 3.7 REFRIGERANT PIPING INSTALLATION REQUIREMENTS

A. General: Install refrigerant piping in accordance with ASHRAE Standard 15.

B. Refrigerant piping indicated is schematic only. Size piping and design the actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes, to ensure proper operation and compliance with warranties of connected equipment

C. Before installation of copper tubing other than Type ACR tubing, clean the tubing and fitting using following cleaning procedure:

1. Remove coarse particles of dirt and dust by drawing a clean, lint free cloth through the tubing by means of a wire or an electrician's tape.
2. Draw a clean, lint free cloth saturated with trichloro-ethylene through the tube or pipe. Continue this procedure until cloth is not discolored by dirt.
3. Draw a clean, lint free cloth, saturated with compressor oil, squeezed dry, through the tube or pipe to remove remaining lint. Inspect tube or pipe visually for remaining dirt and lint.
4. Finally, draw a clean, dry, lint free cloth through the tube or pipe.

D. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings

E. Arrange piping to allow inspection and service of compressor and other equipment. Install valves and specialties in accessible locations to allow for service and inspection

F. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation. Use sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation

G. Belowground, install copper tubing in protective conduit. Vent conduit outdoors

H. Install copper tubing in rigid or flexible conduit in locations where copper tubing will be exposed to mechanical damage

I. Arrange piping to allow normal inspection and servicing of compressor and other equipment. Install valves and specialties in accessible locations to allow for servicing and inspection.

J. Install branch tie-in lines to parallel compressors equal length, and pipe identically and symmetrically.

K. Slope refrigerant piping as follows:

1. Install horizontal hot gas discharge piping with 1/2" per 10 feet downward slope away from the compressor.
2. Install horizontal suction lines with 1/2 inch per 10 feet downward slope to the compressor, with no long traps or dead ends which may cause oil to separate from the suction gas and return to the compressor in damaging slugs.

3. Install traps and double risers where indicated, and where required to entrain oil in vertical runs.
4. Liquid lines may be installed level.

L. Install unions to allow removal of solenoid valves, pressure regulating valves, expansion valves, and at connections to compressors and evaporators

M. When brazing, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion valve bulb

N. Install moisture/liquid indicators in liquid lines between filter/driers and thermostatic expansion valves, in liquid line to receiver and on leaving side of liquid solenoid valves.

1. Install moisture/liquid indicators in lines larger than 2-1/8 inch OD, using a bypass line.

O. Install strainers immediately ahead of each automatic valve, expansion valve, solenoid valve, hot gas bypass valve, compressor suction valve, and as required to protect refrigerant piping system components.

P. Install strainers in main liquid line where multiple expansion valves with integral strainers are used

Q. Install strainers in suction line of steel pipe

R. Install pressure relief valves on ASME receivers; pipe discharge to outdoors

S. Install replaceable-core filter-dryers in vertical liquid line adjacent to receivers and before each solenoid valve.

T. Install permanent filter-dryers in low-temperature systems, in systems using hermetic compressors, and before each solenoid valve

U. Install solenoid valves in liquid line of systems operating with single pump-out or pump-down compressor control, in liquid line of single or multiple evaporator systems, and in oil bleeder lines from flooded evaporators to stop flow of oil and refrigerant into suction line when system shuts down

V. Install receivers, sized to accommodate pump-down charge, on systems 5 tons and larger and on systems with long piping runs

W. Install flexible connectors at the inlet and discharge connection of compressors.

X. Install refrigerant valves where indicated, and in accordance with manufacturer's instructions.

Y. Install globe valves on each side of strainers and driers, in liquid and suction lines at evaporators, and elsewhere as indicated.

Z. Install check valves in compressor discharge lines and in condenser liquid lines on multiple condenser systems

AA. Install packed-angle valve in liquid line between receiver shutoff valve and thermostatic expansion valve for system charging

BB. Install diaphragm packless or packed-angle valves on each side of strainers and dryers, in liquid and suction lines at evaporators, and elsewhere as indicated

CC. Install a full sized, 3-valve bypass around each drier.

DD. Install solenoid valves ahead of each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at the top.

1. Electrical wiring for solenoid valves is specified in Division 26 and 230900. Coordinate electrical requirements and connections.

EE. Thermostatic expansion valves may be mounted in any position, as close as possible to the evaporator.

1. Where refrigerant distributors are used, mount the distributor directly on the expansion valve outlet.
2. Install the valve in such a location so that the diaphragm case is warmer than the bulb.
3. Secure the bulb to a clean, straight, horizontal section of the suction line using two bulb straps. Do not mount bulb in a trap or at the bottom of the line.
4. Where external equalizer lines are required make the connection where it will clearly reflect the pressure existing in the suction line at the bulb location.

FF. Install pressure regulating and relieving valves as required by ASHRAE Standard 15. Pipe pressure relief valve discharge to safe location outdoors

GG. Verify actual evaporator applications and operating conditions, and adjust thermostatic expansion valve to obtain proper evaporator superheat requirements.

HH. Adjust controls and safeties. Replace damaged or malfunctioning controls and equipment with new materials and products.

II. Charge system using the following procedure:

1. Install core in filter dryer after leak test but before evacuation.
2. Evacuate refrigerant system with vacuum pump; until temperature of 35 deg F is indicated on vacuum dehydration indicator.
3. During evacuation, apply heat to pockets, elbows, and low spots in piping.
4. Maintain vacuum on system for minimum of 5 hours after closing valve between vacuum pump and system.
5. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psi.
6. Complete charging of system, using new filter dryer core in charging line. Provide full operating charge.

JJ. Train Owner's maintenance personnel on procedures and schedules related to start-up and shut-down, troubleshooting, servicing, and preventative maintenance of refrigerant piping valves and refrigerant piping specialties.

KK. Refrigerant Installation and Disposal: Perform all work related to refrigerant contained in chillers, cooling coils, air conditioners, and similar equipment, including related piping, in strict accordance with the following requirements:

1. ASHRAE Standard 15 and Related Revisions: Safety Code for Mechanical Refrigeration.
2. ASHRAE Standard 34 and Related Revisions: Number Designation and Safety Classification of Refrigerants.
3. United States Environmental Protection Agency (US EPA) requirements of Section 808 (Prohibition of Venting and Regulation of CFC) and applicable State and local regulations of authorities having jurisdiction.

LL. Recovered refrigerant is the property of the Contractor. Dispose of refrigerant legally, in accordance with applicable rules and regulations of authorities

## 3.8 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.

## 3.9 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 buttwelding 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 buttwelding tee fittings.

G. Shop welded pipe assemblies shall have all welds plainly stamped by the welding operator for inspection by the Engineer before installation.

## 3.10 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.

## 3.11 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.

**3.12 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.

**3.13 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.

**3.14 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.

**3.15 FLUSHING AND CLEANING OF PIPING**

A. Flush the following piping systems:

1. Domestic Cold Water
2. Domestic Hot Water
3. Heating Hot Water Supply and Return

B. Clean the following piping systems:

1. Heating Hot Water Supply and Return

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. 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:

**3.16 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.

**3.17 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 PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing piping systems with following minimum working-pressure ratings, unless otherwise indicated:

1. Domestic Water Piping: 125 psig.
2. Sanitary Waste and Vent Piping: 10 foot head of water.
3. Storm Drainage Piping: 10 foot head of water.
4. Force-Main Piping: 100 psig.

### 1.3 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 the following:

1. Backflow preventers and water regulators
2. Balancing valves, water filters, and strainers
3. Thermostatic water mixing valves
4. Garbage disposal
5. Water hammer arresters, air vents, and trap seal primer valves and systems
6. Drain valves, hose bibbs, hydrants, and hose stations
7. Outlet boxes and washer-supply outlets
8. Backwater valves, cleanouts, floor drains, open receptors, trench drains, and roof drains
9. Air-admittance valves, vent caps, vent terminals, and roof flashing assemblies
10. Grease interceptors, grease recovery units, oil interceptors, and solids interceptors
11. Sleeve penetration systems

B. Shop Drawings: Diagram power, signal, and control wiring.

C. 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 and water tempering valves
4. Trap seal primer valves and systems
5. Hose stations and hydrants
6. Grease interceptors, grease recovery units, oil interceptors, and solids interceptors

### 1.4 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 Sections.

B. Plumbing specialties shall bear label, stamp, or other markings of specified testing agency.

C. 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.

D. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for piping materials and installation.

E. NSF Compliance:

1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components. Include marking "NSF-pw" on plastic potable-water piping and "NSF-dwv" on plastic drain, waste, and vent piping.
2. Comply with NSF 61, "Drinking Water System Components--Health Effects, Sections 1 through 9," for potable domestic water plumbing specialties.

**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. 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 MANUFACTURERS**

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products specified.
2. Products: Subject to compliance with requirements, provide one of the products specified.
3. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
4. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

**2.2 MISCELLANEOUS PIPING SPECIALTIES**

A. Water Hammer Arresters: ASSE 1010 or PDI-WH 201, piston type with pressurized metal-tube cushioning chamber. Sizes indicated are based on ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

1. Manufacturers:

a. MIFAB Manufacturing, Inc.
b. Josam Company
c. Watts Industries, Inc.; Drainage Products Division
d. Watts Industries, Inc.; Water Products Division
e. Zurn Industries, Inc.; Wilkins Division

B. 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.

C. Floor-Drain Inlet Fittings: Cast iron, with threaded inlet and threaded or spigot outlet, and trap seal primer valve connection.

## 2.3 SLEEVE PENETRATION SYSTEMS

A. Manufacturers:

1. ProSet Systems, Inc.
2. Other approved

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.

    a. Special Coating: Include corrosion-resistant interior coating on fittings for plastic chemical waste and vent stacks.

## 2.4 FLASHING MATERIALS

A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:

1. General Use: 4-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.

E. Fasteners: Metal compatible with material and substrate being fastened.

F. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

G. Solder: ASTM B 32, lead-free alloy.

H. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

## 2.5 CLEANOUTS

A. Cleanouts: Comply with [ASME A112.36.2M] [ASME A112.3.1] <Insert other>.

1. Application: Floor cleanout and wall cleanout.
2. Products:

    a. MIFAB Manufacturing, Inc., model C1220
    b. Josam Company
    c. Smith, Jay R. Manufacturing Company
    d. Tyler Pipe, Wade Division
    e. Watts Industries, Inc., Drainage Products Division
    f. Zurn Industries, Inc., Specification Drainage Operation, model Z1400

3. Body or Ferrule Material: Cast iron.
4. Clamping Device: Required.
5. Outlet Connection: Threaded.
6. Closure: Brass plug with straight threads and gasket.
7. Adjustable Housing Material: Set-screws or other device.
8. Frame and Cover Material and Finish: Stainless steel Z1469.
9. Frame and Cover Shape: Round.
10. Top Loading Classification: Heavy duty.

## 2.6 FLOOR DRAINS (REFER TO DRAWING FOR OUTLET SIZE(S))

A. Floor Drains: Comply with ASME A112.21.1M.

1. Application: Type FD-1.
2. Products:

    a. Smith, Jay R. Manufacturing Company, model 2010-T
    b. Zurn Industries, Inc., model ZN-415-SPY
    c. Tyler Pipe, Wade Division
    d. Josam Company
    e. MIFAB Manufacturing, Inc., model F1100C-S6-5-7-1-3

3. Body Material: Gray iron.
4. Seepage Flange: Required.
5. Clamping Device: Required.
6. Outlet: Bottom.
7. Exposed Surfaces and Interior Lining: Not required.
8. Sediment Bucket: Required.
9. Top or Strainer Material: Polished nickel bronze.
10. Top of Body and Strainer Finish: Polished nickel bronze.
11. Top Shape: Square.
12. Dimensions of Top or Strainer: 6 x 6 inch.
13. Top Loading Classification: Medium Duty.
14. Funnel: Not required.
15. Inlet Fitting: Not required.
16. Trap Material: Cast iron.
17. Trap Pattern: Deep-seal P-trap.
18. Trap Features: 1/2" trap seal primer valve drain connection.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Refer to Section 22 0510 "Basic Mechanical Materials and Methods" for piping joining materials, joint construction, and basic installation requirements.

B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.

1. Locate backflow preventers in same room as connected equipment or system.
2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
3. Do not install bypass piping around backflow preventers.

C. Install garbage disposal per manufacturer’s recommendations. Coordinate power receptacle location with the electrical contractor

D. Install pressure regulators with inlet and outlet shutoff valves and balance valve bypass. Install pressure gages on inlet and outlet.

E. Install strainers on supply side of each control valve, pressure regulator, and solenoid valve.

F. Install draining-type ground hydrants with 1 cu. yd. of crushed gravel around drain hole.

1. Set ground hydrants with box flush with grade.
2. Set post hydrants in concrete paving or in 1 cu. ft. of concrete block at grade.

G. Install trap seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

H. 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.

I. Install expansion joints on vertical risers, stacks, and conductors if indicated.

J. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.

K. Install cleanout deck plates with top flush with finished floor, for floor cleanouts for piping below floors.

L. Install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall, for cleanouts located in concealed piping.

M. Install flashing flange and clamping device with each stack and cleanout passing through floors with waterproof membrane.

N. Install vent-flashing sleeves on stacks passing through roof. Secure over stack flashing according to manufacturer's written instructions.

O. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.

P. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:

    a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
    b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
    c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.

3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

Q. 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.

R. Fasten recessed-type plumbing specialties to reinforcement built into walls.

S. Install wood-blocking reinforcement for wall mounting and recessed-type plumbing specialties.

T. Install individual shutoff valve in each water supply to plumbing specialties. Use ball, gate, or globe valve if specific valve is not indicated. Install shutoff valves in accessible locations. Refer to Division 15 Section "Valves" for general-duty ball, butterfly, check, gate, and globe valves.

U. Install air vents at piping high points. Include ball valve in inlet.

V. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

W. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

## 3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Connect plumbing specialties to piping specified in other Division 22 Sections.

D. Ground equipment.

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.

F. Connect plumbing specialties and devices that require power according to Division 26 Sections.

G. Interceptor Connections: Connect piping, flow-control fittings, and accessories.

1. 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.
2. Grease Recovery Units: Connect inlet, outlet, and vent piping; controls; electric power; and factory-furnished accessories to unit.
3. 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.
4. Solids Interceptors: Connect inlet and outlet.

**3.3 FLASHING INSTALLATION**

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

1. Lead Sheets: Burn joints of lead sheets 6-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4-lb/sq. ft., 0.0625-inch thickness or thinner.
2. Copper Sheets: Solder joints of copper sheets.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Sections

F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

**3.4 CASEWORK**

A. Install supply, drainage and vent, piping to and within the casework and hoods. Provide drops to casework and hoods and including final connection to the building service rough-in connection. This includes such items as gas, water or other supplies.

B. Plumbing equipment supports required with the casework shall be supplied and installed as part of the casework.

C. Sinks and fixtures that are not an integral part of the countertop such as epoxy or stainless steel sinks in chemical resistant counter tops shall be set as follows:

1. Stainless steel sinks complete as part of the Work under this Section.
2. Cutouts required for sinks, pedestal, faucets, service fixtures mounted on casework or countertops shall be made as part of the casework in the shop or field for use by the Contractor.

## 3.5 HANDICAPPED PLUMBING FIXTURE INSTALLATION

A. Installation of handicapped plumbing fixture must comply with Michigan Department of Labor - Barrier Free Design Rules (latest edition). Quantity and mounting heights of water closets, urinals, lavatories and drinking fountains must comply with rules in effect when project is being engineered.

## 3.6 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate on or near each backflow preventer.

1. Text: Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit.
2. Refer to Section 15075 “Mechanical Identification" for nameplates and signs.

## 3.7 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.

**END OF SECTION 22 1119**

# 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 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.

### 1.3 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.

### 1.4 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. Urinal Flushometer: ASSE 1037, ANSI/ASME 112.19.6.

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.

## 1.5 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 Lavatory Support, Type II, lavatory carrier with concealed arms and tie rod.

1. Manufacturers:

a. Zurn
b. Josam
c. Tyler Pipe, Wade Division
d. J. R. Smith
e. MI-Fab

2. Accessible Fixture Support: Include rectangular steel uprights.

### 2.3 WATER TEMPERING VALVES

A. Manufacturers:

1. Sparco, Inc.
2. Watts Industries, Inc.; Water Products Division
3. Conbraco Industries, Apollo Division 34D
4. Armstrong Rada
5. Wilkins
6. Symmons

B. General: Manually adjustable, thermostatically controlled water tempering valve; bronze body; and adjustable temperature setting ASSE1070.

C. System Water Tempering Valves: Piston or discs controlling both hot- and cold-water flow, capable of limited anti-scald protection. Include threaded inlets and outlet.

1. Finish: Rough bronze.

D. Limited-Volume, Water Tempering Valves: Solder-joint inlets and NPS 3/4 maximum outlet.

### 2.4 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. Plumberex Pro-2000 Series

b. True Bro Lav-Guard
c. Sanitary Dash
d. Skal-Gard
e. Just Manufacturing Company, model J-ADA-125/150

## 2.5 LAVATORY FAUCETS

A. Lavatory Faucet, LF-1: Single lever 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, 2175-506 Colony Soft

2. Maximum Flow Rate: 1.2 gpm, unless otherwise indicated.
3. Body Material: Copper or brass underbody with brass cover plates.
4. Finish: Polished chrome plate.
5. Type: Single-control mixing.
6. Centers: 4 inches.
7. Mounting: Deck, exposed.
8. Handle(s): Lever.
9. Spout: Rigid.
10. Spout Outlet: Aerator.

## 2.6 LAVATORIES

A. Lavatories, LAV-1: Wall hanging, vitreous-china fixture. Fixture shall be installed to comply with all ADA requirements.

1. Manufacturers:

a. Kohler Company
b. American Standard, Inc. “Lucerne”, model 0355.012
c. Crane Plumbing/Fiat Products
d. 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**:** LF-1.
8. Supplies: NPS 3/8 chrome-plated copper with stops.
9. Drain: Fixed grid strainer.
10. Drain Piping: Offset 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. Protective Shielding Guard on Water and Drain Line: PSG-1.
12. Fixture Support: Concealed arms.
13. Mixing Valve: Water mixing valve.

## 2.7 SINK FAUCETS

A. Sink Faucet, SF-1: 11" Gooseneck, double lever with hot and cold-water indicators. Coordinate faucet inlets with supplies and fixture holes and outlet with spout and fixture receptor.

1. Manufacturers:

   a. Delta, 3579LF-WFLGHDF
   b. American Standard,
   c. Eljer,
   d. Just Manufacturing Company
   e. Moen

2. Maximum Flow Rate: 1.2 gpm, unless otherwise indicated.
3. Body Material: Copper or brass underbody with brass cover plates.
4. Finish: Polished chrome plate.
5. Type: Double control mixing.
6. Mounting: Deck, exposed.
7. Handle(s): Two handle widespread.
8. Spout: Rotating.
9. Spout Outlet: Aerator.

## 2.8 SINKS

A. Sink, SK-1: Classroom, single bowl undermount, seamless, "satin" finish, AISI Type 304 stainless steel, 18 gage. Coat underside with sound deadening non-marring mastic.

1. Manufacturers:

   a. Elkay, ELUHAD121245
   b. Just Manufacturing Company
   c. Kohler
   d. Dayton Products, Inc.

2. Type: Undermount.
3. Overall Rectangular Size: 14-1/2" x 14-1/2" overall, 12" x 12" x 4-3/8" deep inside bowl.
4. Faucet Hole Punching SF-3: 3 hole counter mount.
5. Faucets: SF-3.
6. Supplies: NPS 3/8 chrome-plated brass with stops.
7. Drain: Fixed grid strainer.
8. Provide ASSE 1070 mixing valve.

B. 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.

## 2.9 WATER CLOSET FLUSHOMETERS

A. Flushometer, WC-1: Cast-brass body with corrosion-resistant internal components, non-hold-open feature, control stop with check valve, vacuum breaker, and copper or brass tubing, and polished chrome-plated finish on exposed parts.

1. Manufacturers:

   a. Delany
   b. Sloan, model 111-1.6-YG-G
   c. Zurn

2. Internal Design: Diaphragm or piston operation.
3. Style: Exposed.
4. Inlet Size: NPS 1.
5. Trip Mechanism: Oscillating, lever-handle actuator.
6. Consumption: 1.6 gallons/flush.
7. Tailpiece Size: NPS 1-1/4 or 3/4 inch and standard length to top of bowl.

**2.10 TOILET SEATS**

A. Toilet Seat, TS-1: Solid plastic, with extended back with STA-TITE commercial fastening system.

1. Manufacturers:

a. Beneke
b. Church
c. Bemis
d. Kohler
e. 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.

**2.11 WATER CLOSETS**

A. Water Closets, WC-1: Floor-mounting, floor-outlet, vitreous china fixture designed for flushometer valve operation. Fixture shall be installed to comply with all ADA requirements.

1. Manufacturers:

a. American Standard, Inc.
b. Crane Plumbing/Fiat Products
c. Kohler Company “Highcliff”, model K-96057
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: 1.6 gallons/flush.
6. Color: White.
7. Supply: NPS 1-1/2 chrome plated brass or copper with loose-key stop.
8. Flushometer: WC-1.
9. Toilet Seat: TS-1.

**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 22 0523 "General-Duty 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 22 0510 "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 Division 07 Sections for sealant and installation requirements.

**3.3 INSTALLATION OF WATER CLOSETS - BARRIER FREE**

A. Mounting Heights:

1. Water Closets – Barrier Free: 18" from top of toilet seat to finished floor.

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. Install the electric eye plate, flush with the wall as recommended per the manufactures 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.

**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).

| Item | Waste | Vent | Trap | Cold | Hot |
|---|---|---|---|---|---|
| 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 |
| 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 Division 22 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 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 plenum ceilings, utilized for supply air, to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.

K. Examine strainers for clean screens and proper perforations.

L. Examine 3-way valves for proper installation for their intended function of diverting or mixing fluid flows.

M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

N. Examine open-piping-system pumps to ensure absence of entrained air in the suction piping.

O. Examine equipment for installation and for properly operating safety interlocks and controls.

P. 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.

Q. 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. Determine the best locations in main and branch ducts for accurate duct airflow measurements.

D. 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.

E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

F. Verify that motor starters are equipped with properly sized thermal protection.

G. Check dampers for proper position to achieve desired airflow path.

H. Check for airflow blockages.

I. Check condensate drains for proper connections and functioning.

J. Check for proper sealing of air-handling unit components.

K. 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 PROCEDURES FOR MULTIZONE SYSTEMS

A. Position the unit's automatic zone dampers for maximum flow through the cooling coil.

B. The procedures for multizone systems will utilize the zone balancing dampers to achieve the indicated airflow within the zone.

C. After balancing, place the unit's automatic zone dampers for maximum heating flow. Retest zone airflows and record any variances.

D. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

a. Set outside-air, return-air and relief-air dampers for proper position that simulates minimum outdoor air conditions.
b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

2. Measure fan static pressures as follows:

    a. Measure static pressure directly at the fan outlet or through the flexible connection.
    b. Measure static pressure directly at the fan inlet or through the flexible connection.
    c. Measure static pressure across each component that makes up the air-handling system.
    d. Report artificial loading of filters at the time static pressures are measured.

3. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
4. Obtain approval Architect for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

E. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.

1. Measure airflow of submain and branch ducts.
2. Adjust submain and branch duct volume dampers for specified airflow.
3. Re-measure each submain and branch duct after all have been adjusted.

F. Adjust air inlets and outlets for each space to indicated airflows.

1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
2. Measure inlets and outlets airflow.
3. Adjust each inlet and outlet for specified airflow.
4. Re-measure each inlet and outlet after they have been adjusted.

G. Verify final system conditions.

1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to match design if necessary.
2. Re-measure and confirm that total airflow is within design.
3. Re-measure all final fan operating data, rpms, volts, amps, and static profile.
4. Mark all final settings.
5. Test system in economizer mode. Verify proper operation and adjust if necessary.
6. Measure and record all operating data.
7. Record final fan-performance data.

## 3.7 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.

## 3.8 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.

## 3.9 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.

## 3.10 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.

## 3.11 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.

## 3.12 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.

## 3.13 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. Field test reports prepared by system and equipment installers
2. 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

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. Air-Handling Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data: Include the following:

    a. Unit identification
    b. Location
    c. Make and type
    d. Model number and unit size
    e. Manufacturer's serial number
    f. Unit arrangement and class
    g. Discharge arrangement
    h. Sheave make, size in inches, and bore
    i. Sheave dimensions, center-to-center and amount of adjustments in inches
    j. Number of belts, make, and size
    k. Number of filters, type, and size

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

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. Filter static-pressure differential in inches wg
    f. Preheat coil static-pressure differential in inches wg
    g. Cooling coil static-pressure differential in inches wg
    h. Heating coil static-pressure differential in inches wg
    i. Outside airflow in cfm
    j. Return airflow in cfm
    k. Outside-air damper position
    l. Return-air damper position
    m. Vortex damper position

G. 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

H. Air-Terminal-Device Reports: For terminal units, include the following:

1. Unit Data: Include the following:

    a. System and air-handling unit identification
    b. Location and zone
    c. Test apparatus used
    d. Area served
    e. Air-terminal-device make
    f. Air-terminal-device number from system diagram
    g. Air-terminal-device type and model number
    h. Air-terminal-device size
    i. Air-terminal-device effective area in sq. ft.

2. Test Data: Include design and actual values for the following:

    a. Airflow rate in cfm
    b. Air velocity in fpm
    c. Preliminary airflow rate as needed in cfm
    d. Preliminary velocity as needed in fpm
    e. Final airflow rate in cfm
    f. Final velocity in fpm
    g. Space temperature in deg F

## 3.14 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.

## 3.15 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 Tridium/Niagara 4 Operator Interface System (OIS) including developed system graphics, point trends, equipment schedules, and system alarm annunciation.
3. 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.
4. 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.

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 electric distribution 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 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.

**1.8 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.

**1.9 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. Tridium/Honeywell WEBs N4 Building Control Systems – Honeywell Spyder

B. Acceptable Contractors:

1. ControlNET, LLC

**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 to the existing Owner Operator Interface System (OIS) 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.

I. All provided controls devices and systems shall be fully serviceable by Owner service technicians. The MSCC shall provide any applicable software tools, programs, and databases to the Owner service team as necessary to allow the Owner to self-perform full service and operation.

## 2.3 OPERATOR INTERFACE SYSTEM

A. General

1. The MSCC shall complete Systems Integration of all new controls to the existing Owner Operator Interface System (OIS) including but not limited to developed system graphics, point monitoring, point commanding, point trending, equipment operation schedule management, and system alarm configuration and annunciation. The MSCC shall upgrade the existing OIS as necessary to accommodate integration of all new controls.
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 keyplan 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 status and alarm states. Coloration shall be variable for each class of points, as chosen by the Owner.

j. 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 freezestat has tripped
e. Air Handling Unit discharge air temperature is +/-5°F of setpoint during occupied mode
f. Air Handling Unit end of duct static pressure is +/-0.5” WC of setpoint during occupied mode
g. Air Handling Unit return air relative humidity is >70%RH during occupied mode
h. Hydronic system liquid temperature is +/-5°F of setpoint when the system is enabled
i. Hydronic system pressure is +/-5 psi of setpoint when the system is enabled
j. Space/room temperature is <50°F or >90°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 & 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 & 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 VALVES

A. Valves shall be provided according to the details of this section, and in compliance with the related specification section “Valves”.

B. Valves shall be factory fabricated of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.

C. Valves shall be sized based on indicated system design flowrates, pressures, and temperatures.

D. Unless indicated otherwise, valve bodies NPS 2 inches and smaller shall be bronze with screwed end connections. Valve bodies NPS 2-1/2 inches and larger shall be cast iron with flanged end connections.

E. Manufacturer: Unless noted otherwise, valves shall be Belimo, Honeywell, Johnson, Siemens, or approved equal.

F. Ball valves

1. Fluid: Chilled or hot water (up to 50% glycol)
2. Pressure rating: 125 psi
3. Temperature rating: 250°F
4. Materials:

a. Valve body: Bronze
b. Seat: PTFE
c. Seals: EPDM
d. Ball: Nickel or chrome plated brass

5. Sizing: 3 psig maximum pressure drop at design flow rate.
6. Modulating valve flow characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.

G. Globe valves

1. Fluid: Chilled or hot water (up to 50% glycol) or steam
2. Pressure rating: 125 psi
3. Temperature rating: 250°F (water), 338°F (steam)
4. Materials:

a. Valve body: Bronze (2 inch and smaller), cast iron (2-1/2” and larger)

b. Seat: Stainless steel, Bronze (water 2 inch and smaller)
c. Seals: EPDM

5. Sizing: 3 psig maximum pressure drop at design flow rate.
6. Modulating valve flow characteristics: Two-way valves shall have equal percentage characteristics; three-way hydronic valves shall have linear characteristics.

H. Resilient seated butterfly valves

1. Fluid: Chilled or hot water (up to 50% glycol)
2. Pressure rating: 125 psi
3. Temperature rating: 250°F
4. Rangeability: Minimum 10:1
5. Materials:

a. Valve body: Ductile iron, full lug
b. Disc: Stainless steel
c. Shaft: Stainless steel
d. Seat: EPDM
e. Seals: EPDM

6. Sizing: 3 psig maximum pressure drop at design flow rate.
7. Modulating valve flow characteristics: Two-way valves shall have equal percentage characteristics; three-way control application with two valves shall have linear characteristics.

I. High performance butterfly valves

1. Fluid: Chilled or hot water (up to 50% glycol)
2. Pressure rating: 125 psi
3. Temperature rating: 250°F
4. Rangeability: Minimum 100:1
5. Materials:

a. Valve body: Carbon steel, full lug
b. Disc: 316 stainless steel
c. Shaft: Stainless steel
d. Seat: RTFE
e. Seals: TFE

6. Sizing: 3 psig maximum pressure drop at design flow rate.
7. Modulating valve flow characteristics: Two-way valves shall have equal percentage characteristics; three-way control application with two valves shall have linear characteristics.

J. Self-Contained Thermostatic Radiator Control Valve

1. Fluid: Hot water (up to 50% glycol) or steam
2. Pressure rating: 125 psi
3. Temperature rating: 250°F
4. Valve shall be selected and sized accordingly for the applicable Hot Water (including applicable % glycol mixture) or Steam system application.
5. Valve body shall include packing gland assembly that is replaceable while the system is in operation.
6. Valve shall be provided with integral thermostatic operator including an ambient air temperature sensor and space temperature setpoint adjustment dial capable with a setpoint range of at least 60 deg F to 85 deg F.
7. Contractor shall review the application and shall provide valve mounted operator and dial or remote mounted dial and sensor with capillary tube as necessary for proper temperature control and user temperature adjustment access.
8. Manufacturer: Danfoss (or approved equal)

K. Control Valve Systems Application

1. Hydronic heating or chilled water

a. 2 position valves

1) 2 inch and smaller: Ball valve
2) 2-1/2 inch and larger: Resilient seated butterfly valve

b. Modulating valves

1) 2 inch and smaller: Ball valve
2) 1 inch to 6 inch: Globe valve
3) 4 inch and larger: High performance butterfly valve

2. Steam: Globe valve

## 2.7 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.

## 2.8 TEMPERATURE & 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 85 degF, plus or minus 0.5 degF, 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
g. Outside Air (OA) temperature with a range of minus 40 to plus 130 degF, plus or minus 2 degF
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. 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

2. 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"

3. Low-Voltage, On-Off Thermostats: NEMA DC 3, 24-V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater.
4. 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.

5. Immersion Thermostat: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range and adjustable set point.
6. 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.

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.

## 2.9 GAS DETECTION INSTRUMENTS & 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. Manufacturer: ACI, Telaire, Vaisala, Veris

## 2.10 FLOW INSTRUMENTS

A. Airflow

1. Outside Air Louver Mounted

a. Provide where indicated, outside airflow measurement system with flow sensing elements mounted on the outside air louver, capable of continuously measuring the air volume capacity of the connected system.
b. Static Pressure Differential Type Airflow Measurement

1) The Outdoor Airflow Measurement System shall consist of a dedicated monitor / transmitter and flow sensing element(s) combined to create a complete system. The System shall be factory calibrated and configured based on the application and type of installation. The Airflow Measurement System shall be tested in accordance with ANSI/AMCA standard 610 and licensed to bear the AMCA Certified Ratings program seal for airflow measurement accuracy in accordance with AMCA Publication 611.
2) The Airflow Measurement System shall utilize the uniform static differential pressure field created by air moving across a fixed inlet that has a factory calibrated and AMCA certified flow equation. The system shall use the actual air stream temperature and absolute pressure to provide Actual and Standardized instantaneous airflow rate information.
3) The transmitter shall be housed in a NEMA 1 enclosure [NEMA 4X enclosure; NEMA 4X enclosure with heater and insulation], with an integral color graphic display and four button keypad for use during the configuration and field characterization process. The display shall be configurable to indicate four (4) measured process variables (volume, velocity, temperature, pressure) during normal operation. The transmitter shall utilize a pair of stacked transducers for each channel. The transmitter shall incorporate an absolute pressure sensing system in order to provide automatic airflow compensation at the installed elevation. The transmitter shall incorporate temperature sensor input(s) as required to perform continuous airflow density compensation for each channel. The Transmitter shall provide field configurable analog outputs designed to interface with the building automation system (BAS), including transmitter calculated total airflow. The ability to perform configuration changes and field characterization shall be accomplished via the user interface/display, the need for additional utility software shall not be required.
4) The flow sensing element(s) shall be constructed of 316 SS and only materials that are designed to resist corrosion due to the presence of salt or chemicals in the airstream. The flow sensing element(s) shall not be affected by the presence of moisture, dirt or debris in the airstream and shall not be affected by gusting wind. Flow sensing element types adversely affected by moisture in the airstream, such as thermal dispersion, shall not be allowed.
5) The Outdoor Airflow Measurement System shall provide airflow measurement accuracy of +/- 5% of reading within the factory calibrated velocity range. The System shall be capable of measuring outdoor airflow velocities from 100 to 3000 SFPM. The System's readings shall not be affected by the presence of moisture, dirt or debris in the airstream and shall be unaffected by gusting wind. The measured airflow shall be density corrected for ambient temperature variances and atmospheric pressure due to site altitude.
6) Manufacturer: Air Monitor

## 2.11 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. Liquid/Steam Pressure Sensors

1. Accuracy: 1% of full scale
2. Each pressure sensor shall include a pressure pickup line(s) connected to a pressure transducer.
3. Pressure transducer shall be selected and calibrated for operations between 0 and 200% of the maximum normal operating differential pressure.
4. The transducer shall not be damaged by pressures up to 500 psig on either side of the transducer and all wetted parts shall be inert on the presence of up to a 40% concentration of ethylene or polypropylene glycol in water.
5. Provide drain valve for each side of the pressure chamber. Furnish and install mounting brackets appropriate for the installation location.
6. Span and zero shall be individually adjustable.

C. 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.

## 2.12 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 equipment manufacturer's recommendation and requirements of the mechanical control systems.

## 2.13 PNEUMATIC COMPONENTS AND ACCESSORIES

A. Tubing

1. Copper tubing shall be new hard drawn, air grade, ASTM B75 for 3/8 inch and smaller or type L, ASTM B68 for 1/2 inch and larger, with solder joint or compression type fittings, at the option of the MSCC.
2. Plastic tubing (all sizes) shall be black virgin, polyethylene, ASTM D1248, Type 1, Class C, Grade 5, meeting crack test performance required by ASTM D1693 and be fire retardant (FR) rated. Multi-tube harness material shall be as specified above with a polyester film barrier and vinyl jacket not less than 0.062 inches thick. All non-metallic tubing shall be 1/4" O.D. minimum; micro-sleeve is not acceptable.

B. Differential Pressure Gauges

1. Description:

a. 2000 Series magnahelic differential pressure gauges shall provide an accurate indication of positive, negative, or differential air pressure. The gauge shall include a 4" (10.2 cm) easy to read dial and frictionless magnetic movement in cast aluminum housing and be resistant to shock, vibration, and overpressure. The 2000 Series has both back and side connections so that it may be either surface or flush mounted. Ranges are available from 0" to 0.25" W.C. up to 10" W.C. Select gauge for normal reading to be not less than 25% of full scale.

2. Features:

a. 2% full scale accuracy
b. Easy to read 4" (10.16 cm) white dial and red tipped pointer
c. Flush or surface mounting
d. Easily accessible zero adjustment
e. Corrosion resistant cast aluminum housing
f. Back and side connections

3. Specifications:

a. Accuracy: ± 2% of FS (3% on -0 and 4% on -00 ranges) throughout range @ 70 °F (21 °C).
b. Overpressure: Relief plug designed to open at 25 psig (172 kPa).
c. Ambient Temperature: 20 °F to 140 °F (-7 °C to 60 °C).
d. Rated Total Pressure: -20" Hg to 15 psig (103 kPa).
e. Connections: 1/8" NPT female high and low pressure taps, duplicated-one pair side and one pair back.
f. Housing: Die-cast aluminum, case and aluminum parts iridate-dipped to withstand 168 hour salt spray test, baked dark gray hammerloid exterior finish.
g. Standard Accessories: Two 1/8" NPT plugs for duplicate pressure taps, two 1/8" pipe thread to rubber tubing adapters, and three flush mounting adapters with screws.
h. Weight: 1.0 lb. (2.0 oz).
i. Warranty: 1 year.

C. Pneumatic/Electric Relays

1. Electric, two position type, range and element shall be suitable for the service. Single or two pole, normally open or normally closed as required. Pneumatic signal setpoint shall be adjustable over the full range. Switch rating shall be 15 amps at 120 VAC.

D. Electric/Pneumatic Relays

1. Electric, two position type, range and element shall be suitable for the service. Shall be suitable for field or panel mounting, have a 120 VAC coil, and 3 or 4 ports as applicable.

## 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 2 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. Flexible nonmetallic duct
7. Duct sealants
8. Duct cleaning and disinfecting
9. 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 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 DOWNSTREAM FROM TAU | +2 | G-90 | --- |
| TRANSFER DUCT | +2 | G-90 | --- |
| LINEAR SUPPLY/RETURN GRILLE PLENUM | +2 | G-90 | --- |
| PLENUMS | ± 6 | SAME AS DUCTS SERVED | --- |
| ABBREVIATIONS<br>EF = EXHAUST FAN<br>FCU = FAN COIL UNIT<br>RF = RETURN FAN<br>TAU = TERMINAL AIRFLOW UNIT | NOTES<br>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. 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

D. 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.

E. 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 FLEXIBLE DUCT

A. General

1. Flexible duct shall be UL listed, and shall maintain shape when installed. Sagging shall not exceed 1/2 in. per linear foot when installed horizontally.
2. Flexible duct shall not be used where system pressure is greater than plus or minus 2 in. w.g.
3. Insulated flex shall have a gray fire retardant polyethylene outer jacket with an 8 oz. density, 1-1/3 in. thick fiberglass insulation blanket, factory wrapped.
4. Flexible duct used on negative pressure systems shall be specifically rated for negative pressure use.
5. For connection to supply, return and exhaust diffusers/grilles located in horizontal ceilings, use pre-fabricated 90 degree plastic supports (Flexflow Elbow by Thermaflex), or 90 degree sheet metal elbow fittings.

B. Flexible Nonmetallic Duct

1. Flexible nonmetallic duct shall be constructed of sound transparent foil. Material shall be mechanically locked to the outside helix. Use of adhesives to lock fabric in place is not acceptable. The helix shall be constructed of corrosion resistant galvanized steel, formed and mechanically locked to the duct fabric on the outside to prevent tearing.
2. Flexible fabric duct shall be rated at 6 in. positive pressure and at 4 in. negative pressure.
3. Flexible nonmetallic duct shall be listed UL Class 1.
4. Acceptable Manufacturers

a. Flexmaster
b. Hart & Cooley.
c. Atco

## 2.4 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.

**2.5 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. Repair damaged galvanized surfaces with zinc rich paint.

H. Air volume control on parallel flow branches shall be accomplished with branch dampers. Splitter type dampers are not acceptable.

I. 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.

J. 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.

K. Provide required penetrations and sleeves in building structure.

**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 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. 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.

E. 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.

F. 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.

G. Do not hang ductwork from piping, ducts, other trades' hangers, existing hangers, or equipment.

H. Single band hangers are not acceptable on ducts greater than 24 in. diameter.

I. Provide supplemental steel required to support ductwork in shafts, mechanical rooms or on the floor where structural steel is not properly positioned.

J. 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.

K. Do not modify existing structural steel without approval of Project Manager and a structural engineer's review.

L. Provide clamping systems that are compatible with the structural steel system of the building.

M. Use angle iron "V" construction supports or similarly rigid construction for vertical ducting that requires lateral support.

N. 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.

O. 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.

## 3.4 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.

## 3.5 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.

## 3.6 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 (Lmax in cfm/100 ft2 of duct surface area):

    a. Lmax = 4 x 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.

## 3.7 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. Duct test holes.
3. Duct air turning vanes
4. Balance dampers

### 1.3 SUBMITTALS

A. Product Data: Submit performance data, rated capacities, furnished specialties, sound-power ratings, and accessories for each type of product.

B. Damper manufacturer's installation instructions.

### 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 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

## 2.2 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

## 2.3 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.

## 2.4 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

**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 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.

## 3.3 DUCT TEST HOLES INSTALLATION

A. Provide duct test holes where required for testing and balancing purposes and as shown on Drawings.

## 3.4 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.

## 3.5 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.

**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 1 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. This Section includes centrifugal fans [**and vent sets**].

### 1.3 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base air ratings on actual site elevations.

B. Operating Limits: Classify according to AMCA 99.

### 1.4 SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:

1. Certified fan performance curves with system operating conditions indicated
2. Certified fan sound-power ratings
3. Motor ratings and electrical characteristics, plus motor and electrical accessories
4. Material gages and finishes, including color charts
5. Dampers, including housings, linkages, and operators

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
2. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.

C. Coordination Drawings: Show fan room layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.

D. Maintenance Data: For centrifugal fans to include in maintenance manuals specified in Division 1.

### 1.5 REFERENCES

A. ANSI/AMCA Standard 99-16, “Standards Handbook”

B. ANSI/AMCA Standard 204-05, “Balance Quality and Vibration Levels for Fans”

C. ANSI/AMCA Standard 208-18, “Calculation of the Fan Energy Index”

D. ANSI/AMCA Standard 210-16, “Laboratory Methods of Testing Fans for Aerodynamic Performance Rating”

E. AMCA Publication 211-13, “Certified Ratings Program – Product Rating Manual for Fan Air Performance”

F. ANSI/AMCA Standard 300-08, “Reverberant Room Method for Sound Testing of Fans”

G. AMCA Publication 311-16, “Certified Ratings Program – Product Rating Manual for Fan Sound Performance”

H. AMBA - Method of Evaluating Load Ratings of Bearings ANSI-11 (r1999)

I. ANSI/AMCA Standard 500-D-18, "Laboratory Methods of Testing Dampers for Rating"

J. OSHA guideline 1910.212 – General requirements for Machine Guarding. (www.osha.gov)

K. OSHA guideline 1910.219 – General requirements for guarding safe use of mechanical power transmission apparatus. (www.osha.gov)

L. OSHA guideline 1926.300 – General requirements for safe operation and maintenance of hand and power tools. (www.osha.gov)

M. OSHPD – Office of Statewide Health Planning and Development and Special Seismic Certification Preapproval (OSP)

N. UL/cUL Standard 705, Power Ventilators

## 1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.

C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

## 1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations, with protective crating and covering.

B. Disassemble and reassemble units, as required for moving to the final location, 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.

## 1.9 WARRANTY

A. The warranty of this equipment is to be free from defects in material and workmanship for a period of 24 months from the purchase date. Any units or parts which prove defective during the warranty period will be replaced at the manufacturers’ option when returned to the manufacturer, transportation prepaid.

B. Motor Warranty is warranted by the motor manufacturer for a period of one year. Should motors furnished prove defective during this period, they should be returned to the nearest authorized motor service station.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Manufacturers:

1. Acme Engineering & Manufacturing Corporation
2. Aerovent; a Twin City Fan Company
3. Buffalo Forge Company/Howden Fan Company
4. Carrier Corporation
5. Cook, Loren Company
6. Greenheck

### 2.2 FAN HOUSING AND OUTLET

A. Fan housing to be aerodynamically designed with high-efficiency inlet, engineered to reduce incoming air turbulence.

B. Tubular fan housing shall be completely welded and coated with a minimum of 2-4 mils of Permatector (Polyester Urethane), electrostatically applied and baked. Finish color shall be RAL 7023, concrete grey. No uncoated steel parts will be allowed.

C. Housing and bearing support shall be constructed of welded structural steel members to prevent vibration and rigidly support the shaft and bearings.

D. All mixed flow housings shall include vanes to straighten airflow prior to exiting the fan discharge.

E. Units shall incorporate mounting system that allows for field rotation of the motor position. Bearing life shall not be reduced below specified level in different configurations. Units shall accommodate base mount or ceiling hung mounting without structural modifications to the fan.

F. An access door shall be supplied for impeller inspection and service.

G. OSHA compliant belt guard or motor cover to be included to completely cover the motor pulley and belt(s) (where applicable).

### 2.3 FAN IMPELLER

A. Fan impeller shall be mixed flow design. The impeller shall be electronically balanced both statically and dynamically to balance grade G6.3 per ANSI S2.19.

B. Fan impeller shall be manufactured with contoured blade profiles. Impellers constructed of steel are coated with a minimum of 2-4 mils of Permatector (Polyester Urethane), electrostatically applied and baked. Aluminum constructed impellers will be mill finish.

C. The wheel and fan inlet shall be carefully matched and shall have precise running tolerances for maximum performance and operating efficiency.

### 2.4 FAN MOTORS AND DRIVE

A. Motors shall meet or exceed EISA (Energy Independence and Security Act) efficiencies. Motors to be NEMA T-frame, 1800 or 3600 RPM, Totally Enclosed Fan Cooled (TEFC) with a 1.15 service factor with across the line starting or 1.15 service factor when used with variable frequency drive (VFD).

B. Drive belts and sheaves shall be sized for 150% of the fan operating brake horsepower, and shall be readily and easily accessible for service, if required.

C. Fan shaft to be turned and polished steel that is sized so the first critical speed is at least 25% over the maximum operating speed for each pressure class.

D. Fan shaft bearings shall be Air Handling Quality, bearings shall be heavy-duty grease lubricated, self-aligning ball or roller pillow block type.

E. Air Handling Quality bearings to be designed with low swivel torque to allow the outer race of the bearing to pivot or swivel within the cast pillow block. Bearings shall be 100% tested for noise and vibration by the manufacturer. Bearings shall be 100% tested to ensure the inner race diameter is within tolerance to prevent vibration.

F. Bearings shall be selected for a minimum basic rating fatigue life (L-10) of 80,000 hours at maximum operating speed for each pressure class.

G. Bearings shall have extended lube lines with Zerk fittings to allow for lubrication from the exterior of the fan.

**2.5 SOURCE QUALITY CONTROL**

A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

A. Install centrifugal fans level and plumb.

B. Support suspended units from structure using threaded steel rods and spring hangers. Vibration-control devices are specified in Section 20 0548 "Vibration and Seismic Controls."

C. Install units with clearances for service and maintenance.

**3.2 CONNECTIONS**

A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors.

B. Install ducts adjacent to fans to allow service and maintenance.

C. Ground equipment.

D. 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. Equipment Startup Checks:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
5. Verify lubrication for bearings and other moving parts.
6. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.

B. Starting Procedures:

1. Energize motor and adjust fan to indicated rpm.
2. Measure and record motor voltage and amperage.

C. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.

D. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Shut unit down and reconnect automatic temperature-control operators.

F. Replace fan and motor pulleys as required to achieve design airflow.

G. Repair or replace malfunctioning units. Retest as specified above after repairs or replacements are made.

## 3.4 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Lubricate bearings.

## 3.5 CLEANING

A. On completion of installation, internally clean fans according to manufacturer's written instructions. Remove foreign material and construction debris. Vacuum fan wheel and cabinet.

B. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

## 3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain centrifugal fans.

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 Section 01770 "Closeout Procedures."

3. Review data in maintenance manuals. Refer to Section 01782 "Operation and Maintenance Data."
4. Schedule training with Owner, through Architect, with at least seven days' advance notice.

**END OF SECTION 23 3400**

# SECTION 23 3600 - AIR TERMINAL UNITS

## 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 the following:

1. Single duct air terminals

### 1.3 SUBMITTALS

A. Product Data: Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories for each model indicated. Include a schedule showing drawing designation, room location, number furnished, model number, size, and accessories furnished.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring.

C. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating air outlets with other items installed in ceilings.

D. Maintenance Data: List of parts for each type of air terminal and troubleshooting maintenance guide to include in the maintenance manuals specified in Division 01.

### 1.4 QUALITY ASSURANCE

A. Listing and Labeling: Provide electrically operated air terminals specified in this Section that are listed and labeled.

1. The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100.
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.

B. NFPA Compliance: Install air terminals according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

C. Comply with NFPA 70 for electrical components and installation.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide air terminals by one of the following:

1. Price Industries.
2. Nailor Industries Inc.
3. Titus

## 2.2 SINGLE-DUCT AIR TERMINALS

A. Configuration: Volume-damper assembly inside unit casing. Locate control components inside protective metal shroud.

B. Casings: Steel or aluminum sheet metal of the following minimum thicknesses:

1. Upstream Pressure Side: 0.0239 inch steel.
2. Downstream Pressure Side: 0.0179 inch steel.
3. Upstream Pressure Side: 0.032 inch aluminum.
4. Downstream Pressure Side: 0.025 inch aluminum.

C. Casing Lining: Minimum of 1/2 inch thick, neoprene- or vinyl-coated, fibrous-glass insulation; 1.5 lb/cu. ft. density, complying with NFPA 90A requirements and UL 181 erosion requirements. Secure lining to prevent delamination, sagging, or settling.

1. Coat liner surfaces and edges with erosion-resistant coating or cover with perforated metal.
2. Cover liner with perforated metal.
3. Cover liner with Mylar film.
4. Cover liner with Tedlar film.

D. Plenum Air Inlets: Round stub connections or S-slip and drive connections for duct attachment.

E. Plenum Air Outlets: S-slip and drive connections.

F. Access: Removable panels to permit access to dampers and other parts requiring service, adjustment, or maintenance; with airtight gasket and quarter-turn latches.

G. Volume Damper: Construct of galvanized steel with peripheral gasket and self-lubricating bearings.

1. Maximum Damper Leakage: 2 percent of nominal airflow at 3 inch wg inlet static pressure.
2. Damper Position: Refer to Control Drawings.

H. Round Outlet: Discharge collar matching inlet size.

I. Hot-Water Heating Coil: Two (2) roll, 1/2 inch copper tube, mechanically expanded into aluminum-plate fins; leak tested underwater to 200 psig; and factory installed.

J. Controls: Damper operator, thermostat, and other devices compatible with temperature controls specified in other Division 23 Sections.

K. Electric Controls: 24-V damper actuator with wall-mounted electric thermostat and appropriate mounting hardware.

L. Electronic Controls: By Controls Contractor (see Section 23 0900 “Instrumentation & Control for HVAC”) including bidirectional damper operator and microprocessor-based controller with integral airflow transducer and room sensor. Coordinate with Controls Contractor as necessary for a complete system.Provide control with the following features:

1. Proportional plus integral control of room temperature
2. Time-proportional reheat-coil control
3. Occupied/unoccupied operating mode
4. Remote reset of airflow or temperature set points
5. Adjusting and monitoring with portable terminal
6. Communication with temperature-control system specified in other Division 15 Sections

### 2.3 SOURCE QUALITY CONTROL

A. Testing Requirements: Test and rate air terminals according to ARI 880, "Industry Standard for Air Terminals."

B. Identification: Label each air terminal with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and ARI certification seal.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Install air terminals level and plumb, according to manufacturer's written instructions, rough-in drawings, original design, and referenced standards; and maintain sufficient clearance for normal service and maintenance.

B. Connect ductwork to air terminals according to Division 23 ductwork Sections.

### 3.2 CONNECTIONS

A. Install piping adjacent to air terminals to allow service and maintenance.

B. Hot-Water Piping: In addition to requirements in this specification connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange.

C. 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.

### 3.3 FIELD QUALITY CONTROL

A. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Air terminal unit will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

### 3.4 CLEANING

A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes.

### 3.5 COMMISSIONING

A. Verify that installation of each air terminal is according to the Contract Documents.

B. Check that inlet duct connections are as recommended by air terminal manufacturer to achieve proper performance.

C. Check that controls and control enclosure are accessible.

D. Verify that control connections are complete.

E. Check that nameplate and identification tag are visible.

F. Verify that controls respond to inputs as specified.

**3.6 DEMONSTRATION**

A. Engage a factory-authorized service representative to 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 maintenance manuals. Refer to Section "Closeout Procedures".
3. Review data in the maintenance manuals. Refer to Section 01782 "Operation and Maintenance Data."
4. Schedule training with Owner, through Architect, with at least 7 days' advance notice.

**END OF SECTION 23 3600**

# 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 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.

### 1.3 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.

B. Coordination Drawings: Reflected ceiling plans and wall elevations drawn to scale to show locations and coordination of diffusers, registers, and grilles with other items installed in ceilings and walls.

C. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for diffusers, registers, and grilles with factory-applied color finishes.

D. Samples for Verification: Of diffusers, registers, and grilles, in manufacturer's standard sizes, showing the full range of colors. Prepare Samples from the same material to be used for the Work.

### 1.4 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 Sections.

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 MANUFACTURED UNITS

A. Diffusers, registers, and grilles are scheduled at the end of this Section.

B. Diffusers, registers, and grilles are scheduled on Drawings.

### 2.2 SOURCE QUALITY CONTROL

A. Testing: Test performance according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

### 2.3 DIFFUSERS

A. Manufacturers:

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

   a. Air Systems Components; Krueger Div.
   b. Price.
   c. Nailor Industries Inc.
   d. Titus.

2. Accessories: Include the following:

   a. Equalizer deflectors.
   b. Smudge ring.
   c. Plaster ring.
   d. Extractor.
   e. Blank-off panel.
   f. Operating keys.

### 2.4 REGISTERS

A. Manufacturers:

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

   a. Air Systems Components; Krueger Div.
   b. Price.
   c. Nailor Industries Inc.
   d. Titus.

2. Accessories: Include plaster frame.

### 2.5 GRILLES

A. Manufacturers:

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

   a. Air Systems Components; Krueger Div.
   b. Price.
   c. Nailor Industries Inc.
   d. Titus.

2. Accessories: Include plaster frame.

## 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. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, locate units in the grid. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connection to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

### 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 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 and to the following Division 28 Sections: fire alarm systems, mass notification systems, and emergency response systems.

### 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 and Division 28 sections
13. Related work specified in other Divisions
14. Systems provided by Owner

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. Electrical demolition work
b. Temporary services
c. Cutting and patching
d. Chases and recesses
e. Excavation and backfill
f. Equipment foundations and supports
g. Coordination with other trades
h. Assembly and connection of equipment
i. 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, Division 28 Sections that this section applies to per paragraph 1.1 Related Documents, 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. 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.

E. 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 and Division 28 Sections that this section applies to per paragraph 1.1 Related Documents 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 AND DIVISION 28 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, Division 28 Sections that this section applies to per paragraph 1.1 Related Documents, and as indicated on Drawings.

B. Provide empty raceway systems consisting of conduits, wireways, surface raceways, nylon pull strings, outlet boxes, pull boxes, cover plates and cable trays as indicated for telephone, data, and audio/video wiring, for work specified in all Division 27 Sections, and for work specified in all Division 28 Sections.][Division 28 Sections that this section does not apply to per paragraph 1.1 Related Documents.

## 1.15 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. Furnishing and mounting of all electric motors – Divisions 14, 21, 22 and 23.

B. 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.

C. Furnishing and wiring of low voltage thermostats – Division 23.

D. Furnishing and installing low voltage instrumentation and control wiring – Divisions 21, 22 and 23, except where otherwise indicated.

E. 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.

F. Furnishing and installing of food service equipment and control wiring including integral controls and power – Division 11.

G. Furnishing of receptacles, switches, device plates, supports, and enclosures on laboratory equipment – Division 12.

H. Furnishing and installing field prime and finish painting – Division 09, except as specified in Division 26 Sections and Division 28 Sections that this section applies to per paragraph 1.1 Related Documents.

I. Telephone equipment and wiring – Division 27.

J. Audio/Video equipment and wiring – Division 27.

K. Data LAN equipment and wiring – Division 27.

**PART 2 - PRODUCTS**

**2.1 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.

**2.2 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.

**2.3 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.

**2.4 EXPANSION FITTINGS**

A. Provide expansion fittings in all conduits and cable trays that cross building expansion joints, both in concrete slabs and where exposed, and provide bonding jumpers where required to maintain electrical continuity.

**2.5 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 ELECTRICAL DEMOLITION WORK**

A. General: Perform electrical 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 this Contractor, this Contractor shall include the premium time in his Base Bid.

C. The associated raceway system (conduit, boxes, supports, etc.) and wire of equipment indicated to be demolished shall be removed from the equipment back to the source as noted below:

1. Power: Remove raceway system and wire back to the panel or power source.

   a. When the circuit originates from the panel and serves no other loads, remove raceway system and wire back to the panel, and relabel the associated circuit breaker or fused switch as "spare".
   b. When the circuit originates from a panel but continues on to other loads not intended to be demolished, remove raceway system and wire back to first junction box.
   c. When the removal of the circuit to the equipment to be demolished affects "downstream" devices not indicated to be demolished, re-feed "downstream" devices.

2. Fire alarm wiring: Remove as indicated on the Drawings. Fire alarm system shall remain operational during building occupied hours in all tenant occupied spaces.
3. Data system wiring, telephone wiring, or other auxiliary systems wiring: Remove raceway system and wiring back to communication room or other source.
4. Raceway systems in walls to remain: Abandon raceway systems in place and install blank cover plates.
5. Raceway systems above accessible ceilings or other accessible locations: Remove raceway systems.

D. Perform a circuit trace prior to deactivating feeders and branch circuits to ensure maintaining electrical power in adjacent unrenovated area.

E. Conduit being demolished that is installed in floor slabs shall be cut 1/2 inch below the floor, and the floor shall be patched.

F. Where applicable, existing in-place raceway systems (conduit, boxes, supports, etc.) may be reused for new work providing that the installation is in accordance with requirements for new work found in Division 26 Sections and Division 28 Sections that this section applies to per paragraph 1.1 Related Documents.

G. Where equipment or fixtures are removed, outlets shall be properly blanked-off and conduits shall be capped. After alterations are completed, the entire installation shall present a "finished" look, as approved by the Architect/Engineer. The original function of the present electrical work to be modified shall not be changed unless required by the specific revisions to the system as specified or as indicated.

H. Materials salvaged from this work shall not be reused except where reuse is specifically indicated.

I. Existing fixtures and electrical 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.

J. Existing fixtures and electrical 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.

**3.2 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.

## 3.3 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 cutting of holes through the existing building construction shall only be done by the use of abrasive saws and rotary coring machines. The use or hammer and drill points will not be permitted. The openings shall not be cut larger than necessary for the installation of the electrical 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 Architect/Engineer.

D. Cutting of holes through floors and walls shall be done only at such locations as directed by the Architect/Engineer.

E. Cooperate with the other Trades so that all cutting and repairing in any given area will be done simultaneously.

F. Electrical work which may interfere with building systems uncovered by the cutting of new openings in the present building including but not limited to piping, ducts, or other mechanical equipment as well as conduits and outlets shall be removed at the direction of the Architect/Engineer.

## 3.4 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, 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 and disconnect switches 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.

## 3.5 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.

**3.6 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, 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.

**3.7 FIELD QUALITY CONTROL**

A. Testing Conduits: 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.

**END OF SECTION 26 0500**

# SECTION 26 0519 – LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (0-600V)

## 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 structures electrical systems under 600 volts.
2. Wire and cable systems as required, and all material and equipment, including wire, cable, connectors, lugs, fittings, and identification, as indicated or specified.

### 1.3 SUBMITTALS

A. General: Submit the following according to the Conditions of the Contract and Division 01 Specification Sections.

1. Conductors - Each type and size of wire and cable. Identify material, construction data, insulation thickness, and jacket thickness.

### 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 260570.

### 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

A. General Requirements: Furnish wire and cable per standard specifications established for such material and construction by ASTM, ANSI, IPCEA and NEMA, where applicable. All conductors shall be copper unless otherwise specified. Feeders 100 amperes and above shall be aluminum. 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 #14 AWG shall be as specified in the sections requiring use of such conductors.

1. Manufacturer: Provide products of one of the following:

a. Cerro Wire
b. Encore

c. General Cable Corporation
d. Prysmian
e. Republic Wire
f. Southwire
g. United Copper Industries

B. Wire for General Interior and Exterior Use: Single conductor, annealed copper, NEC Type XHHW, THHN and THHW rated 90°degC or THHN/THWN rated 90 degC in dry locations and 75 degC in wet locations, or NEC Type THW, THWN and XHHW rated 75 degC, all with 600 volt insulation.

C. Wire for Underground Service Entrance: Single conductor, annealed copper, NEC Type USE rated 75 degC, 600 volts.

D. Wire for Direct Burial or In Underground Duct or Conduit: Single or multi-conductor, as indicated on the Drawings, NEC Type USE rated 75 degC, 600 volts.

E. Wire for Use in High Temperature Areas as Indicated: Single conductor annealed copper, NEC Type FEP or PFA rated 200 degC, 600 volts.

F. Cable types MC, MI, NM, NMC or 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 type.

1. Manufacturer: Provide one of the following:

a. Burndy "Hylink”
b. Panduit
c. Thomas & Betts "Sta-Kon"

B. Connectors for Straight Splicing Conductors No. 6 AWG and Larger: Uninsulated solderless compression 2-way type.

1. Manufacturer: Provide one of the following:

a. Burndy “Hylink”
b. Thomas & Betts 54500 Series

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. Buchanan
b. Ideal
c. Scotchlok

D. Connectors for 3-Way Splicing Conductors No. 6 AWG and Larger: Uninsulated solderless compression type.

1. Manufacturer: Provide one of the following:

a. Burndy “Hylink”
b. Thomas & Betts 54700 Series

E. Connectors for termination of motor loads to branch circuits: Set screw type, clean insulation for termination inspection multitap.

1. Manufacturer: Provide one of the following:

a. Burndy Clear UNITAP
b. Thomas & Betts CSB

**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.

1. Manufacturer: Provide one of the following:

a. Burndy Type YA-L
b. Thomas & Betts Series 54000

C. Lugs for Terminating Control and Switchboard Wiring: Solderless compression type with tinned ring tongue.

1. Manufacturer: Provide one of the following:

a. Burndy "Hylug"
b. Thomas & Betts "Sta-Kon"

**2.4 INTERLOCKED ARMOR CABLE FITTINGS**

A. Splicing Sleeves: Metal enclosed, air-filled type for indoor use and compound-filled for outdoor use, equipped with terminators as specified below.

1. Manufacturer: Provide one of the following:

a. G & W Electric Specialty Company
b. PLM Products Division
c. Thomas & Betts

B. Terminators: Armor grounding type, non-watertight for indoor use and watertight for outdoor use.

1. Manufacturer: Provide one of the following:

a. G & W Electric Specialty Company
b. PLM Products Division
c. Thomas & Betts

## 2.5 INSULATING TAPE

A. General Use Tape:

1. Tape shall be vinyl all weather designed for continuous operation in -18°C to 105° applications and shall be 7 mils thick.
2. Manufacturer: Provide one of the following:

   a. Okonite Type CLF Catalog Series 602-20
   b. 3M Scotch Super 33

## 2.6 MISCELLANEOUS

A. Wire Labels for Identification of Conductors.

1. Manufacturer: Provide products of one of the following:

   a. Brady
   b. Westline

B. Lubricating Compound:

1. Manufacturer: Provide products of one of the following:

   a. American Polywater Corporation
   b. Ideal 77 Yellow
   c. Wire Lube

# 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 #10 AWG.

D. For interior branch circuits, provide a separate neutral conductor for each phase conductor for circuits supplying 120 volt convenience receptacles. Sharing neutrals between phase conductors shall not be permitted.

E. Continuously lubricate all non-armored cables of the larger sizes at the pull-in point of conduit systems with an approved compound compatible with conductor insulation or jacket.

F. Install conductors in such a manner that the bending radius of any wire or cable is not less than the minimum recommended by IPCEA 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.

**3.2 COLOR CODING, CONDUCTOR AND CABLE IDENTIFICATION**

A. Provide single conductor cables having black 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 260553 “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 approved splicing sleeves. Locate splicing sleeve outside of and adjacent to the tray, not in the tray.

**3.5 FIELD QUALITY CONTROL**

A. Perform testing on all conductors as indicated in the Electrical Testing and Power Systems (26 0570) Section.

**END OF SECTION 26 0519**

# 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. Support for conductors in vertical conduit.
4. Structural steel for fabricated supports and restraints.
5. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
6. Fabricated metal equipment support assemblies.

## PART 2 - PRODUCTS

### 2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch-diameter holes at a maximum of 8 inches o.c. in at least one surface.

1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
2. Material for Channel, Fittings, and Accessories: Galvanized steel.
3. Channel Width: Selected for applicable load criteria.
4. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
5. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
6. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

C. 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.

D. Structural Steel for Fabricated Supports and Restraints: ASTM A36/A36M steel plates, shapes, and bars; black and galvanized.

E. 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-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

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 single-bolt conduit clamps using spring friction action for retention in support channel.

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. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
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.

## 3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 03 3000 "Cast-in-Place Concrete."

C. Anchor equipment to concrete base as follows:

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

## 3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Touchup: Comply with requirements in Section 09 9100 "Painting" and Section 09 9600 "High-Performance Coatings" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

**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. Raceway systems as required, and all equipment and material, including conduit, fittings, boxes, and wireways, as indicated or specified.

### 1.3 SUBMITTALS

A. Product Data: Submit complete data on each item. Coordinate the items, as they relate to the work, prior to submittal. Shop drawings shall include:

1. Conduit and fittings
2. Boxes
3. Wireways

B. Submit Owner's Operation and Maintenance Manuals for systems and equipment as follows:

## PART 2 - PRODUCTS

### 2.1 CONDUIT

A. Rigid Galvanized Steel (RGS) Conduit, Elbows, and Couplings: Zinc-coated hot dip galvanized threaded steel per ANSI C80.1 "Specification for Rigid Steel Conduit, Zinc-Coated" and UL6. Each length of conduit shall be threaded on both ends.

1. Manufacturer: Provide products of one of the following:

a. Allied
b. Republic
c. Wheatland

B. Intermediate Metal Conduit (IMC), Elbows and Couplings: Zinc-coated hot dip galvanized per UL 1242. Each length of conduit shall be threaded on both ends.

1. Manufacturer: Provide products of one of the following:

a. Allied
b. Republic
c. Wheatland

C. Electrical Metallic Tubing (EMT): Zinc-coated steel per ANSI C80.3-1977 "Specification for Electrical Metallic Tubing, Zinc-Coated".

1. Manufacturer: Provide products of one of the following:

a. Allied
b. Republic
c. Wheatland

D. Flexible Steel Conduit: Per UL-1, "Flexible Steel Conduit".

1. Manufacturer: Provide products of one of the following:

a. Anaconda
b. Electriflex

E. Liquid-Tight Flexible Steel Conduit: Per UL-1, "Flexible Steel Conduit", with a PVC jacket.

1. Manufacturer: Provide products of one of the following:

a. Anaconda
b. Sealtite
c. Electriflex

**2.2 ELECTRICAL PLASTIC CONDUIT**

A. Heavy Wall Conduit: Schedule 40, 90 C, UL-rated, construct of polyvinyl chloride (PUC) and conforming to NEMA TC-2, for direct burial.

B. Thin Wall Conduit: Type A, UL-rated for concrete encasement underground, construct of polyvinyl chloride compound C-2000, and UL-listed in accordance with NEC Article 347.

C. Conduit and Tubing Accessories: Provide conduit, tubing and duct accessories of types, sizes and materials, complying with manufacturer's published product information, which mate and match conduit and tubing.

D. Manufacturers: Provide products of one of the following:

1. Cantex
2. Prime Conduit, Inc.
3. National Pipe

**2.3 CONDUIT FITTINGS**

A. Fittings for Rigid Galvanized Steel or Intermediate Metal Conduit: Cast or malleable iron bodies, cadmium or zinc-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. Appleton Form 35
b. Crouse-Hinds Form 8
c. Steel City/Thomas & Betts
d. Topaz

B. Expansion Fittings for Rigid Galvanized Steel or Intermediate Metal Conduit: Cast or malleable iron bodies, 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. Appleton
b. Crouse-Hinds

c. O-Z
d. Thomas & Betts

C. Couplings and Connectors for EMT: Zinc-plated steel, compression or set screw type.

1. Manufacturer: Provide products of one of the following:

a. Appleton
b. ETP
c. Midwest
d. Steel City/Thomas & Betts

D. Conduit Unions on Continuous Run:

1. Manufacturer: Provide products of the following:

a. Erickson

E. Expansion Fittings for EMT:

1. Manufacturer: Provide products of the following:

a. Thomas & Betts

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. Appleton
b. ETP
c. Steel City/Thomas & Betts

G. Fittings for Liquid-Tight Flexible Steel Conduit: Designed to maintain the liquid-tight feature of the installation.

1. Manufacturer: Provide products of one of the following:

a. Appleton ST Series
b. ETP
c. Thomas & Betts 5331 to 5360

H. Locknuts for Rigid Steel or Intermediate Metal Conduit: Malleable iron or steel, zinc or cadmium plated.

I. Bushings for 1 Inch and Smaller Rigid Steel Conduits, Intermediate Metal Conduits: Insulating plastic type of non-burnable thermosetting phenolic, conforming to Underwriters' Laboratories requirements. Do not furnish non-rigid plastic bushings.

J. Bushings for 1-1/4 Inch and Larger Rigid Steel or Intermediate Metal Conduits: 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 OUTLET BOXES

A. Sheet Steel 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. Appleton
    b. RACO
    c. Steel City

B. Cast or Malleable Iron Boxes: Galvanized or cadmium plated, 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. Appleton
    b. Crouse-Hinds
    c. Pyle-National
    d. Russelstoll
    e. Steel City/Thomas & Betts

C. Aluminum or Aluminum Alloy Boxes: Single or multiple gang, with taper threaded hubs, adapters and cover plates. Furnish cast aluminum or aluminum alloy 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. Appleton
    b. Crouse-Hinds
    c. Pyle-National
    d. Russelstoll

## 2.5 PULL AND JUNCTION BOXES

A. Boxes Less than 5 Inches by 5 Inches: Conform to requirements specified for Outlet Boxes.

B. 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. 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. Cast or Malleable Iron Boxes: Code gage, with threaded hubs or conduit bosses for field drilling and tapping, screw fastened cover of same gage as box. 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.

1. Manufacturer: Provide products of one of the following:

a. Hoffman
b. O-Z

D. Aluminum or Aluminum Alloy Boxes: Code gage, with threaded hubs or conduit bosses for field drilling and tapping, screw fastened cover of same gage as box. Fasten cover with stainless steel machine screws. Provide sizes per 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.

1. Manufacturer: Provide products of one of the following:

a. Hoffman
b. O-Z

## 2.6 FLOOR BOXES AND FITTINGS

A. Boxes: Single gang, watertight, cast iron, shallow type, with corrosion-resistant finish, four 3/4 inch threaded hubs for conduit entrance, and having provision for individual adjustment of the box and cover; match service fitting finish. Furnish plugs for all unused conduit entrances.
1. Manufacturer: Provide products of one of the following:
a. Hubbell B-2537 (Brass Flange)
b. Hubbell BA-2537 (Aluminum Flange)
c. Steel City/Thomas & Betts

B. Covers: 2-1/8 inch by 3/4 inch combination screw type; match service fitting finish.
1. Manufacturer: Provide products of one of the following:
a. Hubbell S-2525 (Forged Brass)
b. Hubbell SA-2525 (Aluminum)
c. Steel City/Thomas & Betts

C. Above-Floor Fittings for 120 Volt Convenience Receptacles: Low profile type, 2-7/8 inches high with 2-1/8 inch threaded base, 3/4 inch nipple, flange fitting, and back to back duplex, U-ground type receptacle rated 15 amperes, 125 volts; with Hubbell S-6288 duplex receptacle.
1. Manufacturer: Provide products of one of the following:
a. Hubbell S-3040 (Brass)
b. Hubbell SA-3040 (Aluminum)

D. Above-Floor Fittings for data Service: Low profile type, 2-7/8 inches high with 2-1/8 inch threaded base, 3/4 inch nipple, flange fitting, and bushed openings for data cable.
1. Manufacturer: Provide products of one of the following:
a. Hubbell S-3041 (Brass)
b. Hubbell SA-3041 (Aluminum)

## 2.7 MISCELLANEOUS

A. Trapeze Hangers

1. Manufacturer: Provide products of one of the following:

a. Kindorf
b. Powerstrut
c. Unistrut

B. Shielding Paint

1. Manufacturer: Provide products of one of the following:

a. Thomas & Betts "KopR-Shield"

C. Sealant: Single component, non-sage urethane:

1. Manufacturer: Provide products of one of the following:

a. Sika Corporation “Sikaflex 1a”
b. Pecora Corporation "Dynatrol 1"
c. Sonneborn "Sonolastic NP-1"
d. Tremco “Dymonic”

**PART 3 - EXECUTION**

**3.1 CONDUIT SYSTEMS**

A. Install conduit for all main feeders which includes feeders to switchboards, distribution panels and panelboards.

B. Install RGS conduit for conduits passing through foundation walls with a 3 inch minimum concrete wall around the conduits and five (5) feet both sides of the wall.

C. Install RGS conduit for conduit elbows used to transition from below the slab and for all RGS conduit imbedded in the slab to vertical users passing through the floor slab.

D. Install RGS elbows and conduits for all vertical users at utility poles.

E. Install RGS conduits for all exposed exterior locations and wet locations.

F. EMT compression type connectors and couplings shall be used for all EMT conduits routed in damp locations or when the use of EMT in lieu of RGS is approved by the Engineer for exposed exterior locations. The use of set screw connectors and couplings is permitted for all other EMT raceways where equipment ground wires exist.

G. Install EMT concealed in wall cavities in offices and similarly “finished areas,” above suspended ceilings and in “unfinished areas” 10’-0” above finished floor.

H. Install flexible conduit in lieu of RGS or EMT for service to individual recessed fixtures, 1/2 inch minimum size. Use liquid-tight type of flexible conduit in lieu of non-jacketed flexible conduit in damp or wet locations.

I. Install liquid-tight flexible steel conduit for final connection to distribution transformers for final connections to all motors and other equipment subject to vibration or movement. Flexible conduits shall not exceed 6’-0” in length.

J. 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” conduit is permitted from receptacle outlet boxes and switch outlet boxes to the nearest junction mounted in the ceiling space. 3/4” conduit minimum shall be

used from the panelboards to the junction boxes and between junction boxes. Use 1/2 inch fixture stems optionally, unless otherwise indicated.

K. Install conduit concealed in office and similar finished areas, and exposed in all other areas unless otherwise indicated or specified.

L. 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.

M. Conduits routed below floor slabs shall have a minimum of 3 inches of sand cover and shall not be required to be run parallel to building walls.

N. 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.

O. 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 Section 078413 “Through-Penetration Firestop Systems”.

P. 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.

Q. 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.

R. 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.

S. Install expansion fittings in exposed conduit runs of excessive length, where conduits cross building expansion joints, and where indicated.

T. 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.

U. Use one hole malleable iron galvanized pipe straps for support of single conduits, or clevis type hangers. Support groups of conduit 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.

**3.2 FLOOR BOXES**

A. Install floor boxes with brass fittings and accessories in laboratory and medical areas, and with aluminum fittings and accessories in office areas.

B. Install floor box such that the cover is flush with floor covering or finish floor as applicable to the area in which the floor box is installed. Install plugs in unused conduit entrances. Install above floor fittings and accessories for services indicated. Install flush plugs in covers where outlets are not installed under this Contract.

**3.3 OUTLET, SWITCH, JUNCTION AND PULL BOXES**

A. Outlet Boxes for Use with Rigid Steel Conduit in Non-Hazardous Areas: Sheet steel for flush or concealed work in dry locations; cast or malleable iron in exposed, damp or wet locations. Do not use sheet steel outlet boxes in utility areas.

B. Outlet Boxes for Use with Electrical Metallic Tubing: Sheet steel for flush or concealed work; cast or malleable iron for exposed locations.

C. Gaskets: Provide cover gaskets for boxes in damp or wet locations.

D. Pull and Junction Boxes for Use with Each Type of Conduit: As specified for outlet boxes for each conduit type under above paragraphs.

E. Install outlets for wall switches controlling lighting on the latch side of door where possible.

F. 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.

**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. Armored and metal-clad cable identification
4. Power and control cable identification
5. Floor marking tape
6. Underground-line warning tape
7. Warning labels and signs
8. Instruction signs
9. Cable ties
10. Miscellaneous identification products

### 1.3 QUALITY ASSURANCE

A. Comply with ANSI A13.1.

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.

### 1.4 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.

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 ARMORED AND METAL-CLAD CABLE IDENTIFICATION

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Colors for Raceways Carrying Circuits at 600 V and Less:

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: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

D. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches wide; compounded for outdoor use.

## 2.4 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.

## 2.5 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 INSTRUCTION SIGNS**

A. Engraved, laminated acrylic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.

1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.
3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch.

C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

**2.8 CABLE TIES**

A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black except where used for color-coding.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black.

C. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F, According to ASTM D 638: 7000 psi.
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F.
5. Color: Black.

## 2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in 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. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.

H. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

I. 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.

J. 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. Switchboards
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. Motor starters
h. Enclosed switches
i. Enclosed circuit breakers
j. Enclosed controllers
k. Variable-speed controllers
l. Contactors
m. Remote-controlled switches, dimmer modules, and control devices

**3.3 RACEWAYS AND CONDUCTOR IDENTIFICATION SCHEDULE**

A. Concealed Raceways and Duct Banks, More Than 600 V:

1. Tape and stencil 4 inch wide black stripes on 10 inch centers over orange background that extends full length of raceway or duct and is 12 inches wide. Stencil legend "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3 inch high black letters on 20 inch centers. Stop stripes at legends. Apply to the following finished surfaces:

a. Floor surface directly above conduits running beneath and within 12 inches of a floor that is in contact with earth or is framed above unexcavated space.
b. Wall surfaces directly external to raceways concealed within wall.
c. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.

B. Accessible Raceways, Armored and Metal-Clad Cables, More Than 600 V:

1. Snap-around labels. Install labels at 30 foot maximum intervals.

C. 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:

1. Self-adhesive vinyl tape applied in bands. Install labels at 30 foot maximum intervals.

D. Accessible Raceways, Cables, Junction Box Cover Plates and Pull Box Covers:

1. Self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:

a. Power

E. Conductor Identification, 600 V or Less:

1. 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.
2. 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 |

3. 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.
4. Install color coding scheme labels at each switchboard, panelboard, distribution panel, power panel and motor control center.
5. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

F. Identify cable groups and conduit at entering and leaving locations in manholes, handholes and at terminations.

G. 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.

H. Identify cables entering or exiting conduits, passing through pull boxes, at each pullbox and at each termination location.

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. 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 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 1 Specification Sections, apply to this Section.

### 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 associated to networked lighting controls:

    a. Wall switch occupancy sensors
    b. Wall switch occupancy sensors with 0-10V dimming
    c. 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, installation and furnishing of a completely operational occupancy sensor lighting control system with automatic emergency power transfer, as described 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 installation details for occupancy and light-level sensors.

1. Lighting plans indicating location, orientation, and coverage area of each sensor. The locations and quantities of sensors indicated on the Drawings are diagrammatic and indicate only the rooms which are to be provided with sensors and emergency lighting.
2. Interconnection diagrams showing field-installed wiring.

C. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

D. Functional Testing Report: For all spaces equipped with lighting controls.

### 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.

### 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 SINGLE POLE AND DUAL POLE OCCUPANCY SENSOR

A. Switching mechanism shall be latching air gap relay, compatible with LED Power supplies, electronic ballasts, compact fluorescent, 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.

B. Sensor shall utilize PIR based technology and be capable of detecting presence in the control area by detecting changes in the infrared energy. Small movements shall be detected such as when a person is writing while seated at a desk.

C. Sensor shall utilize signal technology to provide immunity to RFI and EMI.

D. Sensor shall utilize a temperature compensated, dual element sensor and a multi-element Fresnel lens. Fresnel lens shall be a Poly IR 4 based material to offer superior filtering capability of competing light sources, such as the sun and other visible light sources. Lens shall have grooves facing in to avoid dust and residue build-up which could affect IR reception. To assure detection at the desktop level uniformly across the space, sensor shall have a 2 level, 28 segment, multi-element Fresnel lens system. For protection against lens damage, sensor shall utilize a full radius lens brace.

E. Sensor shall have a coverage area of 900 sq. ft. for walking motion, with a field of view of 180 degrees.

F. Sensor shall operate at 277 VAC and shall be capable of switching 0 to 800 watt ballast or tungsten or 1/6 hp @ 120 volts, 60 Hz; 0 to 1200 watts for ballast or 1/3 hp @ 277 volts, 60 Hz.

G. Sensor shall have a built-in light level feature adjustable from 2 to 200 footcandles that holds lighting OFF when a desired footcandle level is present. Sensor shall have a time delay adjustable from 30 seconds to 30 minutes. Sensor shall have user-adjustable sensitivity setting. Adjustments and mounting hardware shall be concealed under a removable cover to prevent tampering of adjustments and hardware.

H. Sensor shall be set to 15 minute in vacancy mode.

I. 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.

J. 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.

K. Senor color shall be white with white faceplate, unless noted otherwise on drawings.

L. Manufacturer: Provide the following:

1. Sensor Switch “WSX” Series
2. Lutron “Maestro” Series
3. Leviton “ODS” Series

**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. Acuity nLight
b. Intermatic Model K4100
c. Paragon CW201-00UL
d. Tork Model 2100

**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 Power Transfer 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. Minimum acceptable wire gauge from the circuit control hardware relays shall be #14 AWG.

**PART 3 - EXECUTION**

**3.1 WIRING INSTALLATION**

A. Wiring Method: Comply with Division 16 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.

**3.2 IDENTIFICATION**

A. Identify components and power and control wiring according to Division 26 Sections.

**END OF SECTION 26 0923**

# SECTION 26 0943 – 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.

### 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 lighting control system shall provide time-based, sensor-based and manual lighting control.
2. The system shall be capable of turning lighting loads on/off as well as dimming lights (if lighting load is capable of being dimmed).
3. All system devices shall be networked together enabling digital communication and shall be individually addressable.
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 architecture shall facilitate remote operation via a computer connection.
6. The system shall not require any centrally hardwired switching equipment for normal operation.
7. The system shall facilitate control through the building management system.

C. The lighting control system shall include de-centralized lighting control equipment including, control stations, control processing units and other user interface devices, wiring, and ancillary programming equipment. Type of lighting control equipment and wiring specified in this section includes the following:

1. Central processing unit and system interface; master interface providing coordinated control for all of the system's networked devices. The unit acts as the primary gateway for all BAS related connections.
2. Bridge/Digital Controller.
3. Power/Relay Packs.
4. Digital Touchscreens: Color digital touchscreen allowing the user access to local or system-wide actions such as preset programming, precise fixture controls, etc.
5. Digital Low Voltage Pushbuttons and Preset Stations.
6. Occupancy Sensors.
7. Photoelectric Sensors.

D. Abbreviations/Definitions:

1. Bridge/Digital Controller: A digital device which connects lighting control zones to a network backbone.
2. Digital Low Voltage Push Button/Preset: User interface pushbuttons (typically wall mounted) with a discrete address which transmit a low voltage digital signal via the communication bus to the bridge to initiate a selected on/off or dimming action for a preselected group of fixtures.
3. Occupancy Sensors: Devices with a discrete address which detect room occupancy status via infrared, ultrasonic, or microphone, or a combination of infrared and either ultrasonic or microphone technologies and transmit digital signals via the communication bus to the system to initiate a selected action for a preselected group of fixtures.
4. Power/Relay Pack: Device which accepts communication inputs, assigns an address to that device which establishes a zone and has 120/277 volt load rated contacts. When specified, this device also provides 0-10 VDC and line voltage dimming and UL 924 compliant emergency bypass control.

E. Related Sections include the following:

1. Division 25 Section "HVAC Instrumentation and Controls" for input and output requirements related to lighting controls.
2. Division 26 Section "Wiring Devices" for line voltage light switches.

**1.3 SUBMITTALS**

A. Product Data: For each type of product indicated including, but not limited to:

1. All controls equipment and device cut sheets, one (1) for each variation, with the following minimum data:

a. Physical Dimensions
b. Operational Sequences
c. Typical Wiring and Installation Diagrams
d. Applicable listings as required in these specification and drawings (UL, IP, etc).
e. Applicable selected options with complete catalog numbers.
f. Selected Finish
g. Evidence that equipment is compatible with specified interface protocols (BAS, Fire Alarm, A/V, etc.).

B. 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. Wiring and Block Diagrams/Risers; Show project specific power and communications interconnections between all system components, interfacing systems (BAS, Fire Alarm, A/V, etc.) and power distribution systems. Indicate all associated cable and wire types.
4. Plans: Provide device and equipment locations, layouts and system interconnections overlaid on project specific floor plans. Identify devices and equipment types, tied to wiring diagrams and risers.

C. Operation and Maintenance Data: For control modules, control stations, normal system operation, emergency system, operation, and maintenance manuals. In addition to items specified in Division 1 Sections include the following:

1. Software manuals.
2. Adjustments of scene preset controls, adjustable fade rates, and fade overrides.
3. Operation of adjustable zone controls.
4. Testing, operation and adjusting of panic and emergency power features.

D. Functional Testing Report: For all spaces equipped with lighting controls.

**1.4 COORDINATION**

A. Coordinate lighting controls with Sections specifying distribution components that are interfaced with this system such as mechanical controls, AV systems and fire alarm.

B. Coordinate lighting control system with Tridium building automation system (BAS), existing or as provided under Division 23. Provide all necessary hardware and wiring to interface with the BAS through IP-based communications.

C. Equipment: Provide certified documentation that all tests outlined in ASHRAE 90.1-2013, Section 9.4.3 have been performed. Documentation to include:

1. Table/Spreadsheets of all applicable spaces with associated sensor, time clock, override and daylight operations for both occupied and unoccupied conditions.

## 1.5 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 or replace any parts for five (5) years from the date of Substantial Completion.
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.
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 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.

5. Provide software upgrades for all lighting control systems during the warranty period.

## 1.6 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. Bridges/Digital Controllers: Provide two (1) spares.
2. Power/Relay Packs: Provide two (2) spares for each type installed.
3. Pushbutton Stations: Provide two (2) spares for each type installed.
4. Occupancy Sensors: Provide ten (2) spares.

## 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 CODES AND STANDARDS

A. IEEE Standard 2000.1-1998

B. UL 916 Energy Management Equipment

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a UL/CUL testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with 47 CFR 15, Subparts A and B, for Class A digital devices.

E. UL 924 Emergency Lighting.

F. Michigan Energy Code 2015, adopting ASHRAE 90.1-2013.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Acuity Brands, nLight wired network control system
2. Touche Lighting Controls, room manager base system
3. Wattstopper, DLM system
4. Hubbell, NX System

**2.2 SYSTEM DESCRIPTION**

A. The lighting control system shall provide seamless control and monitoring of all lighting sysems included in the scope of work regardless of whether they are relay switched or dimmer controlled and switched or controlled via communication-based 0-10 VDC equipment. All lighting control equipment and devices shall be interconnected by a communication network buss making possible the sharing of control functions and status system wide. The system shall have astronomic clock, scheduling software, trending software, energy management software, administrative software, diagnostic software, programmable inputs and programmable outputs. Where communication links are broken between bridges and room controllers, the room control shall remain operational in some default basic operation.

B. All control inputs shall operate with IP Technologies, shall be discretely addressable and shall be connected to a communication bus originating from the LAN which is connected to the gateways and through the gateways which interconnect the bridges to the local occupancy sensors, daylight sensors, local pushbuttons, power/relay packs and low voltage control packs servicing the lighting in the area. Control inputs consist of occupancy sensors, photo sensors and pushbuttons. Required power for operating these inputs shall originate from the power packs or gateways and shall be transmitted via the communication bus. Control inputs shall be transferable over the network to affect lighting control patterns and zones regardless of to which relay or dimmer the loads are connected. Overrides for after hour use or cleaning shall be accomplished via pushbutton switch.

C. The system software shall be web-based and allow the user to remotely configure and monitor all devices including all of the following:

1. Customize device names
2. Configure device settings
3. Configure device fault settings
4. View device properties
5. Modify device current settings
6. Observe real time device/group operational statuses
7. Update device firmware
8. Zoning network devices
9. Creating lighting profiles that outline device operation
10. Scheduling lighting profiles to operate at prescribed times and on prescribed days
11. Provide access for remote online technical support
12. Print reports for network inventory and profiles
13. Develop reports to calculate and analyze savings in kWH and dollars
14. Develop reports to indicate usage in hours per zone

15. Develop reports to indicate daylight savings
16. Develop reports to indicate status of relays (fixtures)
17. Provide BACnet interface to BAS
18. Provide a matrix (software and printed) indicating address and physical location of all sensors. Software shall transfer information to BAS.

**2.3 NETWORKED SYSTEM PUSHBUTTON AND PRESET STATIONS**

A. Communication and low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.

B. Devices shall be installed into a single gang switch box and fit a standard GFI opening.

C. Provide button configurations, dimming capabilities and presets as indicated on drawings.

D. Devices shall be white unless otherwise indicated on drawings.

**2.4 NETWORKED SYSTEM OCCUPANCY SENSORS**

A. Provide dual-technology occupancy sensors designed for use with specified lighting control system.

B. Sensors shall be available in multiple lens options which are customized for specific applications.

C. Communication and Class 2 low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.

D. Every sensor parameter shall be available and configurable remotely from the software and locally.

E. Sensors shall be able to function together with other sensors in order to provide expanded coverage areas.

F. Sensors shall be white.

**2.5 NETWORKED SYSTEM POWER/RELAY PACKS**

A. Power packs shall accept 120 or 277 VAC (or optionally 347 VAC), be plenum rated, and provide Class 2 power to the system. Power packs/relays may be remote or integral to digital controller.

B. All devices shall have two RJ-45 ports minimum.

C. Every power pack parameter shall be available and configurable remotely from the software and locally.

D. Power pack shall securely mount to junction location through a threaded ½ inch chase nipple or be capable of being secured within a luminaire ballast channel. Plastic clips into junction box shall not be accepted. All Class 1 wiring shall pass through chase nipple into adjacent junction box without any exposure of wire leads. UL Listing under Energy Management or Industrial Control Equipment meets this requirement.

E. When required by local code, power pack shall be installed inside standard electrical enclosure and provide UL recognized support to junction box. All Class 1 wiring is to pass through chase nipple into adjacent junction box without any exposure of wire leads.

F. Power packs shall provide up to 16 amps switching of all lighting load and as 0-10 VDC dimming of LED drivers.

G. Specific power/secondary packs shall be available that are UL924 listed for switching of Emergency Power circuits.

H. Specific Secondary Packs shall be available that control small equipment such as louver/damper motors.

I. Specific secondary packs shall be available that provide a pulse on/pulse off signal for purposes of controlling shade systems via relay inputs.

## 2.6 LIGHTING CONTROL PROFILES

A. Changes to the operation of the system shall be capable of being made in real-time or scheduled via lighting control profiles. These profiles are outlines of settings that direct how a collection of devices function for a defined time period.

B. Lighting control profiles shall be capable of being created and applied to a single device, zone of devices, or customized group of zones.

C. All relays and dimming outputs shall be capable of being scheduled to track or ignore information regarding occupancy, daylight, and local user switches via lighting control profiles.

D. Every device parameter (e.g. sensor time delay and photocell set-point) shall be configurable via a lighting control profile.

E. All lighting control profiles shall be stored on the network equipment and on the software's host server.

F. Lighting control profiles shall be capable of being scheduled to run according to the following calendar options: start date/hour/minute, end date/hour/minute, and sunrise/sunset +/- timed offsets.

G. Sunrise/sunset times shall be automatically derived from location information using an astronomical clock.

H. Daylight savings time adjustments shall be capable of being performed automatically, if desired.

I. Lighting control profile schedules shall be capable of being given the following recurrence settings: daily, weekday, weekend, weekly, monthly, and yearly.

J. Software shall provide a graphical tool for easily viewing scheduled lighting control profiles.

## 2.7 MANAGEMENT SOFTWARE

A. Every device parameter (e.g. sensor time delay and photocell set-point) shall be available and configurable remotely from the software.

B. The following status monitoring information shall be made available from the software for all devices for which it is applicable: current occupancy status, current PIR Status, current Microphonics Status, remaining occupancy time delay(s), current photocell reading, current photocell inhibiting state, photocell transitions time remaining, current dim level, device temperature, and device relay state(s).

C. The following device identification information shall be made available from the software: model number, model description, serial number, manufacturing date code, custom label(s), and parent network device.

D. A printable network inventory report shall be available via the software.

E. A printable report detailing all system profiles shall be available via the software.

F. Software shall require all users to login with a User Name and Password.

G. Software shall provide at least three permission levels for users.

H. All sensitive stored information and privileged communication by the software shall be encrypted.

I. All device firmware and system software updates must be available for automatic download and installation via the internet.

J. Software shall be capable of managing systems interconnected via a WAN (wide area network).

K. System shall provide a BACnet IP gateway as a downloadable software plug-in to its management software. No additional hardware shall be required.

L. BACnet IP gateway software shall communicate information gathered by networked system to other building management systems.

M. BACnet IP gateway software shall translate and forward lighting relay and other select control commands from BMS system to networked control devices.

**2.8 LIGHTING CONTROL SEQUENCE OF OPERATION**

A. Refer to Drawings for Sequence of Operation for interior and exterior lighting control.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

A. Install all equipment at locations indicated, and secure to ceilings, walls, floors or structural members as required.

B. Provide special cable as indicated or specified by manufacturer.

C. Install all wiring in conduit systems as indicated and as specified in Section 260533.

D. Provide final wiring and connections per the manufacturer's wiring diagrams.

E. Provide a dedicated power feed to each piece of equipment requiring line voltage power for operation.

F. Provide control wiring from life safety lighting control devices to normal power lighting control devices serving lighting in the same area as the life safety lighting controls. This 120-volt control wiring shall initiate the life safety lighting control panel relays and dimmers to the "on" and full light output position.

G. Communication bridges shall be installed in electrical closets or above lay-in ceilings at doorways at strategic locations. Gang bridges where possible to minimize 120volt wiring and to centralize their location for maintenance. They shall not be installed in spaces with open ceiling construction.

H. Central processing unit shall be installed in electrical closets.

I. Provide 120 volt power to each processing unit controller provided.

J. I/O devices and power packs for emergency lighting circuits shall be UL 924 rated.

**3.2 QUALITY CONTROL**

A. Independent Testing Laboratory: The control panels shall be tested and listed under the UL 916 Energy Management Equipment standards.

B. System Checkout and Training: A factory authorized technician shall functionally test the system and verify performance after contractor installation. Provide training for operations personnel on the set-up, programming, operation and maintenance of the lighting control system.

C. Adjusting: After completion of system wiring, connect, test, adjust, and readjust as necessary, all equipment in terms of design function and performance.

D. Demonstration: After checking has been completed and system is operational, demonstrate to the Owner 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 intend.

1. When system is in specified operational condition, and when pertinent operational functions have been demonstrated, system shall be accepted.

E. Test all life safety lighting control panels by simulating a power failure to the lighting panelboards serving the normal lighting in the space. Verify and make any adjustments to assure that if power fails in those panelboards or if the transfer switch changes states the life safety lighting control panels shall energize relays and all dimmers energize to full light output.

**3.3 START UP SERVICES**

A. Provide “on-site” start-up services to assist contractor in making final connections, programming, preparing schedules, aiming photo sensors, installing photo sensors, installing occupancy sensors and installing all the electronics.

**3.4 TRAINING**

A. The Contractor shall provide a training session for the Owner’s Representative.

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.

**3.5 COMMISSIONING**

A. The Contractor shall commission the entire lighting control system consisting of testing and documenting all results. The tests shall consist of visiting each space and validating 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 photo sensor, 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.

F. Notify engineers five (5) business days prior to commencing testing for his witness of the testing in related areas and related times.

G. Engage a third party testing agent to perform ASHRAE 90.1-2013 compliant functional testing as outlined in Section 9.4.3.

## 3.6 PRODUCT SUPPORT AND SERVICE

A. Provide a factory authorized technician to verify the installation, test the system, and train the Owner on proper operation and maintenance of 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. Accurate "as-built" load schedules have been prepared for each lighting control panel.
4. Proper notification of the impending start-up has been provided to the Owner's representative.

B. 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 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.

### 1.2 SUMMARY

A. This Section includes the following:

1. Lighting control and receptacle services as required, and all materials and equipment, including switches, receptacles, device plates, photoelectric controllers, time switches, lighting contactors and low voltage control systems, 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. 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 switches and 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
b. Bryant
c. General Electric
d. Hubbell
e. Pass & Seymour

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 Tamper-Resistant 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

b. Bryant
c. General Electric
d. Hubbell
e. Pass & Seymour

B. 20 Ampere Duplex Tamper-Resistant 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, brown 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
2) Bryant
3) Hubbell
4) Pass & Seymour

## 2.3 DEVICE PLATES

A. Device Plates in Finished Areas: Stainless steel 302 finish.

A. Device Plates in Factory, Utility and Similar Areas: Zinc or cadmium plated steel.

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.

## 2.4 POWER CORD REELS

A. Description: Standard or heavy duty power cord reel as required for applicable ampacities, including mounting base, retracting reel mechanism, cord, ball stop, mounting hardware, and pendant outlet box or connectors as indicated on the drawings.

B. Components shall be products from single manufacturer designed for use as a complete matching assembly of hardware and receptacles.

1. Manufacturer: Provide the following:
   a. Woodhead
   b. Reelcraft

C. Provide reel with a minimum cord length of 35’-0”, with hard service cord. Cord shall be rated for the ampacity and conductor quantities required to support the wiring devices indicated on the drawings.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Mount equipment at locations indicated.

B. Install plates on flush mounted outlets 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. Cooper Bussmann, Inc.
2. Edison Fuse, Inc.
3. Ferraz Shawmut, Inc.
4. Littelfuse, Inc.

## 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, 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.

### 3.3 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

### 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 2816 – ENCLOSED SWITCHES AND CIRCUIT BREAKERS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. This Section specifies enclosed switches (safety switches) and circuit breakers as indicated and specified. Provider equipment supports and identification as specified.

B. Provide all labor, materials, and equipment as necessary to complete all work as indicated on the drawings, and as specified herein for a complete operating system.

C. Related Sections:

1. Applicable sections of Division 26 - Electrical

### 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 of the following:

1. Safety switches
2. Enclosed circuit breakers

## PART 2 - PRODUCTS

### 2.1 SAFETY SWITCHES

A. General Description: Fusible or non-fusible as indicated, quick-make, quick-break, NEMA "HD" heavy duty visible blade type, horsepower rated in ratings up to 200 amperes at 600 volts and up to 400 amperes at 250 volts, in NEMA enclosures specified or as required for environment present. Furnish 3 pole, single throw switches unless otherwise indicated, with voltage and current ratings as indicated. Short circuit rating with fuses shall not be less than 50,000 A.I.C. Silver or cadmium plate all contact surfaces including fuse clips.

B. Interlocking: Equip switches with an external operating handle and interlock the operating handle with the cover door such that the cover door cannot be opened unless the switch is in the "off" position. Provide means for triple padlocking the operating handle in the "off" position such that when the operating handle is padlocked in the "off" position, the cover door cannot be opened and the switch cannot be closed. Equip switches with auxiliary contacts when such are indicated.

C. Fuse Clips: Standard rejection type for dual element cartridge type fuses as specified unless otherwise required.

D. Safety switches shall be furnished and installed as indicated on the drawing, with sizes and fusing as noted.

E. Safety switches inside of building shall be NEMA 1.

F. Safety switches for motors on cooling tower fans and similar applications shall be furnished with watertight, stainless steel enclosures NEMA 4X.

G. Safety switches mounted exterior of the building shall be NEMA type 3R.

H. Safety switches for two speed motors shall be six pole, single throw.

I. Manufacturers: Provide one of the following:

1. Eaton Cutler-Hammer H-600
2. General Electric Type TH
3. Siemens
4. Square D Heavy Duty

**2.2 ENCLOSED CIRCUIT BREAKERS**

A. General Description: Molded case circuit breakers sized to accommodate the motor starting inrush currents, in NEMA enclosures specified or as required for environment present. Furnish 3 pole, single throw circuit breakers unless otherwise indicated, with voltage and current ratings as indicated. Short circuit rating shall not be less than 25,000 A.I.C.

B. Interlocking: Provide means for triple padlocking the operating handle in the "off" position such that when the operating handle is padlocked in the "off" position, the cover door cannot be opened and the switch cannot be closed. Equip switches with auxiliary contacts when such are indicated.

C. Enclosed circuit breakers shall be furnished and installed as indicated on the drawing, with ampacities as indicated.

D. Enclosed circuit breakers inside of building shall be NEMA 1.

E. Enclosed circuit breakers mounted exterior of the building shall be NEMA type 3R.

F. Manufacturers: Provide one of the following:

1. Eaton Cutler-Hammer
2. General Electric
3. Siemens
4. Square D

**PART 3 - EXECUTION**

**3.1 EQUIPMENT SUPPORTS**

A. Mount all electrical equipment, not self supporting, including enclosed switches and circuit breakers 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. Safety switches and enclosed circuit breakers shall be mounted on separate structures from HVAC housings, duct work, exhaust fans, pump frames, etc.

**3.2 EQUIPMENT IDENTIFICATION**

A. Safety switches and enclosed circuit breakers shall be provided with name plate indicating equipment controlled by that particular device.

B. Provide identification on all electrical equipment installed. Refer to Section 26 0553.

### 3.3 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 2816**

# 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. Control devices.
b. Safety switches.
c. Fuses.

### 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. Three phase magnetic motor starters full voltage combination type.
2. Three phase manual motor starters full voltage type.
3. Single phase manual motor starters fractional horsepower type.
4. Control devices.
5. Safety switches.
6. Fuses.

## PART 2 - PRODUCTS

### 2.1 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 enclosure in 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. Cutler-Hammer/Westinghouse.
2. General Electric.
3. Siemens-ITE.
4. Square D.

## 2.2 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. Cutler-Hammer/Westinghouse.
2. General Electric.
3. Siemens-ITE
4. Square D.

## 2.3 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. Cutler-Hammer/Westinghouse Type MS.
2. General Electric CR101.
3. Siemens-ITE Class SMF.
4. Square D Class 2510.

## 2.4 CONTROL DEVICES

A. 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.

1. Manufacturer: Provide one of the following:

a. Cutler-Hammer/Westinghouse 10250T
b. General Electric CR104P
c. Siemens-ITE
d. Square D Class 9001, Type K

B. 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.

1. Manufacturer: Provide one of the following:

a. Cutler-Hammer/Westinghouse 10250T
b. General Electric CR104P
c. Siemens-ITE
d. Square D Class 9001, Type K

C. 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.

1. Manufacturer: Provide products of one of the following:

a. Cutler-Hammer/Westinghouse
b. General Electric
c. Siemens-ITE
d. Square D

D. 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.

1. Manufacturer: Provide products of one of the following:

a. Cutler-Hammer/Westinghouse
b. General Electric
c. Siemens-ITE
d. Square D

E. Motor-Driven Timing Relays: As indicated.

F. Enclosures: NEMA 12 factory areas and NEMA 1 in other areas unless otherwise indicated.

## 2.5 SAFETY SWITCHES

A. General Description: Fusible or non-fusible as indicated, quick-make, quick-break, NEMA "HD" heavy duty visible blade type, horsepower rated in ratings up to 200 amperes at 600 volts and up to 400 amperes at 250 volts, in NEMA 1 enclosures in indoor areas unless otherwise noted. Furnish 3 pole, single throw switches unless otherwise indicated, with voltage and current ratings as indicated. Short circuit rating with fuses shall not be less than 50,000 A.I.C. Silver or cadmium plate all contact surfaces including fuse clips.

B. Interlocking: Equip switches with an external operating handle and interlock the operating handle with the cover door such that the cover door cannot be opened unless the switch is in the "off" position. Provide means for padlocking the operating handle in the "off" position such that when the operating handle is padlocked in the "off" position, the cover door cannot be opened and the switch cannot be closed. Equip switches with auxiliary contacts when such are indicated.

C. Fuse Clips: Standard rejection type for dual element cartridge type fuses as specified unless otherwise required.

D. Manufacturers: Provide one of the following:

1. Cutler-Hammer/Westinghouse H-600
2. General Electric Type TH
3. Siemens-ITE
4. Square D Heavy Duty

# PART 3 - EXECUTION

## 3.1 INSTALLATION

A. Motors: Refer to Section 16025 "Electrical Systems" 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.

**END OF SECTION 26 2913**

# SECTION 26 5100 – INTERIOR LIGHTING SYSTEMS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. This Section includes the following:

1. Lighting systems as required, and all materials and equipment, including lighting fixtures, accessories and associated systems and equipment, as indicated or specified.

### 1.3 SUBMITTALS

A. Product Data: For each type of lighting fixture indicated, arranged in order of fixture designation. Include data on features, accessories, and the following:

1. Dimensions of fixtures.
2. Certified results of independent laboratory tests for fixtures and lamps for electrical ratings and photometric data.
3. Certified results of laboratory tests for fixtures and lamps for photometric performance.

B. Maintenance Data: For lighting fixtures to include in maintenance manuals specified in Division 01.

### 1.4 QUALITY ASSURANCE

A. Fixtures, Emergency Lighting Units, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

B. Comply with NFPA 70.

C. FM Compliance: Fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM.

D. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs and emergency lighting and OFS Policy No. 2-19 referencing Section 5-9.2.1 of NFPA 101 (see emergency lighting submittal requirements).

E. Regulatory Requirements:

1. Furnish lighting fixtures and other equipment, including all modifications thereto and component electrical parts, listed by Underwriters' Laboratories as meeting National Electrical Code requirements and bearing the UL Label where such service is available for equipment specified.
2. All lighting fixtures with plastic lenses shall comply with the Michigan Department of State Police, Fire Marshal Division, Policy Letter 11-6, dated March 24, 1992, applying to schools, colleges, hospitals, institutions, nursing homes, etc. Shop drawings and product data fixture cuts of such fixtures shall be accompanied by an approved certification stating compliance with the above ruling for forwarding to the State Fire Marshal by the Architect/Engineer.

### 1.5 COORDINATION

A. Fixtures, Mounting Hardware, and Trim: Coordinate layout and installation of lighting fixtures with ceiling system and other construction.

### 1.6 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 for Batteries: Written warranty, executed by manufacturer agreeing to replace rechargeable batteries that fail in materials or workmanship within specified warranty period.

1. Special Warranty Period for Batteries: Manufacturer's standard, but not less than 10 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for last nine years.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the products indicated for each designation in the Lighting Fixture Schedule on the drawings. No substitutions or alternates shall be accepted for lighting fixtures.

### 2.2 FIXTURES AND FIXTURE COMPONENTS, GENERAL

A. Metal Parts: Free from burrs, sharp corners, and edges.

B. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.

C. Doors, Frames, and Other Internal Access: Smooth operating, free from light leakage under operating conditions, and arranged to permit relamping without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during relamping and when secured in operating position.

D. Reflecting Surfaces: Minimum reflectance as follows, unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.
4. Laminated Silver Metallized Film: 90 percent.

E. Lenses, Diffusers, Covers, and Globes: 100 percent virgin acrylic plastic or annealed crystal glass, unless otherwise indicated.

1. Plastic: High resistance to yellowing and other changes due to aging, exposure to heat, and ultraviolet radiation.
2. Lens Thickness: 0.125 inch minimum, unless greater thickness is indicated.

F. Electromagnetic Interference Filters: Integral to fixture assembly. Provide one filter for each ballast. Suppress conducted electromagnetic interference filters as required by MIL-STD-461.

**2.3 EXIT SIGNS**

A. See lighting fixture schedule on drawings. Alternates will not be accepted.

**2.4 LED**

A. LED (Light Engine): Complies with IEC and FCC Standards.

1. LED color temperature: 3500°K for downlights, 4000°K for all other fixtures.
2. Operating Temperature: -40°C to +50°-C (-40°F to 122°F).
3. Operating Hours: Designed for 50,000+ hours of maintenance free operation.
4. Warranty: Limited 5 year warranty.
5. IP66 rated.
6. LM79 and LM80 compliant
7. UL listed.

B. Driver: Complies with IEC and FCC standards.

1. Driver: Remote LED Class 2 power supply.
2. Total fixture wattage should not exceed 90% of power supply rating.
3. Provides transient voltage protection in accordance with IEEE/ANSI C62.41.2 guidelines.
4. Input Voltage 120-277AC, Output Voltage 24V DC
5. Warranty: 5-year warranty.
6. UL listed.

**2.5 FIXTURE SUPPORT COMPONENTS**

A. Comply with Division 26 Sections for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Aircraft Cable Support: Use cable, anchorages, and intermediate supports recommended by fixture manufacturer.

**2.6 FINISHES**

A. Fixtures: Manufacturer's standard, unless otherwise indicated.

1. Paint Finish: Applied over corrosion-resistant treatment or primer, free of defects.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

A. Fixtures: Set level, plumb, and square with ceiling and walls, and secure according to manufacturer's written instructions and approved submittal materials. Install lamps in each fixture.

B. Support for Fixtures in Grid-Type Suspended Ceilings:

1. Install a minimum of two ceiling support system rods or wires independent from the ceiling grid “T” for each fixture. Locate not more than 6 inches from fixture corners.
2. Support Clips: Fasten to fixtures and to ceiling grid members at or near each fixture corner.
3. Fixtures of Sizes Less Than Ceiling Grid: Arrange as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.

## 3.2 CONNECTIONS

A. 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. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Advance Notice: Give dates and times for field tests 5 business days prior to testing.

C. Provide instruments to make and record test results.

D. Tests: As follows:

1. Verify normal operation of each fixture after installation.
2. Emergency Lighting: Interrupt electrical supply to demonstrate proper operation.
3. Verify normal transfer to battery source and retransfer to normal.
4. Report results in writing.

E. Malfunctioning Fixtures and Components: Replace or repair, then retest. Repeat procedure until units operate properly.

F. Corrosive Fixtures: Replace during warranty period.

## 3.4 CLEANING AND ADJUSTING

A. Clean fixtures internally and externally after installation. Use methods and materials recommended by manufacturer.

B. Adjust aimable fixtures to provide required light intensities.

**END OF SECTION 26 5100**

# SECTION 28 3111 - FIRE ALARM SYSTEM - ADDRESSABLE

## 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 work of this section.

### 1.2 SUMMARY

A. This Specification provides the requirements for the installation of a complete point-addressable type manual and automatic fire detection system network. The system shall include, but not be limited to: Control panel, remote annunciator panel, alarm initiating and indicating peripheral devices, fire door holders, conduit, wire and accessories required to finish a complete operational system including a communication link that provides the transmission of the status of the fire alarm system via two (2) dedicated telephone lines, to a remote off-site command station.

B. The system specified herein will provide emergency/voice alarm notification throughout the entire facility. That is, voice notification is required in both the new and existing portions of the building. All notification devices in the existing building are to be replaced.

C. The completed system shall be certified on State Fire Marshal Form FM-12A in accordance with Public Act 144.

### 1.3 FIRE ALARM AND PROTECTIVE SYSTEM SEQUENCE OF OPERATION

A. The operation of a manual station or activation of any area smoke detector, duct smoke detector, thermal detector, sprinkler water flow switch, or any automatic alarm initiation device shall automatically:

1. Sound all alarm signals (Code 3) throughout the building.
2. Flash all alarm lights/strobe throughout the building. Silencing the devices (audible circuit) shall not automatically turn off flashing alarm lamp/strobes.
3. Operate prioritized outputs to release all smoke doors and magnetically-locked doors throughout the building.
4. Initiate the transmission of an alarm to central stations selected by the Owner or his representative. This selection, its fees and fees for any telephone lines are the sole responsibility of the Owner or his representative.
5. Visually indicate via the control panel LCD or an alarm LED, the addressable device of the circuit of alarm initiation. When the control panel goes into the alarm condition the (GREEN) NORMAL LED shall extinguish and the (RED) ALARM LED shall light, the BUZZER shall pulsate and the first line of the 80 character LCD shall indicate the REAL TIME, the number of MESSAGES WAITING< the TYPE OF ALARM, the ALARM ZONE NUMBER, and the TIME THAT THE ALARM OCCURRED>. The second line shall display the user specified message. In order to reduce false alarms, all inputs shall be capable of alarm verification. The system shall be capable of setting the sensitivity of all analog sensors by point and be capable of displaying the analog value of the sensor by device and/or traditional input and vectoring the value to the printer. The system shall automatically identify any analog sensor which becomes dirty (maintenance alert) prior to false alarming.
6. Upon operation of the associated duct smoke detector, the air handling systems shall be deactivated so as to prevent the recirculation of smoke. Such actions shall override the regular mechanical systems controls.
7. All smoke detector circuits shall be provided with alarm verification with adjustable time from 0 to 60 seconds. Time to set at 10 seconds.
8. A break in the initiating loop wiring shall light both the common trouble lamp and the respective zone trouble lamp on the control unit, as well as sound a trouble signal at the fire alarm control panel.
9. A break in the indicating loop wiring shall light the common trouble LED and "Indicating Loop Trouble" LED on the fire alarm control unit, as well as sound a trouble signal at the fire alarm control unit.

B. The operator shall acknowledge the alarm by pressing the acknowledge button, and the buzzer will silence providing there is not an additional alarm pending. If there are additional alarms waiting, the operator shall acknowledge all pending alarms before the buzzer will silence. To silence audible devices, the operator shall press the ALARM SILENCE button, a new alarm shall cause the audibles to resound. To reset the system, the operator shall press the RESET button.

C. Activation of a supervisory condition such as a sprinkler valve tamper switch, etc. shall automatically:

1. Display on the control panel LCD the zone or the addressable device from which the off normal (active point) condition was initiated. During the SUPERVISORY condition the amber SUPERVISORY LED shall light, the NORMAL LED shall go out, and the BUZZER shall pulsate. The LCD shall indicate ("SUPERV. SHORT") and the zone/ device number. The operator shall silence the buzzer by acknowledging all messages and pressing the TROUBLE SILENCE button.
2. Operate the prioritized output to initiate transmission to the central station.
3. Supervisory alarms shall be differentiated from trouble condition on circuit.

## 1.4 STANDARDS

A. The equipment and install shall comply with the current provisions of the following standard:

1. National Electric Code, Article 760 and applicable standards of NFPA 90A including (not an inclusive list):

a. NFPA 72A National Fire Alarm Code.
b. NFPA 101 Life Safety Code.

2. Local and State building codes.
3. Local authorities having jurisdiction: ULC, CSFM, BSA, State Fire Marshal.
4. Underwriters' Laboratories, Inc.

B. The system and all components shall be listed by Underwriters' Laboratories, Inc. for use in fire protective signaling system under the following standards as applicable:

1. NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems".
2. UL 217, "Single and Multiple Station Smoke Detectors".
3. UL 268, "Smoke Detectors for Fire Protective Signaling Systems".
4. UL 268A, "Smoke Detectors for Duct Applications".
5. UL 464, "Audible Signal Appliances".
6. UL 521, "Heat Detectors for Fire Protective Signaling Systems".
7. UL 864, "Control Units for Fire Protective Signaling Systems"
8. UL 1480, "Speakers for Fire Protective Signaling Systems".
9. UL 1971, "Signaling Devices for the Hearing Impaired".

## 1.5 RELATED WORK PROVIDED BY OTHERS

A. Furnished and installed under a separate contract, but wired as part of the work of this Section.

1. Water flow switches, gate valve supervisory switches and post indicator valve switch.

## 1.6 SUBMITTALS

A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.

1. Shop Drawings: Submit detailed point-to-point wiring diagrams and installation instructions. Shop drawings shall show color coding of connections and mounting dimensions of equipment.
2. Product Data: Submit product data for each fire alarm system component specified.

B. A complete set of shop drawings shall be submitted to the State of Michigan (SOM) Office of Fire Safety for approval in accordance with Act 144 of 1982. Shop drawings shall be approved by the SOM and all SOM comments reflected on the documents prior to submission of the shop drawings to the Engineer for approval. Shop drawings submitted to the Engineer prior to SOM approval will be returned - rejected.

C. The Contractor shall submit complete sets of documentation within 30 calendar days after award of purchase order. Indicate the type, size, rating, style, catalog number, manufacturers' names, photos, and/or catalog data sheets for all items to ensure compliance with these Specifications. This equipment shall be subject to his approval and no equipment shall be ordered without this approval. Equipment devices are shown on the Contract Drawings, provide shop drawings as follows:

1. Complete one-line riser diagram showing all equipment and the size, type and number of all conductors.
2. Drawing of typically multiplexed field panel.
3. Provide calculations to support the size of standby batteries submitted.
4. Include programming and installation manuals.

D. At Contract close-out deliver six (6) copies of the following to the Owner's Representative within thirty (30) days of date of system acceptance:

1. Installation and programming manuals covering the installed system.
2. Point-to-point diagrams of the entire system as installed. Number all conductors and show all terminations and splices.
3. The application program listing for the system as installed at the time of acceptance.
4. Name, address, and telephone of the authorized factory representative.

**1.7 WARRANTY**

A. Warranty all materials, installation and workmanship for one (1) year from date of acceptance, unless otherwise specified.

**1.8 MAINTENANCE**

A. Maintenance and Service Contract: Submit a maintenance and service contract with service rates covering all labor and materials necessary to repair damages to the system. The service contract shall include a differentiation between and definitions of "emergency" and "non-emergency" service with applicable rates for each.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

A. Manufacturer: Provide products by one of the following:

1. National Time & Signal
2. Simplex Grinnell

**2.2 CONTROL PANEL**

A. The Fire Alarm Control Panel shall be an addressable modular panel with solid state, microprocessor based electronics. It shall display only those primary controls and displays essential to operation during a fire alarm condition.

B. The fire alarm system shall allow for loading and editing special instructions and operating sequences as required. The system shall be capable of onsite programming to accommodate system expansion and facilitate changes in operation. All software operations shall be stored in a non-volatile programmable memory within the fire alarm control panel. Loss of primary and secondary power shall not erase the instructions stored in memory.

1. Full flexibility for selective input/output control functions based on ANDing, ORing, NOTing, timing and special coded operations shall also be incorporated in the resident software programming of the system.

C. The system shall have the capability of recalling alarms and trouble conditions in chronological order for the purpose of recreating an event history.

D. The control panel shall provide the following:

1. Setting of time and date.
2. LED testing.
3. Alarm, trouble, and abnormal condition listing.
4. Enabling and disabling of each monitor point separately.
5. Activation and deactivation of each control point separately.
6. Changing operator access levels.
7. Walk test enable.
8. Running diagnostic functions.
9. Displaying software revision level.
10. Displaying historical logs.
11. Displaying card status.
12. Point listing.
13. Connections to a remote off-site command station via a communication link.

E. For maintenance purposes the following lists shall be available from the point lists menu:

1. All points list by address.
2. Monitor point list.
3. Signal/Speaker list.
4. Auxiliary control list.
5. Feedback point list.
6. Pseudo point list.
7. LED/Switch status list.

F. Primary Keys, LED's and LCD Display: The Control Panel shall have a 2 line x 40 character liquid crystal display which shall be backlit for enhanced readability. So as to conserve battery standby power, it shall not be lit during an AC power failure unless an alarm condition occurs or there is keypad activity. The display shall support both upper and lower case letters. Lowercase letters shall be used for softkey titles and prompting the user. Uppercase letters shall be used for System Status information. A cursor shall be visible when entering information.

G. History Logging: The system shall be capable of logging and storing 300 events in an alarm log and 300 events in a trouble log. These events shall be stored in a battery protected random access memory. Each recorded event shall include the time and date of that event's occurrence.

1. The following Historical Alarm log events shall be stored:

a. Alarms
b. Alarm Acknowledgment
c. Alarm Silence
d. System Reset
e. Alarm Historical log cleared.

2. The following Historical Trouble log events shall be stored:

    a. Trouble conditions
    b. Supervisory alarms
    c. Trouble acknowledgment
    d. Supervisory acknowledgment
    e. Alarm verification tallies
    f. Walk test results
    g. Trouble Historical log cleared

H. Silent Walktest with History Logging: The system shall be capable of being tested by one person. While in testing mode the alarm activation of an initiating device circuit shall be silently logged as an alarm condition in the historical date file. The panel shall automatically reset itself after logging of the alarm. The momentary disconnection of an initiating or indicating device circuit shall be silently logged as a trouble condition in the historical data file. The panel shall automatically reset itself after logging of the trouble condition.

I. Access Levels: Provide a minimum of four (4) access levels with level 4 being the highest level. Level 1 actions shall not require a passcode. Passcodes shall consist of up to ten (10 digits. Changes to passcodes shall only be made by authorized personnel.

J. Communication with Addressable Devices: The system shall provide communication with initiating and control devices individually. All of these devices shall be individually annunciated at the control panel. Annunciation shall include the following conditions for each point:

1. Alarm
2. Trouble
3. Open
4. Short
5. Device Missing/Failed

K. All addressable devices shall have the capability of being disable or enabled individually.

L. Up to 127 addressable devices may be multi-dropped from a single pair of wires. Systems that require factory reprogramming to add or delete devices shall not be acceptable.

M. Identification of Addressable Devices: Each addressable device shall be uniquely identified by a dip switch address entered on each device at time of installation. The use of jumpers to set address shall not be acceptable due to the potential of vibration and poor contact. Device identification schemes that do not use uniquely set addresses but rely on electrical position along the communication channel are unacceptable. These systems cannot accommodate T-tapping because the addition of an addressable device between existing devices requires reprogramming of all existing electrically further devices.

N. All controls and visual indicators shall be located behind key-locked doors and windows to prevent tampering and unauthorized operation. Access shall be to the switches only and shall not expose wiring or components. The unit enclosure shall be key-locked to prevent unauthorized access. The unit enclosure shall be semiflush mounted with module termination drawings mounted on the inside of the panel cover.

O. Actuation of the disconnect switch shall light a disconnect trouble lamp and cause the local system trouble signal to operate.

P. The fire alarm panel shall provide a communication link to transmit the status of the fire alarm system to a remote of-site command station via dedicated telephone line.

Q. Provide modems at both ends of the communication link and appropriate software, including conduit and wiring. The dedicated telephone line will be provided by others.

R. Supplementary Relay Controls: Provide alarm activated relays as pilot controls for fan shutdown, door release, elevator recall, etc., as indicated on the Drawings and control diagrams.

S. System Power Failure Indicator: Provide a system power failure indicator to supervise the AC supply voltage to the fire alarm control unit. The unit shall contain a battery, automatic charger, and "power on" indicator.

T. Standby batteries shall be capable of operating the fire alarm system for a minimum of 24 hours and then operating all indicating units for at least five minutes. Batteries shall be placed in the fire alarm control unit or similar type enclosure located next to the control unit.

**2.3 NODE AND NAC PANELS**

A. Node and NAC panels shall be modular with solid state, microprocessor based electronics, operator interfaces, power supplies, audio generators, amplifiers, battery chargers and batteries as required. All components shall be supervised.

**2.4 BATTERIES**

A. Batteries shall be lead calcium and supervised so that a failure produces a "TROUBLE" signal.

**2.5 REMOTE ANNUNCIATOR**

A. The remote annunciator shall duplicate the backlit LCD display; the alarm acknowledge, supervisory acknowledge, trouble acknowledge, alarm silence, and system reset pushbuttons; the alarm, supervisory, and trouble audible signals; the alarm, supervisory, trouble, and power "on" LED’s; and the programmable function keys of the fire alarm control panel. A key "enable" switch or door lock, keyed to match the fire alarm control panel door lock, shall permit activating or deactivating the controls.

B. A remote microphone shall be included when the fire alarm system includes emergency voice/alarm communications, along with the same pushbuttons as the fire alarm control panel for selecting pre-recorded voice messages, and the same controls to choose total building or selected areas communications.

**2.6 ADDRESSABLE SPOT DETECTOR BASES**

A. Spot detector mounting bases shall be individually addressable, suitable for two wire operation, with a twist-lock head locking feature a DIP switch or electronic addressing means, and an LED that provides power "on", alarm and trouble indications. The bases shall be listed for ceiling and wall mounting. Removal of the detector head shall cause a trouble condition at the panel.

B. Where shown, the bases shall include an auxiliary relay that is controlled from the panel.

C. When bases are not in plain view, bases shall be connected to remote alarm indicators mounted in plain view at 48 inches above the floor.

**2.7 MULTISENSOR SMOKE DETECTOR HEADS**

A. Multi-sensor type smoke detector heads shall include sampling and reference ionization chambers with a single radioactive source, a photoelectric sensor and a programmable heat detector. The detectors shall support at least four levels of sensitivity selectable at the panel and 360 degree smoke entry.

**2.8 PHOTOELECTRIC SMOKE DETECTOR HEADS**

A. Photoelectric type smoke detector heads shall include a pulsed LED light source and a silicon photodiode receiver, at least seven levels of sensitivity selectable at the panel, an integral insect screen and 360 degree smoke entry. This type of detector shall be installed in all duct detectors.

## 2.9 HEAT DETECTOR HEADS

A. Heat detector heads shall include combination rate-of-rise and rate compensated fixed temperature sensing, two levels of rate-of-rise sensitivity selectable at the panel, and an independent 135 degrees F fixed temperature set point. Heat detector heads shall be self-restoring.

B. Heat detector heads for steam tunnels, cage wash areas and dish machine areas shall have a 135 degrees F fixed temperature set point and shall be self-restoring.

## 2.10 DUCT DETECTORS

A. Duct detectors shall be individually addressable and consist of a housing, sampling tubes, a baffle and a detachable detector head. Duct detectors shall include an alarm LED, a local test switch, and an auxiliary SPDT relay for ventilation system control. Duct detectors shall be resettable by actuating the panel reset pushbutton. The sampling tubes shall be capable of being cleaned through the housing cover.

B. The detector heads shall be photoelectric as specified above, but shall be capable of accepting ionization detector heads.

C. When not in plain view, duct detectors shall include remote alarm indicators and test switches mounted in plain view at 48 inches above the floor.

## 2.11 MANUAL PULL STATIONS

A. Manual pull stations shall be individually addressable, suitable for two wire operation, with a high impact red Lexan body and raised white lettering. Stations shall include an ADA compliant single action operating mechanism with a mechanical latch to hold an operated station open until reset.

B. Reset shall be accomplished through use of a key common to the panel or a small flat-blade screwdriver. Stations which use allen wrenches or special tools to reset are not acceptable. The point of reset shall be front accessible so stations with tamper-resistant covers can be reset easily.

## 2.12 MONITOR MODULES

A. Monitor modules for individual two wire contact monitoring shall be individually addressable, suitable for two wire operation, with a DIP switch or electronic addressing means, and a programmable latch feature for monitoring momentary contacts. Monitor modules shall monitor a single normally open dry contact using a Class B, Style B, initiating device circuit.

B. Monitor modules for zone or four wire device monitoring shall be individually addressable, suitable for four wire operation utilizing 24 volt DC power from the panel, and with a DIP switch or electronic addressing means. Zone monitor modules shall monitor multiple normally open dry contacts using a Class B, Style B, two wire initiating device circuit, or monitor a four wire device using a Class B, Style D, four wire initiating device circuit.

## 2.13 CONTROL MODULES

A. Control modules shall be individually addressable with DIP switches or electronic addressing means. Control modules shall provide either one normally open and one normally closed contact or a Form C contact per digital output. Control modules may have more than one digital output per module if each output has a unique address. Contacts shall be rated 0.5 amps at 120 volts AC or 2 amps at 28 volts DC resistive and shall be controlled by the panel.

## 2.14 SPEAKERS

A. Speakers shall be rated 125 to 12,000 Hertz, include four taps rated at from 1/4 to 2 watts, produce a sound level of 82 dBA at 10 feet when set at the 1/2 watt tap, and with a semi-flush body capable of wall or ceiling mounting.

B. Speakers for locations with high ambient noise may be high efficiency horns rated 500 to 6,000 Hertz minimum, 10 watts minimum, include four or more taps, produce a sound level of 106 dBA minimum at 1 meter when set at the 1 watt tap, and be capable of wall or ceiling mounting.

## 2.15 STROBES

A. Strobes shall be rated 15, 30, 60, 75, 110 or 177 candela as shown for proper illuminance, with a 1 Hertz flash rate, Xenon flash tube, white body, clear Lexan lens with red "FIRE" or international fire symbol lettering, capable of being synchronized, and capable of wall or ceiling mounting.

## 2.16 COMBINATION HORN/STROBES AND SPEAKER/STROBES

A. Combination horn/strobes and speaker/strobes shall consist of the horns, speakers and strobes specified above, but combined on a single mounting plate. Combination units used outdoors and in wet areas shall be waterproof and mounted to waterproof back boxes.

## 2.17 DOOR HOLD-OPEN POWER SUPPLY

A. The door hold-open power supply shall produce 24 volts DC of sufficient amperage to provide 0.4 amps of current to every door hold-open device being controlled. The power supply shall be supervised and capable of withstanding the inrush current that will occur when the door hold-open devices are energized.

B. The output of the power supply shall be distributed by individually fused circuits. Fuse each circuit at 5 amps.

C. The power supply shall release the held open doors upon a fire alarm or an AC power failure.

## 2.18 EMERGENCY VOICE/ALARM COMMUNICATIONS

A. Emergency voice/alarm communications shall include audio control modules for evacuation tone and voice message generation, controls to choose total building or selected areas communications, audio amplifiers, a local microphone, and a remote microphone at each remote annunciator. All of the components except for the remote microphones shall be located in or adjacent to the fire alarm control panel.

B. The audio control module default mode shall provide for automatic total building fire alarm evacuation. The evacuation tone shall consist of a three-pulse temporal pattern followed by a pre-recorded fire alarm voice message. At the end of each voice message, the evacuation tone shall resume. The evacuation tone and voice message shall sound alternately until the alarm silence pushbutton at the fire alarm control panel or remote annunciator has been pressed. Audio tones and voice messages shall be digitally transmitted between nodes.

C. The audio control modules shall provide for manual total building or selected area live voice communications. Upon keying of the local or a remote microphone, a three second continuous alert tone shall sound over the speakers indicating a live voice message will occur.

D. The evacuation and alert tones shall be digitally generated by programmable software so that changes can be made without component rewiring. The pre-recorded voice messages shall be stored digitally in non-volatile EPROM memory.

E. Audio amplifiers shall have a frequency response of 125 Hz to 12,000 Hz minimum.

F. Microphones shall be of a hand-held, push-to-talk, noise-canceling type with a frequency range of 200 Hz to 4000 Hz and a self-winding five foot coiled cable. An LED shall indicate the microphone push-to-talk pushbutton has been pressed and the speaker circuits are ready for transmission.

G. Remote microphones shall be enclosed in remote annunciator cabinets with lockable doors.

1. Remote microphones shall duplicate the manual voice transmission capability of the local microphone at the fire alarm control panel. The fire alarm control panel microphone shall have priority over any remote microphones.
2. The remote microphone cabinets shall include controls for total building or selected areas communications.

H. Should a Fire Department telephone communication system be provided, the telephones system shall be capable of being patched to the emergency voice/alarm communications system and controlled at the fire command center.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. System shall be installed with dedicated conduits, conductors, outlet boxes, fittings, connectors and accessories necessary to ensure a complete, operable system in compliance with all applicable codes and regulations.

B. Install all equipment at locations indicated, and secure to ceilings, walls, floors or structural members as required.

C. Provide final wiring and connections per the manufacturer's wiring diagrams. Wiring for the fire alarm system shall be in separate conduits from any other system.

D. Outlet, pull and junction boxes shall be installed in accordance with Section 26 0533.

E. All fire alarm system conduits and outlet boxes shall be marked and labeled.

F. T-tapped connections will not be allowed on any supervised circuits. Connections shall be directly to and from device terminal screws. Screw terminal shall have rising plates to terminate more than one wire or each wire shall be terminated to individual screws or each wire shall terminate in a ring lug.

1. Notification appliance circuits (NAC) shall be Class B.
2. Communication (initiating) circuits shall be Class A.

G. The location of smoke detectors in air ducts shall be as required by code and shall be accessible for maintenance. Duct smoke detectors shall be hard wired to shutdown associated air handlers.

H. Provide as-built wiring diagrams at completion of Project.

### 3.2 IDENTIFICATION

A. All junction box covers, conduit couplings and panels shall be painted red to match system manufacturer's hue.

B. Label all control and monitor modules and detectors with point numbers and function.

## 3.3 FIELD 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.

1. Provide equipment to check the calibration of instruments. Instruments not in calibration, shall be recalibrated to function as required, or shall be replaced.
2. 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.

B. Demonstration: After calibration, adjustment, and checking have been completed and system is operational, demonstrate to the governing authorities having jurisdiction and to the Architect-Engineer 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.

1. When system is in specified operational condition, and when pertinent operational functions have been demonstrated, system will be accepted.

**END OF SECTION 28 3111**

# SECTION 31 1000 - SITE CLEARING

## 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.

B. CAD files will be made available for use in construction staking. Contact the engineer regarding applicable fee and requirements for signing of the CAD File Transfer Agreement.

### 1.2 SUMMARY

A. This Section includes the following:

1. Protecting existing trees, shrubs and other vegetation to remain.
2. Removing existing trees, shrubs and other vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Removing above-grade and below-grade site improvements.
6. Disconnecting, capping or sealing, and abandoning site utilities in place or removing site utilities.
7. Temporary erosion and sedimentation control measures.

B. Related Sections include the following:

1. Division 31 2000 Section "Earth Moving" for soil materials, excavating, backfilling, and site grading.

### 1.3 DEFINITIONS

A. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter; and free of subsoil and weeds, roots, toxic materials, or other nonsoil materials.

B. Tree Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and defined by the drip line of individual trees or the perimeter drip line of groups of trees, unless otherwise indicated.

### 1.4 MATERIAL OWNERSHIP

A. Except for stripped topsoil or other materials indicated to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site unless otherwise noted on the plans.

### 1.5 SUBMITTALS

A. Photographs or videotape, sufficiently detailed, of existing conditions of trees and plantings, adjoining construction, and site improvements that might be misconstrued as damage caused by site clearing.

B. Record drawings per Division 01 Sections.

1. Identifying and accurately locating capped utilities and other subsurface structural, electrical, and mechanical conditions.

### 1.6 QUALITY ASSURANCE

A. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Sections.

### 1.7 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by owner or authorities having jurisdiction.

B. Improvements on Adjoining Property: Authority for performing site clearing indicated on property adjoining Owner's property will be obtained by Owner before award of Contract. Contractor is to confirm that this authority has been obtained before beginning work on adjoining property.

C. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.

D. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.

E. Do not commence site clearing operations until temporary erosion and sedimentation control measures are in place.

## PART 2 - PRODUCTS

### 2.1 SOIL MATERIALS

A. Satisfactory Soil Materials: Requirements for satisfactory soil materials are specified in Division 31 2000 Section "Earth Moving."

1. Obtain approved borrow soil materials off-site when satisfactory soil materials are not available on-site. Contractor is responsible for doing an independent earthwork computation and including all necessary import and/or export of materials in their bid.

## PART 3 - EXECUTION

### 3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction. If said points will be disturbed, establish new points prior to removal.

B. Locate and clearly flag trees and vegetation to remain or to be relocated.

C. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

### 3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements

of authorities having jurisdiction and the sediment and erosion control drawings, whichever is more stringent.

B. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

C. Remove erosion and sedimentation controls only after all areas are restored and stabilized.

**3.3 TREE PROTECTION**

A. Erect and maintain temporary fencing around tree protection zones before starting site clearing. Remove fence when construction is complete.

1. Do not store construction materials, debris, or excavated material within fenced area.
2. Do not permit vehicles, equipment, or foot traffic within fenced area.
3. Maintain fenced area free of weeds and trash.

B. Do not excavate within tree protection zones, unless otherwise indicated.

C. Where excavation for new construction is required within tree protection zones, hand clear and excavate to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.

1. Cover exposed roots with burlap and water regularly.
2. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.
3. Coat cut faces of roots more than 1-1/2 inches in diameter with emulsified asphalt or other approved coating formulated for use on damaged plant tissues.
4. Backfill with soil as soon as possible.

D. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by Architect.

**3.4 UTILITIES**

A. Owner will arrange for disconnecting and sealing indicated utilities that serve existing structures before site clearing, when requested by Contractor.

1. Verify that utilities have been disconnected and capped before proceeding with site clearing.

B. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.

1. Arrange with utility companies to shut off indicated utilities.
2. Owner will arrange to shut off indicated utilities when requested by Contractor.

C. Existing Utilities: 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 according to requirements indicated:

1. Notify Architect not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Architect's written permission.

D. Excavate for and remove underground utilities indicated to be removed.

E. Removal of underground utilities is included in Division 33 Sections for covering site utilities.

## 3.5 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction.

1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
2. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
3. Grind stumps and remove roots, obstructions, and debris extending to a depth of 18 inches below exposed subgrade.
4. Use only hand methods for grubbing within tree protection zone.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

## 3.6 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.

1. Remove subsoil and nonsoil materials from topsoil, including trash, debris, weeds, roots, and other waste materials.

C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile topsoil material in locations approved by the Owner or Architect.

## 3.7 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.

1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.
2. Paint cut ends of steel reinforcement in concrete to remain to prevent corrosion.

## 3.8 DISPOSAL

A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, other vegetation and waste materials including trash and debris, and legally dispose of them off Owner's property.

1. Burning of materials on project property is prohibited.

**END OF SECTION 31 1000**

# SECTION 31 1012 - FINE GRADING

## 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.

B. CAD files will be made available for use in construction staking. Contact the engineer regarding applicable fee and requirements for signing of the CAD File Transfer Agreement.

### 1.2 SUMMARY

A. Work included: All labor, materials, necessary equipment and services to complete the Fine Grading work, as indicated on the drawings, as specified herein or both, except as for items specifically indicated as not in contract on the plans.

B. Related work specified elsewhere:

1. Division 31 2000 Section “Earth Moving.”

### 1.3 SITE INSPECTION

A. The Contractor shall visit the site and acquaint himself with all existing conditions. The Contractor shall be responsible for his own subsurface investigations, as necessary, to satisfy requirements of this Section. All subsurface investigations shall be performed only under time schedules and arrangements approved in advance by the Landscape Architect or Owner's Representative.

### 1.4 UTILITIES

A. Before starting site operations verify that the earlier Contractors have disconnected all temporary utilities which might interfere with the fine grading work.

B. Locate all existing, active utility lines traversing the site and determine the requirements for their protection. Preserve in operating condition all active utilities adjacent to or transversing the site that are designated to remain.

C. Observe rules and regulations governing respective utilities in working under requirements of this section. Adequately protect utilities from damage, remove or relocate as indicated, specified or required. Remove, plug or cap inactive or abandoned utilities encountered in excavation. Record location of active utilities.

D. Contact “Miss Dig” for existing utilities survey confirmation.

### 1.5 QUALITY ASSURANCE

A. Requirements of all applicable building codes and other public agencies having jurisdiction upon the work.

B. Primary emphasis should be given to the aesthetic appearance and functioning of berming and swales, as directed by the Landscape Architect or Owner's Representative. The Contractor shall employ skilled personnel and any necessary equipment to insure that finish grading is smooth, aesthetically pleasing, drains well and is ideal for receiving sod and plant materials.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

A. Existing Soil:

1. Strip existing topsoil for new construction unless otherwise directed by Owner's Representative, free from debris, sod, biodegradable materials and other deleterious materials. The Contractor shall insure that all existing soil has sufficient percolation and surface drainage to support grasses and plant material and that extreme compaction occurs only in areas to receive paving.
2. In areas to receive seed, verify that soil is scarified to depth of 3 inches and that soil contains enough organic matter to support and encourage rooting of seeded lawn.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Job Conditions

1. Dust control: Use all means necessary to prevent dust from construction operations from being a nuisance to adjacent property owners and from damaging finish surfaces on adjacent building, paving, etc. Methods used for dust control are subject to approval by the Architect or Owner's Representative.
2. Burning: On-site burning will not be permitted.
3. Protection: Use all means necessary to protect curbs, gutters, sprinklers, utilities and vegetation designated to remain, and, in the event of damage, immediately make all repairs, replacements and dressings to damaged plants necessary to the approval of the Landscape Architect. Contractor shall incur all cost for the replacement of damaged objects and vegetation.

### 3.2 SCHEDULING

A. Schedule all work in a careful manner with all necessary consideration for adjoining property owners and the public.

B. Coordinate schedule with other Contractors to avoid conflicts with their work.

### 3.3 EXCAVATION

A. Excavate where necessary to obtain subgrades, percolation and surface drainage as required.

B. Materials to be excavated are unclassified.

C. Remove entirely any existing obstructions after approval by the Architect's or Owner's Representative.

D. Remove from site and dispose of debris and excavated material not required.

### 3.4 GRADING

A. The Contractor shall establish finished grades as shown on the construction plans and as directed by the Architect, including areas where the existing grade has been disturbed by other work.

B. Finished grading shall be smooth, aesthetically pleasing, drain well and ready to receive sod and other plant material to full satisfaction of the Owner's Representative, Architect and Construction Manager.

## 3.5 COMPACTION

A. Compact each layer of fill in designated areas with approved equipment to achieve a maximum density at optimum moisture, AASHTO T 180 - latest edition.

1. Under buildings, roadways, curbs, walks and other paved areas: compaction shall be to 95% of maximum density.
2. Under landscaped area, compaction shall not exceed 85% of maximum density.

B. No backfill shall be placed against any masonry or other exposed building surface until permission has been given by the Owner's Representative, and in no case until the masonry has been in place seven days.

C. Compaction in limited areas shall be obtained by the use of mechanical tampers or approved hand tampers. When hand tampers are used, the materials shall be deposited in layers not more than four inches thick. The hand tampers used shall be suitable for this purpose and shall have a face area of not more than 100 square inches. Special precautions shall be taken to prevent any wedging action against masonry or other exposed building surfaces.

## 3.6 CORRECTION OF GRADE

A. Bring to required grade levels areas where settlement, erosion or other grade changes occur. Adjust grades as required to carry drainage away from buildings and to prevent ponding around the buildings and on pavements.

B. Remove all rock or objectionable material larger than 1 inch in any direction prior to commencing landscaping.

C. Contractor shall be responsible for stabilizing grades by approved methods prior to landscaping, and shall be responsible for correction of grades as mentioned above, and clean up of any wash outs or erosion.

**END OF SECTION 31 1012**

# SECTION 31 2000 - EARTH MOVING

## 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.

B. All earthwork operations shall confirm to the current Michigan Department of Transportation standards and specifications.

C. CAD files will be made available for use in construction staking. Contact the engineer regarding applicable fee and requirements for signing of the CAD File Transfer Agreement.

### 1.2 SUMMARY

A. This Section includes the following:

1. Preparing subgrades for slabs-on-grade, walks, pavements, lawns, and plantings.
2. Subbase course for concrete walks and pavements.
3. Base course for asphalt paving.
4. Excavation and backfill for utility trenches.

B. Related Sections include the following:

1. Division 31 1000 Section "Site Clearing" for site stripping, grubbing, removing topsoil, and protecting trees to remain.

### 1.3 DEFINITIONS

A. Backfill: Soil materials used to fill an excavation.

B. Base Course: Layer placed between the subbase course and asphalt paving.

C. Bedding Course: Layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Layer supporting slab-on-grade used to minimize capillary flow of pore water.

F. Engineered Fill: Fill placed and compacted to densities specified herein, in a controlled manner using lift thickness limited herein, monitored and tested by the Testing Agency or independent Geotechnical Inspector.

G. Excavation: Removal of material encountered above subgrade elevations.

H. Fill: Soil materials used to raise existing grades.

I. Rock: Rock material in beds, ledges, unstratified masses, and conglomerate deposits and boulders of rock material 3/4 cu. yd. (0.57 cu. m) or more in volume.

J. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

K. Subbase Course: Layer placed between the subgrade and base course for asphalt paving, or layer placed between the subgrade and a concrete pavement or walk.

L. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

M. Undercutting: Necessary excavation of poor quality soils which occur below the existing Topsoil and any uncontrolled fill soils as described in the Geotechnical Investigation.

N. Utilities include on-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

**1.4 SUBMITTALS**

A. Product Data: For the following:

1. Drainage fabric if required for the project .
2. Separation fabric if required for the project.

B. Test Reports: Testing Agency shall submit the following reports directly to the architect and shall copy the contractor:

1. Analysis of soil materials, whether procured on or off site, and including fill, backfill, and borrow materials.
2. In-place density test reports.
3. Moisture-density relationship test reports.
4. Compressive strength or bearing test reports.

C. Material Test Reports: Interpreting test results for compliance of the following with requirements indicated:

1. Classification according to ASTM D 2487 of each on-site or borrow soil material proposed for fill and backfill.

**1.5 QUALITY ASSURANCE**

A. Testing Agency Services

1. The Owner will secure and pay for the services of a qualified, independent geotechnical engineer to classify existing soil materials, to recommend and to classify proposed borrow materials when necessary, to verify compliance of materials with specified requirements, and to perform required field and laboratory testing. Geotechnical engineer shall be acceptable to the architect and the owner and shall be licensed to practice in the state in which the project is located.

B. Pre-excavation Conference: Conduct conference at Project site to comply with requirements in Division 01 Specification Sections for meetings.

**1.6 PROJECT CONDITIONS**

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Architect or Owner and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Architect and Owner not less than three (3) calendar days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Architect's or Owner’s written permission.
3. Contact utility-locator service for area where Project is located before excavating.

B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

## PART 2 - PRODUCTS

### 2.1 SOIL MATERIALS

A. General: Provide borrow soil materials without additional cost to Owner when sufficient satisfactory soil materials are not available from excavations. Contractor is responsible for doing an independent earthwork calculation and including any import of appropriate fill material required to bring the site to the proposed grades.

B. Satisfactory Soil Material (ASTM D 2487): Free of stones larger than 2 inches in any dimension, trash, debris, organic material, other objectionable material and classified as follows:

1. GP (poorly graded gravel).
2. GM (silty gravel).
3. GC (clayey gravel).
4. SW (well-graded sand).
5. SP (poorly graded sand).
6. SM (silty sand).

C. Unsatisfactory Soil Material (ASTM D 2487):

1. SC (clayey sand).
2. CL (lean clay).
3. ML (silt).
4. OL (organic clay).
5. OL (organic silt).
6. CH (fat clay).
7. MH (elastic silt).
8. OH (organic clay).
9. OH (organic silt).
10. PR (peat).

D. Backfill and Fill: Satisfactory soil materials.

E. Subbase: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; Generally either an MDOT Class II sand or 21AA gravel will meet this requirement. Refer to the plans for specific requirements.

F. Base: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; Generally either an MDOT Class II sand or 21AA gravel will meet this requirement. Refer to the plans for specific requirements.

G. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; Generally either an MDOT Class II sand or 21AA gravel will meet this requirement.

1. Clean granular fill meeting MDOT Class II grading requirements.
2. On-site granular deposits within the excavation can be used as engineered fill if approved by the geotechnical engineer and if selective excavation procedures are employed to manage existing clay deposits.
3. Import fill as required to make-up volumes necessary to raise the building site.
4. Refer to the plans for specific requirements.

H. Bedding: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; Generally either an MDOT 3G, 5G, 6A, or 34R will meet this requirement. Bedding requirements of the agencies having jurisdiction over the utility installation take precedence over these specifications.

I. Drainage Fill: Washed, narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D 448; Generally either an MDOT 6A or 34R will meet this requirement. Refer to the plans for specific requirements.

J. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

**2.2 ACCESSORIES**

A. Drainage Fabric: Nonwoven geotextile, specifically manufactured as a drainage geotextile; made from polyolefins, polyesters, or polyamides; with minimum properties determined according to ASTM D 4759 and referenced standard test methods.

B. Separation Fabric: Woven geotextile, specifically manufactured for use as a separation geotextile; made from polyolefins, polyesters, or polyamides; with minimum properties determined according to ASTM D 4759 and referenced standard test methods.

**PART 3 - EXECUTION**

**3.1 PREPARATION**

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

B. Protect subgrades and foundation soils against freezing temperatures or frost. Provide protective insulating materials as necessary.

C. Provide erosion-control measures approved by agency having jurisdiction to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

**3.2 EXPLOSIVES**

A. Explosives: Explosives are prohibited for use on the Project site.

**3.3 EXCAVATION, GENERAL**

A. General: Excavation includes the removal of any materials necessary to achieve the required subgrade elevations and includes reuse or disposal of such materials.

B. Unnecessary Excavation: The expense of excavation of materials outside of limits indicated or ordered in writing by the architect and the correction thereof to the satisfaction of the architect shall be borne by the contractor.

1. Unnecessary excavation under footings: Either deepen footings to bear on actual subgrade elevation without changing top elevations or place concrete fill up to required elevation, as required by the architect.
2. Unnecessary excavation other than under footings: Either place compacted fill or otherwise correct conditions, as required by the architect.

C. Approval of Subgrade: Notify the Testing Agency when required elevations have been reached.

1. When required by the architect due to the unforeseen presence of unsatisfactory materials or other factors, perform additional excavation and replace with approved compacted fill material in accordance with the architect's or geotechnical engineer's instructions.
2. Payment for unforeseen additional work will be made in accordance with established unit prices or, if none, in accordance with provisions for changes in the work. No payment will be made for correction of subgrades improperly protected against damage from freeze-thaw or accumulation of water, or for correction of otherwise defective subgrades.

D. Excavation Stabilization: Slope faces of excavations to maintain stability in compliance with requirements of governing authorities. Do not use shoring and bracing where faces can be sloped.

## 3.4 EXCAVATION FOR STRUCTURES

A. Do not proceed with excavations for building structures until Subgrade Preparation operations are complete and tested.

B. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch (25 mm). Extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
2. Pile Foundations: Stop excavations from 6 to 12 inches (150 to 300 mm) above bottom of pile cap before piles are placed. After piles have been driven, remove loose and displaced material. Excavate to final grade, leaving solid base to receive concrete pile caps.
3. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch (25 mm). Do not disturb bottom of excavations intended for bearing surface.

C. Coordinate excavations with Dewatering operations as required to allow construction of foundations to dry.

## 3.5 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated cross sections, elevations, and grades.

## 3.6 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths and elevations.

B. Excavate trenches to uniform widths to provide a working clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches (300 mm) higher than top of pipe or conduit, unless otherwise indicated.

C. Trench Bottoms: Excavate and shape trench bottoms in accordance with the plans and standard details. Excavate trenches a minimum 4 inches (100 mm) deeper than bottom of pipe elevation to allow for bedding course (excavate deeper as required by the regulating agency). Hand excavate for bell of pipe. Remove projecting stones and sharp objects along trench subgrade.

1. Excavate trenches a minimum 4 inches (100 mm) deeper than bottom of pipe elevation to allow for bedding course (excavate deeper as required by the regulating agency). Hand excavate for bell of pipe. Remove projecting stones and sharp objects along trench subgrade. Provide bedding course per the plan notes and/or details.

## 3.7 SUBGRADE PREPARATION AND INSPECTIONS

A. Perform mass earthwork operations to remove all existing topsoil and other organic materials in their entirety within the footprint of the proposed building and pavement areas. Buried objects should be removed in their entirety.

B. Notify Testing Agency when excavations have reached required subgrade elevations.

C. Proof-roll subgrade in the presence of the Testing Agency to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction repeating proof-rolling in direction perpendicular to the first direction. Limit vehicle speed to 3 mph.
2. Proof-roll subgrade with heavy pneumatic-tired equipment or loaded 10-wheel, tandem-axle truck weighing not less than 15 tons.
3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by the Testing Agency, and replace with engineered fill as directed.

D. If Testing Agency determines that unsatisfactory soil is present, continue excavations and replace with compacted backfill or fill materials as directed.

1. Additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities.

## 3.8 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill may be used at no additional cost to the Owner.

## 3.9 STORAGE OF SOIL MATERIALS

A. Stockpile borrow materials and satisfactory excavated soil materials. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

## 3.10 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, dampproofing, waterproofing, and perimeter insulation.
2. Surveying locations of underground utilities for record documents.
3. Inspecting and testing underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring and bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

## 3.11 UTILITY TRENCH BACKFILL

A. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

B. Place and compact initial backfill of subbase material, free of particles larger than 1 inch (25 mm), to a height of 12 inches (300 mm) over the utility pipe or conduit. All pipe backfill to be done according to the details shown on the plans or the requirements of the regulating agency.

C. Fill voids with approved backfill materials while shoring and bracing, and as sheeting is removed.

## 3.12 FILL

A. Preparation: Remove vegetation, topsoil, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface before placing fills

B. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

C. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use satisfactory soil material.
2. Under walks and pavements, use satisfactory soil material as long as the geotechnical engineer deems the material to be suitable and the compaction requirements can be met.
3. Under steps and ramps, use engineered fill.
4. Under building slabs, use engineered fill.
5. Behind walls, use engineered drainage fill.
6. Under footings and foundations, use engineered fill.
7. Over excavated areas, use engineered fill or lean concrete.

## 3.13 MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to within two (2) percent of optimum moisture content

1. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

## 3.14 COMPACTION OF BACKFILLS AND FILLS

A. Place backfill and fill materials in layers not more than 8 inches (200 mm) in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches (100 mm) in loose depth for material compacted by hand-operated tampers

B. Place backfill and fill materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

C. Compact soil to not less than the following percentages of maximum dry unit weight according to ASTM D 698 and ASTM D 1557:

1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches (300 mm) of existing subgrade and each layer of backfill or fill material at 95 percent.
2. Under walkways, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill material at 95 percent.
3. Under lawn or unpaved areas, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill material at 88 percent.

## 3.15 GRADING

A. General: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.
2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish Subgrades to required elevations within plus or minus 1 inch.

C. Grading Inside Grading Lines: Finish subgrade to a tolerance of ½ inch, when tested with a 10 foot straight-edge.

D. Contractor shall confirm that the proposed grades shown on the plans will not create a ponding water condition (i.e. an unintended low spot or pavement grades of less than 1%).

## 3.16 SUBSURFACE DRAINAGE

A. Subsurface Drain: Place a layer of drainage fabric around perimeter of drainage trench. Place a 6 inch course of filter material on drainage fabric to support drainage pipe. Encase drainage in a minimum of 12 inches of filter material and wrap in a drainage fabric, overlapping sides and ends at least 6 inches.

1. Compact each course of filter material to 95 percent of maximum dry unit weight according to ASTM D 698.

B. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 12 inches of final subgrade. Overlay drainage backfill with one layer of drainage fabric, overlapping sides and ends at least 6 inches.

1. Compact each course of filter material to 95 percent of maximum dry density according to ASTM D 698.

## 3.17 SUBBASE AND BASE COURSES

A. If indicated on the plans or deemed necessary by the geotechnical engineer, install separation fabric on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.

B. Under pavements and walks, place subbase course on separation fabric according to fabric manufacturer's written instructions if fabric is called for on the plan or deemed necessary by the geotechnical engineer.

C. Under pavements and walks, place base on prepared subbase or subgrade as follows:

1. Place base course material over subbase (or subgrade if subbase is not indicated).
2. Compact subbase and base courses at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.
3. When thickness of compacted subbase or base course exceeds 6 inches, place materials in equal layers, with no layer more than 6 inches thick or less than 3 inches thick when compacted.

D. Pavement Shoulders: Place shoulders along edges of subbase and base course to prevent lateral movement. Construct shoulders, at least 12 inches wide, of satisfactory soil materials and compact simultaneously with each subbase and base layers to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.

## 3.18 DRAINAGE COURSE

A. Under slabs-on-grade, if indicated on the plans, place drainage fabric on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.

B. Under slabs-on-grade, place drainage course on prepared subgrade and as follows:

1. Compact drainage course to required cross sections and thickness to no less than 95 percent of maximum dry unit weight according to ASTM D 698.
2. When compacted thickness of drainage course exceeds 6 inches, place materials in equal layers, with no more than 6 inches thick or less than 3 inches thick when compacted.

## 3.19 FIELD QUALITY CONTROL

A. Testing Agency: Construction Manager/Owner will engage a qualified independent Geotechnical engineering testing agency to perform field quality-control testing.

B. Allow testing agency to inspect and to test any subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work. Comply with requirements.

C. Testing agency will test compaction of soils in place according to ASTM D 1556. ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable.

D. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate and remove and replace soil to depth required, recompact and retest until specified compaction is obtained.

## 3.20 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces becomes eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

C. Protect all existing trees, bushes, plants, etc. indicated to remain during construction activities.

## 3.21 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Unless otherwise indicated on the drawings, remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of it off the Owner's property.

1. Do not burn materials on the Owner's property.

**END OF SECTION 31 2000**

# SECTION 32 1313 - CEMENT CONCRETE PAVEMENTS, CURBS AND GUTTERS

## 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.

B. All paving materials and construction methods shall conform to the current standards and specifications of the Michigan Department of Transportation. Where these specifications are less stringent than the requirements of MDOT, the MDOT standards shall govern.

### 1.2 SUMMARY

A. This Section includes exterior cement concrete pavement for the following:

1. Driveways and roadways.
2. Parking lots.
3. Curbs and gutters.
4. Sidewalks and platforms.
5. Wheel stops.

B. Related Sections include the following:

1. Division 31 2000 Section “Earth Moving” for subgrade preparation, grading and subbase course.

### 1.3 PERFORMANCE REQUIREMENTS

A. Refer to MDOT’s current Standard Specifications for Construction.

### 1.4 SUBMITTALS

A. Submit aggregate and concrete mix designs for review. Contractor shall confirm that the materials provided meet the required specifications, and provide material certification to the engineer. Material certification shall state that the products meet or exceed the requirements indicated on the plans and the requirements of the regulating authority.

### 1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer with at least three (3) years in business who has completed pavement work similar in material, design, and extent to that indicated for this Project.

B. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment and approved by authorities having jurisdiction or the DOT of the state in which Project is located.

1. Manufacturer must be certified according to the National Ready Mix Concrete Association's Plant Certification Program.

C. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.

D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant and each aggregate from one source.

### 1.6 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

B. Do not place concrete when base surface temperature is less than 40 degrees F (4 degrees C) or surface is wet or frozen.

## PART 2 - PRODUCTS

### 2.1 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces.

1. Use flexible or curved forms for curved conditions.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces.

### 2.2 STEEL REINFORCEMENT

A. Plain-Steel Welded Wire Fabric: ASTM A 185, fabricated flat sheets, unfinished.

B. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed billet steel, unfinished.

C. Epoxy-Coated Reinforcement Bars: ASTM A 775/A 775M; with ASTM A 615/A 615M, Grade 60, deformed bars.

D. Steel Bar Mats: ASTM A 184/A 184M; with ASTM A 615/A 615M, Grade 60, deformed bars; assembled with clips.

E. Joint Dowel Bars: Plain steel bars, ASTM A 615/A 615M, Grade 60. Cut bars true to length with ends square and free of burrs.

F. Epoxy-Coated Joint Dowel Bars: ASTM A 775/A 775M; with ASTM A 615/A 615M, Grade 60, plain steel bars.

G. Tie Bars: ASTM A 615/A 615M, Grade 60, deformed.

H. Hook Bolts: ASTM A 307, Grade A, internally and externally threaded. Design hook-bolt joint assembly to hold coupling against pavement form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.

I. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcement bars, welded wire fabric, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete or fiber-reinforced concrete of greater compressive strength than concrete.

J. Epoxy Repair Coating: Liquid two-part epoxy repair coating, compatible with epoxy coating on reinforcement.

### 2.3 CONCRETE MATERIALS

A. General: Use the same brand and type of cementitious material from the same manufacturer throughout the Project. All material to meet current MDOT specifications.

## 2.4 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry where indicated on Contract Documents.

B. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

C. Clear Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.

## 2.5 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.

1. Thickness: ½ inch minimum and thicker where indicated.

B. Coloring Agent: Where indicated, ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, nonfading, and resistant to lime and other alkalis.

1. Color: n/a

C. Wheel Stops (use only if indicated on the plans): Precast, air-entrained concrete; 2500-psi minimum compressive strength; approximately 6 inches high, 9 inches wide, and 84 inches long. Provide chamfered corners and drainage slots on underside, and provide holes for dowel-anchoring to substrate.

1. Dowels: Galvanized steel, diameter of 3/4 inch, minimum length 18 inches.

D. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery with emery aggregate containing not less than 50 percent aluminum oxide and not less than 25 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.

E. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

F. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class and grade to suit requirements.

## 2.6 CONCRETE MIXES

A. Prepare design mixes, proportioned according to ACI 211.1 and ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trial mixes.

B. Use a qualified independent testing agency for preparing and reporting proposed mix designs for the trial batch method.

C. Proportion mixes to provide concrete for driveways, roads, parking lots, curbs and gutters with the following properties:

1. Compressive Strength (28 Days): 4000 psi, unless otherwise indicated.
2. Maximum Water-Cementitious Materials Ratio: 45% by weight.
3. Maximum Aggregate Size: 1.5 inch (38 mm).

D. Sidewalks and platforms provide 4000 psi.

E. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements for concrete exposed to deicing chemicals.

F. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content of 5.0 to 8.5 percent.

G. Use appropriate treatment per MDOT specifications where concrete will be placed under freezing conditions. Obtain approval of architect prior to placing concrete in freezing conditions.

H. Coloring Agent: Where indicated, add coloring agent to mix according to manufacturer's written instructions.

**2.7 CONCRETE MIXING**

A. Ready-Mixed Concrete: Comply with requirements and with ASTM C 94 and ASTM C 1116.

1. When air temperature is between 85 deg F and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Comply with requirements and measure, batch, and mix concrete materials and concrete according to ASTM C 94. Mix concrete materials in appropriate drum-type batch machine mixer.

**PART 3 - EXECUTION**

**3.1 PREPARATION**

A. Proof-roll prepared subbase surface to check for unstable areas and verify need for additional compaction and repair as required.

B. Verify that grades are correct.

**3.2 EDGE FORMS AND SCREED CONSTRUCTION**

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations.

B. Clean forms after each use and coat with form release agent to ensure separation from concrete without damage.

**3.3 STEEL REINFORCEMENT**

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating reinforcement and with recommendations in CRSI's "Placing Reinforcing Bars" for placing and supporting reinforcement.

B. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

C. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

D. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap to adjacent mats.

## 3.4 JOINTS

A. General: Construct construction, isolation, and contraction joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.

B. At all locations where new concrete abuts existing concrete, building wall, or supported slabs, place expansion joint and joint sealant.

C. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour, unless pavement terminates at isolation joints.

1. Provide preformed galvanized steel or plastic keyway-section forms or bulkhead forms with keys, unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.

D. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where required.

1. Terminate joint filler 1 inch below finished surface to allow placement of joint sealant.
2. Joint sealant is required for all projects even if not indicated on the plans.

E. Expansion Joints: Place 1 inch (25 mm) wide expansion joints at maximum 40 foot intervals, if not indicated on drawings. Joints to be full depth of pavement. Place joint sealant at all expansion joints.

F. Install dowel bars and support assemblies at joints if indicated on the plans. Lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint.

G. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas. Construct ¼ inch wide contraction joints for a depth equal to at least one-third of the concrete thickness. Maximum spacing of contractions joints shall be 8'.

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 3/8-inch (10-mm) radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover marks on concrete surfaces.
2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.
3. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

H. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to the following radius.

1. Radius: 3/8 inch (10 mm).

## 3.5 CONCRETE PLACEMENT

A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcement steel, and items to be embedded or cast in. Notify other trades to permit installation of their work.

B. Remove snow, ice, or frost from subbase surface and reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Do not add water to concrete during delivery, at Project site, or during placement.

D. Consolidate concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures to consolidate concrete according to recommendations in ACI 309R.

E. Cold-Weather Placement: Comply with ACI 306.1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mix designs.

F. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R when hot-weather conditions exist.

**3.6 CONCRETE FINISHING**

A. General: Wetting of concrete surfaces during screeding, initial floating, or finishing operations is prohibited.

B. Float Finish: Float surface with power-driven floats, or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots, and fill low spots.

1. Area Paving: Light broom, texture perpendicular to pavement direction.
2. Curbs and Gutters: Light broom, texture parallel to pavement direction.
3. Direction of Texturing: Parallel to pavement direction.
4. Inclined Vehicular Ramps: Heavy broomed perpendicular to slope.
5. Place sealer on exposed concrete surfaces immediately after finishing. Apply in accordance with manufacturer’s instructions.

C. Provide detectable warning surface at all handicap ramps to meet ADA requirements in accordance with ANSI sections 406.13 and 705.

**3.7 CONCRETE PROTECTION AND CURING**

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and follow recommendations in ACI 305R for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions.

C. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

a. Water.
b. Continuous water-fog spray.
c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions.

## 3.8 PAVEMENT TOLERANCES

A. Comply with tolerances of ACI 117 and as follows:

1. Elevation Variation: 1/4 inch.
2. Thickness: Plus 3/8 inch, minus 1/4 inch.
3. Surface Variation: Gap below 10-foot- long, unleveled straightedge not to exceed 1/4 inch.
4. Maximum cross slope for walks, ramps, platforms: 2%
5. Maximum longitudinal walk slopes not requiring landings and handrails: 5%
6. Maximum longitudinal ramp slopes: 8.33% (1 on 12 slope)

## 3.9 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

B. Allow concrete pavement to cure for 28 days and be dry before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce pavement markings of dimensions indicated with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.

1. If indicated on the plans, spread glass beads uniformly into wet pavement markings at a rate of 6 lb/gal.

## 3.10 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspection agency to sample materials, perform tests, and submit test reports during concrete placement according to requirements specified.

B. Testing Services: Testing shall be performed according to the following requirements:

1. Compression Test Specimens: ASTM C 31/C 31M; one set of four standard cylinders for each compressive-strength test. Cylinders shall be molded and stored for laboratory-cured test specimens unless field-cured test specimens are required.
2. Compressive-Strength Tests: ASTM C 39; one set for each day's pour of each concrete class exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. One specimen shall be tested at 7 days and two specimens at 28 days; one specimen shall be retained in reserve for later testing if required.

C. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 24 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing agency, concrete type and class, location of concrete batch in pavement, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

D. Additional Tests: Testing agency shall make additional tests of the concrete when test results indicate slump, air entrainment, concrete strengths, or other requirements have not been met. Testing agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed.

## 3.11 REPAIRS AND PROTECTION

A. Remove and replace concrete pavement that is broken, damaged, or defective, or does not meet requirements as directed by the Architect.

B. Remove and replace concrete sidewalks and/or ramps that do not comply with maximum slopes indicated in Section 3.8A above.

C. Protect concrete from damage. Exclude traffic from pavement for at least fourteen (14) calendar days after placement.

**END OF SECTION 32 1313**

# SECTION 32 1373 - CONCRETE PAVING 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.

B. All paving materials and construction methods shall conform to the current standards and specifications of the Michigan Department of Transportation. Where these specifications are less stringent than the requirements of MDOT, the MDOT standards shall govern.

### 1.2 SUMMARY

A. General – all expansion joints are to receive joint sealant. Contraction and other joints receive sealant only if indicated on the plan.

B. This Section includes the following:

1. Expansion and contraction joints within cement concrete pavement.
2. Joints between cement concrete and asphalt pavement.

C. Related Sections include the following:

1. Division 32 Section "Cement Concrete Pavements, Curbs and Gutters" for constructing joints in concrete pavement.

### 1.3 SUBMITTALS

A. Product Data, shop drawing submittals are not required. Contractor shall confirm that the materials provided meet the required specifications, and provide material certification to the engineer. Material certification shall state that the products meet or exceed the requirements indicated on the plans and the requirements of the regulating authority.

### 1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

### 1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials to comply with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

### 1.6 PROJECT 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.
2. When joint substrates are wet or covered with frost.

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.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Available Products: Use products meeting MDOT's current specifications.

### 2.2 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backing materials, 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: Gray.

### 2.3 COLD-APPLIED JOINT SEALANTS

A. Type NS Silicone Sealant for Concrete: Single-component, low-modulus, neutral-curing, nonsag silicone sealant complying with ASTM D 5893 for Type NS.

1. Products:

a. Crafco Inc.; RoadSaver Silicone.
b. Dow Corning Corporation; 888.
c. Approved equal.

B. Type SL Silicone Sealant for Concrete and Asphalt: Single-component, low-modulus, neutral-curing, self-leveling silicone sealant complying with ASTM D 5893 for Type SL.

1. Products:

a. Crafco Inc.; RoadSaver Silicone SL.
b. Dow Corning Corporation; 890-SL.
c. Approved equal.

### 2.4 HOT-APPLIED JOINT SEALANTS

A. Elastomeric Sealant for Concrete: Single-component formulation complying with ASTM D 3406.

1. Products:

a. Crafco Inc.; Superseal 444/777.
b. Meadows, W. R., Inc.; Poly-Jet 3406.
c. Approved equal.

B. Sealant for Concrete and Asphalt: Single-component formulation complying with ASTM D 3405.

1. Products:

a. Koch Materials Company; Product No. 9005.
b. Koch Materials Company; Product No. 9030.

c. Meadows, W. R., Inc.; Sealtight Hi-Spec.
d. Approved equal.

**2.5 JOINT-SEALANT BACKER MATERIALS**

A. General: Provide joint-sealant backer materials that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by joint-sealant manufacturer based on field experience and laboratory testing.

B. Round Backer Rods for Cold- and Hot-Applied Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

C. Backer Strips for Cold- and Hot-Applied Sealants: ASTM D 5249; Type 2; of thickness and width required to control sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

D. Round Backer Rods for Cold-Applied Sealants: ASTM D 5249, Type 3, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

**2.6 PRIMERS**

A. Primers: Product 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.

**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 joint-sealant performance.

1. 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.

B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on 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.

**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 C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install backer materials of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of backer materials.

2. Do not stretch, twist, puncture, or tear backer materials.
3. Remove absorbent backer materials that have become wet before sealant application and replace them with dry materials.

D. 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 provided for each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified 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 sealants from surfaces adjacent to joint.
2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.

F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions, unless otherwise indicated.

G. Provide recessed joint configuration for silicone sealants of recess depth and at locations indicated.

## 3.4 CLEANING

A. Clean off excess sealants or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved 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 and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations with repaired areas are indistinguishable from the original work.

**END OF SECTION 32 1373**

# SECTION 32 9200 - TURFS AND GRASSES

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

### 1.2 SUMMARY

A. Section Includes:

1. Seeding.
2. Turf Renovation.
3. Sodding.

B. Related Sections:

1. Division 31 Section "Site Clearing" for topsoil stripping and stockpiling.
2. Division 31 Section "Earth Moving" for excavation, filling and backfilling, and rough grading.
3. Division 32 Section “Fine Grading” for final grades for planting.

### 1.3 DEFINITIONS

A. Finish Grade: Elevation of finished surface of planting soil.

B. Manufactured Soil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

C. Planting Soil: Native or imported topsoil, manufactured topsoil, or surface soil modified to become topsoil; mixed with soil amendments.

D. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill immediately beneath planting soil.

### 1.4 SUBMITTALS

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

B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture stating the botanical and common name and percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.

C. Certification of Bio-Retention Area Seed: From seed vendor for each bio-retention-seed monostand or mixture stating the botanical and common name and percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.

D. Product Certificates: For fertilizers, signed by product manufacturer.

E. Qualification Data: For landscape Installer.

F. Material Test Reports: For imported topsoil.

G. Planting Schedule: Indicating anticipated planting dates for each type of planting.

H. Maintenance Instructions: Recommended procedures to be established by Contractor for the Owner for maintenance of lawns during a calendar year. Submit before expiration of required maintenance periods.

**1.5 QUALITY ASSURANCE**

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful lawn establishment.

1. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when planting is in progress.

B. Soil-Testing Laboratory Qualifications: An independent laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.

C. Topsoil Analysis: Furnish soil analysis by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; location exchange capacity; sodium absorption ratio; deleterious material; pH; and mineral and plant-nutrient content of topsoil.

1. Report suitability of topsoil for lawn growth. State recommended quantities of nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce a satisfactory topsoil.

**1.6 DELIVERY, STORAGE, AND HANDLING**

A. Seed: Deliver seed in original sealed, labeled, and undamaged containers.

B. Sod: Harvest, deliver, store, and handle sod according to requirements in TPI's "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" in its "Guideline Specifications to Turfgrass Sodding."

**1.7 SCHEDULING**

A. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.

1. Spring Planting: April 1st and June 1st.
2. Fall Planting: September 15th and October 15th.

B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit.

**1.8 LAWN MAINTENANCE**

A. Begin maintenance immediately after each area is planted and continue until acceptable lawn is established, but for not less than the following periods:

1. Seeded Lawns: 60 days from date of Substantial Completion.

a. When full maintenance period has not elapsed before end of planting season, or if lawn is not fully established, continue maintenance during next planting season.
b. A minimum of two (2) lawn cuttings (MANICURED LAWN ZONES ONLY) will be completed before the owner takes over maintenance.

B. Maintain and establish lawn by watering, fertilizing, weeding, mowing, trimming, replanting, and other operations. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth lawn.

1. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch. Anchor as required to prevent displacement.

C. Watering: Provide and maintain temporary piping, hoses, and lawn-watering equipment to convey water from sources and to keep lawn uniformly moist to a depth of 4 inches.

1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
2. Water lawn at a minimum rate of 1 inch per week.

D. Mow lawn as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than 40 percent of grass height. Remove no more than 40 percent of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:

1. Mow grass to 2 inches height.

E. Lawn Postfertilization: Apply fertilizer after initial mowing and when grass is dry.

1. Apply Type B fertilizer to lawns approximately 30 days after seeding at a rate equal to 1.0 lb. of actual nitrogen per 1,000 sq. ft. (140 lbs./acre). Apply with a mechanical rotary or drop type distributor. Thoroughly water into soil. (Provide 3 applications)

F. Weed Control: If an infestation of weeds or crab grass develops prior to acceptance of the lawn, the Contractor shall treat the infestation by hand weeding or chemical control. The chemical control shall be furnished and installed by the contractor as recommended by the manufacturer and approved by the Landscape Architect. At least two weeks shall elapse after chemical control is applied before a request or inspection for acceptance is made to the Landscape Architect.

G. Apply fungicides and insecticides as required to control diseases and insects.

**PART 2 - PRODUCTS**

**2.1 SEED**

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Journal of Seed Technology; Rules for Testing Seeds" for purity and germination tolerances.

B. Seed shall be provided from one of the following suppliers

1. Lesco (248) 689-5005
2. Rhino Seed & Supply (800) 482-3130
3. Michigan State Seed Solutions (800) 647-8873

C. Seed Species: Seed of grass species as follows, with not less than 95 percent germination, not less than 85 percent pure seed, and not more than 0.5 percent weed seed:

1. General Seeded Lawn Areas (for lawn restoration areas only):

a. 50 percent Kentucky Bluegrass, a minimum of (3) three cultivars

b. 50 percent Perennial Ryegrass, a minimum of (2 or 3) two or three cultivars.

**2.2 TURFGRASS SOD**

A. Turfgrass Sod: Certified Number 1 Quality/Premium, including limitations on thatch, weeds, diseases, nematodes, and insects, complying with TPI's "Specifications for Turfgrass Sod Materials" in its "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture, strongly rooted, and capable of vigorous growth and development when planted.

B. Turfgrass Species: Sod of grass species as follows, with not less than 95 percent germination, not less than 85 percent pure seed, and not more than 0.5 percent weed seed:

1. Full Sun: Kentucky bluegrass (Poa pratensis), a minimum of three cultivars

**2.3 TOPSOIL**

A. Topsoil: ASTM D 5268, pH range of 5.5 to 7, a minimum of 4 percent organic material content; free of stones 1 inch or larger in any dimension and other extraneous materials harmful to plant growth.

1. Topsoil Source: Import topsoil or manufactured topsoil from off-site sources. Obtain topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 4 inches deep; do not obtain from agricultural land, bogs or marshes.

**2.4 INORGANIC SOIL AMENDMENTS**

A. Lime: ASTM C 602, agricultural limestone containing a minimum 80 percent calcium carbonate equivalent and as follows:

1. Class: Class T, with a minimum 99 percent passing through No. 8 sieve and a minimum 75 percent passing through No. 60 sieve.

B. Sulfur: Granular, biodegradable, containing a minimum of 90 percent sulfur, with a minimum 99 percent passing through No. 6 sieve and a maximum 10 percent passing through No. 40 sieve.

C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.

D. Aluminum Sulfate: Commercial grade, unadulterated.

E. Perlite: Horticultural perlite, soil amendment grade.

F. Agricultural Gypsum: Finely ground, containing a minimum of 90 percent calcium sulfate.

G. Sand: Clean, washed, natural or manufactured, free of toxic materials.

**2.5 ORGANIC SOIL AMENDMENTS**

A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1/2-inch sieve; soluble salt content of 5 to 10 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:

1. Organic Matter Content: 60 percent of dry weight.
2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.

B. Peat: Finely divided or granular texture, with a pH range of 6 to 7.5, containing partially decomposed moss peat, native peat, or reed-sedge peat and having a water-absorbing capacity of 1100 to 2000 percent.

C. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, and material harmful to plant growth.

**2.6 PLANTING ACCESSORIES**

A. Selective Herbicides: EPA registered and approved, of type recommended by manufacturer for application.

**2.7 FERTILIZER**

A. Granular, non-burning product composed of not less than 50% organic slow acting, guaranteed analysis professional fertilizer.

1. Type A: Starter fertilizer containing 11% nitrogen, 23% phosphoric acid, and 10% potash by weight or similar approved composition.
2. Type B: Top dressing fertilizer containing 31% nitrogen, 3% phosphoric acid, and 10% potash by weight or similar approved composition.

    a. Apply Type A fertilizer at initial sowing of seed and a Type B fertilizer application 4 weeks after initial germination.
    b. (Provide a min. one (1) Type A fertilizer application and three (3) Type B fertilizer applications)

**2.8 MULCHES**

A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.

B. Fiber Mulch: Biodegradable, dyed-wood, cellulose-fiber mulch; nontoxic; free of plant-growth or germination inhibitors; with maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.

C. Nonasphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.

D. Asphalt Emulsion: ASTM D 977, Grade SS-1; nontoxic and free of plant-growth or germination inhibitors.

**2.9 EROSION-CONTROL MATERIALS**

A. Erosion-Control Blankets: Biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a photodegradable plastic mesh. Include manufacturer's recommended steel wire staples, 6 inches long.

B. Erosion-Control Fiber Mesh: Biodegradable twisted jute or spun-coir mesh, a minimum of 0.92 lb/sq. yd., with 50 to 65 percent open area. Include manufacturer's recommended steel wire staples, 6 inches long.

## 2.10 PLANTING SOIL MIX

A. Planting Soil Mix: Mix topsoil with the following soil amendments in the following quantities:

1. Planting Beds:

a. Three parts well-drained screened organic imported topsoil to one part clean imported sand to one part Canadian sphagnum peat moss, to one part natural compost (weed-free).

2. Lawns:

a. Manicured Lawns shall use screened stock-piled topsoil from specified on-site location.

## 2.11 SEEDING

A. General: Provide grasses for seeding.

## 2.12 MATERIALS

A. Topsoil for Seeding Lawn Areas.

B. Seed: Fresh, clean and new crop seed mixture. Mixed by approved methods.

C. Composed of the following varieties, mixed to the specified proportions by weight and tested to minimum percentages of purity and germination.

D. Seed Mixture: Proportioned by weight as indicated below:

1. Lawns

| MDOT Mix THM | Proportion | Minimum Purity | Minimum Germination |
|---|---|---|---|
| Kentucky Bluegrass | 30% | 98% | 85% |
| Creeping Red Fescue | 50% | 97% | 85% |
| Perennial Ryegrass | 20% | 96% | 85% |

a. Spread at a rate of 220 lbs./acre
b. No noxious weed seeds permitted.

E. Fertilizer: 13-25-12. Granular, non-burning product composed of not less than 50% organic slow acting, guaranteed analysis, professional fertilizer.

F. Ground Limestone: Used if required by soil test report. Containing not less than 85% of total carbonates and ground to such fineness that 50% will pass through a 100 mesh sieve and 90% will pass through a 20% mesh sieve.

G. Granulated sulfur 0-0-0-90 to lower pH. Use if determined by soil tests to be necessary. Apply per soil test recommendations at specified rate.

H. Straw Mulch: Used in crimping process only. Clean oat or wheat straw well seasoned before bailing, free from mature seed-bearing stalks or roots of prohibited or noxious weeds.

I. Water: Free of substance harmful to seed growth. Hoses or other methods of transportation furnished by Contractor. Test for excess Alkalinity, if necessary.

J. Wood Cellulose Fiber Mulch: Degradable green dyed wood cellulose fiber or 100% recycled long fiber pulp, free from weeds or other foreign matter toxic to seed germination and suitable to hydra-mulching.

1. Available Manufacturer and Type:

a. Conwed Hydromulch: Conwed Corp., St. Paul, MN
b. Cellin Hydromulch: Cellin Mfg. Inc., Lorton, VA

K. Paper Mulch: Degradable paper mulch, free of foreign debris. Do not use on slopes over 30%. Available manufacturer and type NU Wool Hydro Mulch, Jennison, MI.

L. Tackifier: Liquid concentrate diluted with water forming a transparent 3-dimensional film like crust permeable to water and air and containing no agents toxic to seed germination.

1. Available Manufacturer and Type:

a. Finn Hydrostik, Fairfield, OH
b. Polying DLR: Celite Inc., Cleveland, OH

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine areas to receive lawns and grass for compliance with requirements and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.

1. Protect adjacent and adjoining areas from hydro-seeding overspray.

B. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

### 3.3 LAWN PREPARATION

A. Limit lawn subgrade preparation to areas to be planted.

B. Newly Graded Subgrades: Loosen subgrade to a minimum depth of 4 inches Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

1. Thoroughly blend planting soil mix off-site before spreading or spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil mix.

a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.
b. Mix lime with dry soil before mixing fertilizer.

2. Spread lawn planting soil mix to a depth of 3 inches but not less than required to meet finish grades after light rolling and natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.

C. Unchanged Subgrades: If lawns are to be planted in areas unaltered or undisturbed by excavating, grading, or surface soil stripping operations, prepare surface soil as follows:

1. Remove existing grass, vegetation, and turf. Do not mix into surface soil.
2. Loosen surface soil to a depth of at least 6 inches.
3. Remove stones larger than 1 inch in any dimension and sticks, roots, trash, and other extraneous matter.
4. Legally dispose of waste material, including grass, vegetation, and turf, off Owner's property.

D. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/4 inch of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit fine grading to areas that can be planted in the immediate future.

E. Moisten prepared lawn areas before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

F. Restore areas if eroded or otherwise disturbed after finish grading and before planting.

**3.4 SODDING**

A. Lay sod within 24 hours of harvesting. Do not lay sod if dormant or if ground is frozen or muddy.

B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to subgrade or sod during installation. Tamp and roll lightly to ensure contact with subgrade, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.

1. Lay sod across angle of slopes exceeding 1:3.
2. Anchor sod on slopes exceeding 1:6 with wood pegs or steel staples spaced as recommended by sod manufacturer but not less than 2 anchors per sod strip to prevent slippage.

C. Saturate sod with fine water spray within two hours of planting. During first week, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches below sod.

**3.5 SEEDING**

A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.

1. Do not use wet seed or seed that is moldy or otherwise damaged.

B. Sow seed at the rate of 220 lb/acre as indicated per specified seed mix.

C. Rake seed lightly into top 1/8 inch of topsoil, roll lightly, and water with fine spray.

D. Protect seeded areas with slopes exceeding 1:6 with erosion-control fiber mesh and 1:4 with erosion-control blankets installed and stapled according to manufacturer's written instructions.

E. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre to form a continuous blanket 1-1/2 inches in loose depth over seeded areas. Spread by hand, blower, or other suitable equipment.

1. Anchor straw mulch by crimping into topsoil with suitable mechanical equipment.

## 3.6 TURF RENOVATION

A. Renovate existing lawn.

B. Renovate existing lawn damaged by Contractor's operations, such as storage of materials or equipment and movement of vehicles.

1. Reestablish lawn where settlement or washouts occur or where minor regrading is required.

C. Remove sod and vegetation from diseased or unsatisfactory lawn areas; do not bury in soil.

D. Remove topsoil containing foreign materials resulting from Contractor's operations, including oil drippings, fuel spills, stone, gravel, and other construction materials, and replace with new topsoil.

E. Mow, dethatch, core aerate, and rake existing lawn.

F. Remove weeds before seeding. Where weeds are extensive, apply selective herbicides as required. Do not use pre-emergence herbicides.

G. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of them off Owner's property.

H. Till stripped, bare, and compacted areas thoroughly to a soil depth of 6 inches.

I. Apply soil amendments and initial fertilizers required for establishing new lawns and mix thoroughly into top 4 inches of existing soil. Provide new planting soil to fill low spots and meet finish grades.

J. Apply seed and protect with straw mulch as required for new lawns.

K. Water newly planted areas and keep moist until new lawn is established.

## 3.7 MULCHING

A. Place straw mulch on seeded areas within twenty-four (24) hours after seeding.

B. Place straw mulch uniformly in a continuous blanket at a rate of 2-1/2 tons per acre or two (2) 50 lb. bales per 1,000 sq. ft. of area. A mechanical blower may be used for straw mulch application when acceptable to the Engineer.

C. Crimp straw into soil by use of a “crimper.” Two (2) passes in opposite direction required.

## 3.8 SLIT SEEDING (OPTIONAL METHOD)

A. Lawn to be professionally slit seeded by using equipment designed for this purpose. Recommended brands: Brillant, Jacobsen or Olathe.

## 3.9 HYDROSEEDING (OPTIONAL METHOD)

A. Use a hydromulcher (sprayer) and apply mixture(s) at the following rate. Mix in accordance with manufacturer’s recommendations.

B. Apply hydroseed slurry to indicated areas. Use tackifier only on erosion prone areas. Apply fertilizer with hydro mix.

| | | |
|---|---|---|
| 1. | Seed: | At specified seeding rates (300 pounds per acre) |
| 2. | Fertilizer: | 400 pounds per acre |
| 3. | Tackifier: | 60 gallons per acre |
| 4. | Wood Cellulose Fiber Mulch: | 2000 pounds per acre |

C. Care must be taken not to get hydroseed materials on buildings, walks, roadways, plant beds, etc.

**3.10 SATISFACTORY LAWNS**

A. Satisfactory Seeded Lawn: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. (0.92 sq. m) and bare spots not exceeding 4 by 4 inches.

**3.11 CLEANUP AND PROTECTION**

A. Promptly remove soil and debris created by lawn work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Erect barricades and warning signs as required to protect newly planted areas from traffic. Maintain barricades throughout maintenance period and remove after lawn is established.

C. Remove erosion-control measures after grass establishment period.

**END OF SECTION 32 9200**