# Brunswick County Health and Human Services Building

30 GOVERNMENT CENTER DRIVE · BOLIVIA, NC 28422

EDIFICE CONSTRUCTION

**PERMIT SET**

02.06.2026

mcmillan pazdan smith ARCHITECTURE

1422 SOUTH TRYON STREET · SUITE 700 · CHARLOTTE, NC 28203 · (980) 201-3035

NC FIRM LICENSE # 52413

**ARCHITECT PROJECT 024370.01**

# DOCUMENT 00 01 07

# SEALS PAGE

## 1.1 SEALS PAGE

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| MPS ARCHITECTS, P.C. |
| ARCHITECT |

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| STEWART |
| STRUCTURAL ENGINEER |

NORRIS & TURNSTALL CONSULTING ENGINEERS

CIVIL ENGINEER AND LANDSCAPE ARCHITECT

QUALITY CONSULTING ENGINEERS, PLLC

COMMUNICATIONS AND ELECTRONIC SAFETY & SECURITY

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| CBHF ENGINEERS |
| PLUMBING ENGINEER |

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| CBHF ENGINEERS |
| HEATING VENTILATION AIR CONDITIONING ENGINEER |

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| CBHF ENGINEERS |
| ELECTRICAL ENGINEERS |

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| CBHF ENGINEERS |
| FIRE PROTECTION ENGINEERS |

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Date of Original Issue: Unless noted otherwise by a revised date, all documents and sections in this Project Manual are dated 02.06.2026
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## DESIGN TEAM LEADERS

Principal in Responsible Charge: Marcus Sheward
Project Manager: Lisa Howell
Design Professional: Brian Fessler
Specification Writer: Lois DaCrema
Construction Administrator: N/A
Interior Designer: Camille Fox


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**ATTACHMENTS:**

**ATTACHMENT A: Hydrant Flow Test Report**

**ATTACHMENT B: Geotechnical Report and Seismic Testing Report**

**END OF SECTION**

# DOCUMENT 00 31 00

# AVAILABLE PROJECT INFORMATION

## 1.1 SUBSURFACE INVESTIGATION REPORT

A. A copy of a Geotechnical Engineering Report is included with this Project Manual as Attachment B. Report is dated July 16, 2025 and produced by Timmons Group.

B. A copy of Geophysical Testing Report is included with this Project Manual As Attachment B. Report is dated August 21, 2025 and produced by S&ME, Inc.

C. The report identifies properties of below grade conditions and offers recommendations for design of foundations, prepared primarily for use of Engineer.

D. The report recommendations are not Contract requirements.

E. The report cannot reveal all conditions existing on the site. Should subsurface conditions be found to vary substantially from this report, Engineer may change the foundation design and construction by Change Order.

## 1.2 EXISTING CONDITIONS SURVEY

A. A copy of the Water Flow Tests prepared by Mark Palmer, Deputy Fire Marshal, is Attachment A to this Project Manual.

B. The existing conditions survey identifies conditions of existing construction prepared primarily for use of Engineer to establish extent of new versus existing work.

C. The existing conditions survey is not a Contract Document.

**END OF SECTION**

# SECTION 01 10 00

# 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. Section Includes:
1. Project information.
2. Work covered by Contract Documents.
3. Phased construction.
4. Work performed by Owner.
5. Multiple Work Packages.
6. Work under Owner's separate contracts.
7. Future work not part of this Project.
8. Owner's product purchase contracts.
9. Owner-furnished/Contractor-installed (OFCI) products.
10. Owner-furnished/Owner-installed (OFOI) products.
11. Contractor-furnished/Owner-installed (CFOI) products.
12. Contractor's use of site and premises.
13. Coordination with occupants.
14. Work restrictions.
15. Specification and Drawing conventions.
16. Miscellaneous provisions.

B. Related Requirements:
1. Section 01 50 00 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.
2. Section 01 73 00 "Execution" for coordination of Owner-installed products.

### 1.3 DEFINITIONS

A. Work Package: A group of specifications, drawings, and schedules prepared by the design team to describe a portion of the Project Work for pricing, permitting, and construction.

## 1.4 PROJECT INFORMATION

A. Project Identification: 024370.00.
   1. Project Location: 30 Government Center Drive NE, Bolivia, North Carolina, 28422, United States.

B. Owner: Brunswick County NC Government, 30 Government Center Drive, NE, Bolivia, North Carolina, 28422, United States.
   1. Owner's Representative: William L. Pinnix, william.pinnix@brunswickcountync.gov.

C. Architect: McMillan Pazdan Smith - Charlotte, 328 West Carson Boulevard, Suite 300, Charlotte, North Carolina, 28203.
   1. Architect's Representative: MPS Architects, P.C.

D. Project Coordinator for Multiple Contracts: Owner shall serve as Project coordinator.

E. Web-Based Project Software: Project software will be used for purposes of managing communication and documents during the construction stage.
   1. See Section 01 31 00 "Project Management and Coordination." for requirements for using web-based Project software.

## 1.5 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and includes, but is not limited to, the following:
   1. <Insert a brief description of Project indicating the size, code classification for occupancy and construction type, and general description of major building assemblies> and other Work indicated in the Contract Documents.

B. Type of Contract:
   1. Project will be constructed under a single prime contract.

## 1.6 WORK PERFORMED BY OWNER

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.

B. Preceding Work: Owner will perform the following construction operations at Project site. Those operations are scheduled to be substantially complete before Work under this Contract begins.

C. Concurrent Work: Owner will perform the following construction operations at Project site. Those operations will be conducted simultaneously with Work under this Contract.

## 1.7 OWNER-FURNISHED/CONTRACTOR-INSTALLED (OFCI) PRODUCTS

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.

## 1.8 CONTRACTOR'S USE OF SITE AND PREMISES

A. Unrestricted Use of Site: Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.

B. 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.

C. 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.

D. 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.

E. 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.

## 1.9 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 8:00 a.m. to 6:00 p.m., Monday through Friday, unless otherwise indicated. Work hours may be modified to meet Project requirements if approved by Owner and authorities having jurisdiction.

C. Smoking and Controlled Substance Restrictions: Use of tobacco products , alcoholic beverages, and other controlled substances on Owner's property is not permitted.

D. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.

E. Employee Screening: Comply with Owner's requirements for drug and background screening of Contractor personnel working on Project site.
   1. Maintain list of approved screened personnel with Owner's representative.

## 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.

C. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

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**

# SECTION 01 21 00

# ALLOWANCES

## 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 governing allowances.

B. Types of allowances include the following:
   1. Unit-cost allowances.

### 1.3 DEFINITIONS

A. Allowance: A quantity of work or dollar amount included in the Contract, established in lieu of additional requirements, used to defer selection of actual materials and equipment to a later date when direction will be provided to Contractor. If necessary, additional requirements will be issued by Change Order.

### 1.4 SELECTION AND PURCHASE

A. At the earliest practical date after award of the Contract, advise Architect of the date when final selection, or purchase and delivery, of each product or system described by an allowance must be completed by the Owner to avoid delaying the Work.

B. At Architect's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.

C. Purchase products and systems selected by Architect from the designated supplier.

### 1.5 ACTION SUBMITTALS

A. Submit proposals for purchase of products or systems included in allowances in the form specified for Change Orders.

## 1.6 INFORMATIONAL SUBMITTALS

A. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.

B. Submit time sheets and other documentation to show labor time and cost for installation of allowance items that include installation as part of the allowance.

C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

## 1.7 UNIT-COST ALLOWANCES

A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include [taxes, ]freight [,] and delivery to Project site.

B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner or selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.

C. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.
   1. If requested by Architect, retain and prepare unused material for storage by Owner. Deliver unused material to Owner's storage space as directed.

# PART 2 PRODUCTS - NOT USED

# PART 3 EXECUTION

## 3.1 EXAMINATION

A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

## 3.2 PREPARATION

A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

## 3.3 SCHEDULE OF ALLOWANCES

A. Allowance No. 1: Unit-Cost Allowance: Include the sum of $1200.00 per door leaf for interior doors and $2,000 per door leaf for exterior doors.

**END OF SECTION**

# SECTION 01 23 00

# ALTERNATES

## 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 alternates.

### 1.3 DEFINITIONS

A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if the Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
   1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
   2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternates into the Work. No other adjustments are made to the Contract Sum.

### 1.4 PROCEDURES

A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
   1. Include, as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation, whether or not indicated as part of alternate.

B. Execute accepted alternates under the same conditions as other Work of the Contract.

C. Schedule: A Part 3 "Schedule of Alternates" Article is included at the end of this Section. Specification Sections referenced in schedule contain requirements for

materials necessary to achieve the work described under each alternate.

## PART 2 PRODUCTS - NOT USED

## PART 3 EXECUTION

### 3.1 SCHEDULE OF ALTERNATES

A. Alternate No. <Insert number> : <Insert title of alternate>.
   1. Base Bid: <Insert brief description of base-bid requirement> as indicated on Drawing <Insert title of Drawing> and as specified in Section <Insert Section number> "<Insert Section title>."
   2. Alternate: <Insert brief description of alternate requirement> as indicated on Drawing <Insert title of Drawing> and as specified in Section <Insert Section number> "<Insert Section title>."

**END OF SECTION**

# SECTION 01 25 00

# 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 form [provided in Project Manual], [that is part of web-based Project management software], and [acceptable to Architect].
   2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
      a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
      b. 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.

c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. 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.
d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
e. Samples, where applicable or requested.
f. Certificates and qualification data, where applicable or requested.
g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
i. Research reports evidencing compliance with building code in effect for Project, from [ICC-ES].
j. 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.
k. Cost information, including a proposal of change, if any, in the Contract Sum.
l. 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.
m. 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. HYPERLINK "http://www.arcomnet.com/sustainable_design.aspx?topic=115" <Click to insert sustainable design text for requested substitution.>
      c. Substitution request is fully documented and properly submitted.
      d. Requested substitution will not adversely affect Contractor's construction schedule.
      e. Requested substitution has received necessary approvals of authorities having jurisdiction.
      f. Requested substitution is compatible with other portions of the Work.
      g. Requested substitution has been coordinated with other portions of the Work.
      h. Requested substitution provides specified warranty.
      i. 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: Not allowed [ unless otherwise indicated].

C. Substitutions for Convenience: Architect will consider requests for substitution if received within [60] days after [commencement of the Work], [the Notice to Proceed], and [the Notice of Award]. 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. HYPERLINK "http://www.arcomnet.com/sustainable_design.aspx?topic=115" <Click to insert sustainable design text for requested substitution.>
e. Substitution request is fully documented and properly submitted.
f. Requested substitution will not adversely affect Contractor's construction schedule.
g. Requested substitution has received necessary approvals of authorities having jurisdiction.
h. Requested substitution is compatible with other portions of the Work.
i. Requested substitution has been coordinated with other portions of the Work.
j. Requested substitution provides specified warranty.
k. 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**

# SECTION 01 26 00

# CONTRACT MODIFICATION 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 handling and processing Contract modifications.

### 1.3 MINOR CHANGES IN THE WORK

A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on web-based Project management software.

### 1.4 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
   1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
   2. Within 20 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
      a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
      b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
      c. Include costs of labor and supervision directly attributable to the change.
      d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity

duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

e. Quotation Form: Use form provided as part of web-based Project management software.

B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Section 01 25 00 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
7. Proposal Request Form: Use form provided as part of web-based Project management software.

## 1.5 ADMINISTRATIVE CHANGE ORDERS

A. Allowance Adjustment: See Section 01 21 00 "Allowances" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect actual costs of allowances.

B. Unit-Price Adjustment: See Section 01 22 00 "Unit Prices" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect measured scope of unit-price work.

## 1.6 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Work Change Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on AIA Document G701.

## 1.7 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
   1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
   1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

## PART 2 PRODUCTS - NOT USED

## PART 3 EXECUTION - NOT USED

**END OF SECTION**

# SECTION 01 31 00

# PROJECT MANAGEMENT AND COORDINATION

## PART 1 GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. Section includes administrative provisions for coordinating construction operations on Project, including, but not limited to, the following:
   1. General coordination procedures.
   2. Coordination drawings.
   3. RFIs.
   4. Digital project management procedures.
   5. Web-based Project management software package.
   6. Project meetings.

B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.

### 1.3 DEFINITIONS

A. BIM: Building Information Modeling.

B. RFI: Request for Information. Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

### 1.4 INFORMATIONAL SUBMITTALS

A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
   1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
   2. Number and title of related Specification Section(s) covered by subcontract.

3. Drawing number and detail references, as appropriate, covered by subcontract.

B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses, cellular telephone numbers, and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
   1. Post copies of list in Project meeting room, in temporary field office, in web-based Project software directory, and in prominent location in each built facility. Keep list current at all times.

## 1.5 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.

B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
   1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities [ and scheduled activities of other contractors] and [and direction of Project coordinator] to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
   1. Preparation of Contractor's construction schedule.
   2. Preparation of the schedule of values.
   3. Installation and removal of temporary facilities and controls.
   4. Delivery and processing of submittals.
   5. Progress meetings.
   6. Preinstallation conferences.
   7. Project closeout activities.
   8. Startup and adjustment of systems.

## 1.6 COORDINATION DRAWINGS

A. Provide Coordination Drawings locating all exterior wall-mounted devices for Architect review prior to installation.
   1. Exterior wall-mounted devices include but are not limited to lights, security cameras, and speakers.
   2. Exterior wall-mounted devices shall be located in regular rhythms and spaced centered on bays, windows, etc. to produce an overall harmonious appearance.

B. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
   1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
      a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
      b. Coordinate the addition of trade-specific information to coordination drawings [by multiple contractors ]in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
      c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
      d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
      e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
      f. Indicate required installation sequences.
      g. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

C. Coordination Drawing Organization: Organize coordination drawings as follows:
   1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
   2. Plenum Space: Indicate subframing for support of ceiling , raised access floor, and wall systems, mechanical and electrical equipment, and related Work. Locate components within plenums to accommodate layout of light fixtures and other components indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
   3. Mechanical Rooms: Provide coordination drawings for mechanical rooms,

showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.

4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
6. Mechanical and Plumbing Work: Show the following:
    a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
    b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
    c. Fire-rated enclosures around ductwork.
7. Electrical Work: Show the following:
    a. Runs of vertical and horizontal conduit 1-1/4 inches in diameter and larger.
    b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
    c. Panel board, switchboard, switchgear, transformer, busway, generator, and motor-control center locations.
    d. Location of pull boxes and junction boxes, dimensioned from column center lines.
8. Fire-Protection System: Show the following:
    a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
9. Review: Architect will review coordination drawings to confirm that, in general, the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make suitable modifications and resubmit.
10. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 01 33 00 "Submittal Procedures."

D. Coordination Drawing Process: Prepare coordination drawings in the following manner:
    1. Schedule submittal and review of Fire Sprinkler, Plumbing, HVAC, and Electrical Shop Drawings to make required changes prior to preparation of coordination drawings.
    2. Commence routing of coordination drawing files with HVAC Installer, who will provide drawing plan files denoting approved ductwork. HVAC Installer will locate ductwork and piping on a single layer, using orange color. Forward drawings to Plumbing Installer.
    3. Plumbing Installer will locate plumbing and equipment on a single layer, using blue color.
    4. Fire Sprinkler Installer will locate piping and equipment, using red color. Fire Sprinkler Installer shall forward drawing files to Electrical Installer.
    5. Electrical Installer will indicate service and feeder conduit runs and equipment in green color. Electrical Installer shall forward drawing files to Communications and

Electronic Safety and Security Installer.

6. Communications and Electronic Safety and Security Installer will indicate cable trays and cabling runs and equipment in purple color. Communications and Electronic Safety and Security Installer shall forward completed drawing files to Contractor.
7. Contractor shall perform the final coordination review. As each coordination drawing is completed, Contractor will meet with Architect to review and resolve conflicts on the coordination drawings.

E. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
   1. File Preparation Format:
      a. Same digital data software program, version, and operating system as original Drawings.
      b. DWG, Version <Insert designation>, operating in Microsoft Windows operating system.
   2. File Submittal Format: Submit or post coordination drawing files using PDF format.
   3. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.
      a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
      b. Contractor shall execute a data licensing agreement in the form of AIA Document C106.

## 1.7 REQUEST FOR INFORMATION (RFI)

A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor 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 Contractor.
   2. Coordinate and submit RFIs in a prompt manner to avoid delays in Contractor's work or work of subcontractors.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
   1. Project name.
   2. Owner name.
   3. Owner's Project number.
   4. Name of Architect .
   5. Architect's Project number.
   6. Date.
   7. Name of Contractor.
   8. RFI number, numbered sequentially.
   9. RFI subject.
   10. Specification Section number and title and related paragraphs, as appropriate.
   11. Drawing number and detail references, as appropriate.

12. Field dimensions and conditions, as appropriate.
13. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
14. Contractor's signature.
15. 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: Software-generated form with substantially the same content as indicated above, acceptable to Architect.
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 Contractor-generated 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. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 01 26 00 "Contract Modification Procedures."
    a. If Contractor believes the RFI response 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. Use software log that is part of web-based Project management software.
1. Project name.
2. Name and address of Contractor.
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.
9. Identification of related Field Order, Work 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 seven days if Contractor disagrees with response.

## 1.8 PROJECT MEETINGS

A. General: [Schedule and conduct] and [Construction Manager will schedule and conduct] meetings and conferences at Project site unless otherwise indicated.
   1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times a minimum of [seven] days prior to meeting.
   2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
   3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner [, Construction Manager,] and Architect, within [three] days of the meeting.

B. Preconstruction Conference: [Architect will schedule and conduct], [Construction Manager will schedule and conduct], and [Schedule and conduct] a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than [15] days after execution of the Agreement.
   1. Attendees: Authorized representatives of Owner [, Owner's Commissioning Authority,] and [, Construction Manager,] Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
   2. Agenda: Discuss items of significance that could affect progress, including the following:
      a. Responsibilities and personnel assignments.
      b. Tentative construction schedule.
      c. Phasing.
      d. Critical work sequencing and long lead items.
      e. Designation of key personnel and their duties.
      f. Lines of communications.
      g. Use of web-based Project software.
      h. Procedures for processing field decisions and Change Orders.
      i. Procedures for RFIs.
      j. Procedures for testing and inspecting.
      k. Procedures for processing Applications for Payment.
      l. Distribution of the Contract Documents.
      m. Submittal procedures.
      n. Sustainable design requirements.
      o. Preparation of Record Documents.

p. Use of the premises [ and existing building].
q. Work restrictions.
r. Working hours.
s. Owner's occupancy requirements.
t. Responsibility for temporary facilities and controls.
u. Procedures for moisture and mold control.
v. Procedures for disruptions and shutdowns.
w. Construction waste management and recycling.
x. Parking availability.
y. Office, work, and storage areas.
z. Equipment deliveries and priorities.
aa. First aid.
bb. Security.
cc. Progress cleaning.

3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

C. Sustainable Design Requirements Coordination Conference: [Owner will schedule and conduct] and [Construction Manager will schedule and conduct] a sustainable design coordination conference before starting construction, at a time convenient to Owner [, Construction Manager,] Architect, and Contractor.
1. Attendees: Authorized representatives of Owner, [ Owner's Commissioning Authority,] and [ Construction Manager,] Architect, and their consultants; Contractor and its superintendent and sustainable design coordinator; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Discuss items of significance that could affect meeting sustainable design requirements, including the following:
a. Sustainable design Project checklist.
b. General requirements for sustainable design-related procurement and documentation.
c. Project closeout requirements and sustainable design certification procedures.
d. Role of sustainable design coordinator.
e. Construction waste management.
f. Construction operations and sustainable design requirements and restrictions.
3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

D. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity when required by other Sections and when required for coordination with other construction.
1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect [, Construction Manager] and [, and Owner's Commissioning Authority] of scheduled meeting dates.

2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
   a. Contract Documents.
   b. Options.
   c. Related RFIs.
   d. Related Change Orders.
   e. Purchases.
   f. Deliveries.
   g. Submittals.
   h. Sustainable design requirements.
   i. Review of mockups.
   j. Possible conflicts.
   k. Compatibility requirements.
   l. Time schedules.
   m. Weather limitations.
   n. Manufacturer's written instructions.
   o. Warranty requirements.
   p. Compatibility of materials.
   q. Acceptability of substrates.
   r. Temporary facilities and controls.
   s. Space and access limitations.
   t. Regulations of authorities having jurisdiction.
   u. Testing and inspecting requirements.
   v. Installation procedures.
   w. Coordination with other work.
   x. Required performance results.
   y. Protection of adjacent work.
   z. Protection of construction and personnel.
3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

E. Project Closeout Conference: [Schedule and conduct] and [Construction Manager will schedule and conduct] a project closeout conference, at a time convenient to Owner and Architect, but no later than [90] days prior to the scheduled date of Substantial Completion.
   1. Conduct the conference to review requirements and responsibilities related to Project closeout.
   2. Attendees: Authorized representatives of Owner, [Owner's Commissioning Authority,] and [Construction Manager,] Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
   3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:

a. Preparation of Record Documents.
b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
c. Procedures for completing and archiving web-based Project software site data files.
d. Submittal of written warranties.
e. Requirements for completing sustainable design documentation.
f. Requirements for preparing operations and maintenance data.
g. Requirements for delivery of material samples, attic stock, and spare parts.
h. Requirements for demonstration and training.
i. Preparation of Contractor's punch list.
j. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
k. Submittal procedures.
l. Coordination of separate contracts.
m. Owner's partial occupancy requirements.
n. Installation of Owner's furniture, fixtures, and equipment.
o. Responsibility for removing temporary facilities and controls.

4. Minutes: Entity conducting meeting will record and distribute meeting minutes.

F. Progress Meetings: [Conduct] and [Construction Manager will conduct] progress meetings at [weekly], [biweekly], [monthly], and [regular] intervals.
1. Coordinate dates of meetings with preparation of payment requests.
2. Attendees: In addition to representatives of Owner [, Owner's Commissioning Authority] and [, Construction Manager,] and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
   a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
      1) Review schedule for next period.
   b. Review present and future needs of each entity present, including the following:
      1) Interface requirements.
      2) Sequence of operations.
      3) Resolution of BIM component conflicts.
      4) Status of submittals.
      5) Status of sustainable design documentation.
      6) Deliveries.
      7) Off-site fabrication.

8) Access.
9) Site use.
10) Temporary facilities and controls.
11) Progress cleaning.
12) Quality and work standards.
13) Status of correction of deficient items.
14) Field observations.
15) Status of RFIs.
16) Status of Proposal Requests.
17) Pending changes.
18) Status of Change Orders.
19) Pending claims and disputes.
20) Documentation of information for payment requests.

4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
   a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

G. Coordination Meetings: [Conduct], [Construction Manager will conduct], and [Project Coordinator will conduct] Project coordination meetings at [weekly], [biweekly], [monthly], and [regular] intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
   1. Attendees: In addition to representatives of Owner [, Owner's Commissioning Authority] and [, Construction Manager,] and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.
   2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
      a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
      b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
      c. Review present and future needs of each contractor present, including the following:
         1) Interface requirements.
         2) Sequence of operations.

3) Resolution of BIM component conflicts.
4) Status of submittals.
5) Deliveries.
6) Off-site fabrication.
7) Access.
8) Site use.
9) Temporary facilities and controls.
10) Work hours.
11) Hazards and risks.
12) Progress cleaning.
13) Quality and work standards.
14) Status of RFIs.
15) Proposal Requests.
16) Change Orders.
17) Pending changes.

3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION - NOT USED**

**END OF SECTION**

# SECTION 01 32 00

# CONSTRUCTION PROGRESS DOCUMENTATION

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
   1. Startup construction schedule.
   2. Contractor's Construction Schedule.
   3. Construction schedule updating reports.
   4. Daily construction reports.
   5. Material location reports.
   6. Site condition reports.
   7. Unusual event reports.

### 1.2 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction Project. Activities included in a construction schedule consume time and resources.
   1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
   2. Predecessor Activity: An activity that precedes another activity in the network.
   3. Successor Activity: An activity that follows another activity in the network.

B. Cost Loading: The allocation of the schedule of values for completing an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum.

C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine the critical path of Project and when activities can be performed.

D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

E. Event: The starting or ending point of an activity.

F. Float: The measure of leeway in starting and completing an activity.
   1. Float time is not for the exclusive use or benefit of either Owner or Contractor,

but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

G. Resource Loading: The allocation of labor and equipment necessary for completing an activity as scheduled.

## 1.3 INFORMATIONAL SUBMITTALS

A. Format for Submittals: Submit required submittals in the following format:
1. Working electronic copy of schedule file.
2. PDF file.

B. Startup construction schedule.
1. Submittal of cost-loaded startup construction schedule will not constitute approval of schedule of values for cost-loaded activities.

C. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.

D. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
1. Submit a working digital copy of schedule, using software indicated, and labeled to comply with requirements for submittals.

E. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports to contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
1. Activity Report: List of activities sorted by activity number and then early start date, or actual start date if known.
2. Logic Report: List of preceding and succeeding activities for each activity, sorted in ascending order by activity number and then by early start date, or actual start date if known.
3. Total Float Report: List of activities sorted in ascending order of total float.

F. Construction Schedule Updating Reports: Submit with Applications for Payment.

G. Daily Construction Reports: Submit at weekly intervals.

H. Material Location Reports: Submit at monthly intervals.

I. Site Condition Reports: Submit at time of discovery of differing conditions.

J. Unusual Event Reports: Submit at time of unusual event.

K. Qualification Data: For scheduling consultant.

## 1.4 QUALITY ASSURANCE

A. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 "Project Management and Coordination." Review methods and procedures related to the preliminary construction schedule and Contractor's Construction Schedule, including, but not limited to, the following:
   1. Review software limitations and content and format for reports.
   2. Verify availability of qualified personnel needed to develop and update schedule.
   3. Discuss constraints, including phasing, work stages, and interim milestones.
   4. Review delivery dates for Owner-furnished products.
   5. Review schedule for work of Owner's separate contracts.
   6. Review submittal requirements and procedures.
   7. Review time required for review of submittals and resubmittals.
   8. Review requirements for tests and inspections by independent testing and inspecting agencies.
   9. Review time required for Project closeout and Owner startup procedures .
   10. Review and finalize list of construction activities to be included in schedule.
   11. Review procedures for updating schedule.

## 1.5 COORDINATION

A. Coordinate Contractor's Construction Schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.
   1. Secure time commitments for performing critical elements of the Work from entities involved.
   2. Coordinate each construction activity in the network with other activities, and schedule them in proper sequence.

## 1.6 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.
   1. Use scheduling component of Project management software package specified in Section 01 31 00 "Project Management and Coordination," for current Windows operating system.

B. Time Frame: Extend schedule from date established for the Notice of Award to date of Final Completion.
   1. Contract completion date to not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

C. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
   1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
   2. Temporary Facilities: Indicate start and completion dates for the following as applicable:
      a. Securing of approvals and permits required for performance of the Work.
      b. Temporary facilities.
      c. Construction of mock-ups, prototypes and samples.
      d. Owner interfaces and furnishing of items.
      e. Interfaces with Separate Contracts.
      f. Regulatory agency approvals.
      g. Punch list.
   3. Procurement Activities: Include procurement process activities for the following long lead-time items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
   4. Submittal Review Time: Include review and resubmittal times indicated in Section 01 33 00 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
   5. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
   6. Commissioning Time: Include no fewer than [15] days for commissioning.
   7. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and Final Completion.

D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
   1. Phasing: Arrange list of activities on schedule by phase.
   2. Work under More Than One Contract: Include a separate activity for each contract.
   3. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
   4. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Section 01 10 00 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
   5. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 01 10 00 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
   6. Work Restrictions: Show the effect of the following items on the schedule:
      a. Coordination with existing construction.
      b. Limitations of continued occupancies.
      c. Uninterruptible services.
      d. Partial occupancy before Substantial Completion.
      e. Use-of-premises restrictions.
      f. Provisions for future construction.
      g. Seasonal variations.
      h. Environmental control.
   7. Work Stages: Indicate important stages of construction for each major portion of

the Work, including, but not limited to, the following:
a. Subcontract awards.
b. Submittals.
c. Purchases.
d. Mockups.
e. Fabrication.
f. Sample testing.
g. Deliveries.
h. Installation.
i. Tests and inspections.
j. Adjusting.
k. Curing.
l. Building flush-out.
m. Startup and placement into final use and operation.
n. Commissioning.

8. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
   a. Structural completion.
   b. Temporary enclosure and space conditioning.
   c. Permanent space enclosure.
   d. Completion of mechanical installation.
   e. Completion of electrical installation.
   f. Substantial Completion.

E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion .
   1. Temporary enclosure and space conditioning.

F. Cost Correlation: Superimpose a cost correlation timeline, indicating planned and actual costs. On the line, show planned and actual dollar volume of the Work performed as of planned and actual dates used for preparation of payment requests.
   1. See Section 01 29 00 "Payment Procedures" for cost reporting and payment procedures.

G. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
   1. Unresolved issues.
   2. Unanswered Requests for Information.
   3. Rejected or unreturned submittals.
   4. Notations on returned submittals.
   5. Pending modifications affecting the Work and the Contract Time.

H. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
   1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
   2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
   3. As the Work progresses, indicate Final Completion percentage for each activity.

I. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.

J. Distribution: Distribute copies of approved schedule to Architect  Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
   1. Post copies in Project meeting rooms and temporary field offices.
   2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

## 1.7 STARTUP CONSTRUCTION SCHEDULE

A. Gantt-Chart Schedule: Submit startup, horizontal, Gantt-chart-type construction schedule within seven days of date established for the Notice to Proceed.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

## 1.8 GANTT-CHART SCHEDULE REQUIREMENTS

A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's Construction Schedule within 30 days of date established for the Notice of Award.
   1. Base schedule on the startup construction schedule and additional information received since the start of Project.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.
   1. For construction activities that require three months or longer to complete,

indicate an estimated completion percentage in 10 percent increments within time bar.

## 1.9 CPM SCHEDULE REQUIREMENTS

A. Prepare network diagrams using AON (activity-on-node) format.

B. Startup Network Diagram: Submit diagram within 14 days of date established for the Notice to Proceed. Outline significant construction activities for the first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

C. CPM Schedule: Prepare Contractor's Construction Schedule using a cost- and resource-loaded, time-scaled CPM network analysis diagram for the Work.
   1. Develop network diagram in sufficient time to submit CPM schedule, so it can be accepted for use no later than 60 days after date established for the Notice of Award.
      a. Failure to include any work item required for performance of this Contract must not excuse Contractor from completing all work within applicable completion dates.
   2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
   3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
   4. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule to coordinate with the Contract Time.

D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.
   1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
      a. Preparation and processing of submittals.
      b. Mobilization and demobilization.
      c. Purchase of materials.
      d. Delivery.
      e. Fabrication.
      f. Utility interruptions.
      g. Installation.
      h. Work by Owner that may affect or be affected by Contractor's activities.
      i. Testing and inspection.
      j. Commissioning.
      k. Punch list and Final Completion.
      l. Activities occurring following Final Completion.

2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates to be consistent with Contract milestone dates.
3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
    a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.
5. Cost- and Resource-Loading of CPM Schedule: Assign cost to construction activities on the CPM schedule. Do not assign costs to submittal activities. Obtain Architect's approval prior to assigning costs to fabrication and delivery activities. Assign costs under main subcontracts for testing and commissioning activities, operation and maintenance manuals, punch list activities, Project record documents, and demonstration and training (if applicable), in the amount of 5 percent of the Contract Sum.
    a. Each activity cost to reflect an appropriate value subject to approval by Architect.
    b. Total cost assigned to activities to equal the total Contract Sum.

E. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall Project schedule.

F. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:
1. Contractor or subcontractor and the Work or activity.
2. Description of activity.
3. Main events of activity.
4. Immediate preceding and succeeding activities.
5. Early and late start dates.
6. Early and late finish dates.
7. Activity duration in workdays.
8. Total float or slack time.
9. Average size of workforce.
10. Dollar value of activity (coordinated with the schedule of values).

G. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
1. Identification of activities that have changed.
2. Changes in early and late start dates.
3. Changes in early and late finish dates.
4. Changes in activity durations in workdays.
5. Changes in the critical path.
6. Changes in total float or slack time.
7. Changes in the Contract Time.

H. Value Summaries: Prepare two cumulative value lists, sorted by finish dates.
   1. In first list, tabulate activity number, early finish date, dollar value, and cumulative dollar value.
   2. In second list, tabulate activity number, late finish date, dollar value, and cumulative dollar value.
   3. In subsequent issues of both lists, substitute actual finish dates for activities completed as of list date.
   4. Prepare list for ease of comparison with payment requests; coordinate timing with progress meetings.
      a. In both value summary lists, tabulate "actual percent complete" and "cumulative value completed" with total at bottom.
      b. Submit value summary printouts one week before each regularly scheduled progress meeting.

## 1.10 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
   1. List of subcontractors at Project site.
   2. List of separate contractors at Project site.
   3. Approximate count of personnel at Project site.
   4. Equipment at Project site.
   5. Material deliveries.
   6. High and low temperatures and general weather conditions, including presence of rain or snow.
   7. Testing and inspection.
   8. Accidents.
   9. Meetings and significant decisions.
   10. Unusual events.
   11. Stoppages, delays, shortages, and losses.
   12. Meter readings and similar recordings.
   13. Emergency procedures.
   14. Orders and requests of authorities having jurisdiction.
   15. Change Orders received and implemented.
   16. Construction Change Directives received and implemented.
   17. Services connected and disconnected.
   18. Equipment or system tests and startups.
   19. Partial completions and occupancies.
   20. Substantial Completions authorized.

B. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List to be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:
   1. Material stored prior to previous report and remaining in storage.
   2. Material stored prior to previous report and since removed from storage and

installed.

3. Material stored following previous report and remaining in storage.

C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

D. Unusual Event Reports: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, responses by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.
   1. Submit unusual event reports directly to Owner within [one] day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.

## PART 2 PRODUCTS - NOT USED

## PART 3 EXECUTION - NOT USED

**END OF SECTION**

# SECTION 01 33 00

# 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.

### 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."

### 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. Initial Submittal Schedule: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those

required early because of long lead time for manufacture or fabrication.

3. Final Submittal Schedule: Submit concurrently with the first complete submittal of Contractor's construction schedule.
    a. Submit revised submittal schedule as required to reflect changes in current status and timing for submittals.
4. 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.
    g. Scheduled dates for purchasing.
    h. Scheduled date of fabrication.
    i. Scheduled dates for installation.
    j. Activity or event number.

## 1.5 SUBMITTAL FORMATS

A. Submittal Information: Include the following information in each submittal:
    1. Project name.
    2. Date.
    3. Name of Architect.
    4. Name of Contractor.
    5. Name of firm or entity that prepared submittal.
    6. Names of subcontractor, manufacturer, and supplier.
    7. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier and alphanumeric suffix for resubmittals.
    8. Category and type of submittal.
    9. Submittal purpose and description.
    10. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
    11. Drawing number and detail references, as appropriate.
    12. Indication of full or partial submittal.
    13. Location(s) where product is to be installed, as appropriate.
    14. Other necessary identification.
    15. Remarks.
    16. Signature of transmitter.

B. Options: Identify options requiring selection by Architect.

C. 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.

D. Electronic Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

E. Submittals Utilizing Web-Based Project Software: Prepare submittals as PDF files or other format indicated by Project management software.

## 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 submittals as PDF package and transmit to Architect by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Architect.
      a. Architect will return annotated file. Annotate and retain one copy of file as a digital Project Record Document file.
   2. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project management software website. Enter required data in web-based software site to fully identify submittal.
   3. Paper: Prepare submittals in paper form and deliver to Architect.

B. 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.

C. 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 will advise Contractor when a submittal being processed must be delayed for coordination.
   2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
   3. Resubmittal Review: Allow 15 days for review of each resubmittal.
   4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of

each submittal.

5. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow 15 days for review of each submittal. Submittal will be returned to Architect before being returned to Contractor.
    a. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Architect .

D. Resubmittals: Make resubmittals in same form and number of copies 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.

E. 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.

F. 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 unless submittal based on Architect's digital data drawing files is otherwise permitted.
   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 Transmittal: Provide PDF transmittal. Include digital image file illustrating Sample characteristics and identification information for record.
   4. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
   5. Paper Transmittal: Include paper transmittal, including complete submittal information indicated.
   6. 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.
   7. 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 will return submittal with options selected.

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 paper copies of certificate, 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.
    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.

## 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 or indication in web-based Project management software. 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. PDF Submittals: Architect will indicate, via markup on each submittal, the appropriate action
      a. <Insert description of each action indicated on Architect's (and Construction Manager's) stamp>.
   2. Submittals by Web-Based Project Management Software: Architect will indicate, on Project management software website, the appropriate action.

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 .

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.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION - NOT USED**

**END OF SECTION**

# SECTION 01 41 00 - SPECIAL INSPECTIONS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

B. Refer to individual technical specification sections for specific qualifications, inspections, tests, frequency, and standards required.

### 1.2 GENERAL REQUIREMENTS

A. Special Inspections shall be in accordance with Chapter 17 of the International Building Code.

B. The program of Special Inspection is a system intended to ensure that the work is performed in accordance with the Contract Documents. These services do not relieve the Contractor and/or the Construction Manager of responsibility for compliance with the requirements of the Contract Documents.

C. This specification section is intended to inform the Contractor and/or the Construction Manager of the Owner's Special Inspection program and the extent of the responsibilities. This specification section is also intended to notify the Special Inspector, Testing Company/Testing Laboratory, and other Agents of the Special Inspector of their requirements and responsibilities.

D. Perform inspections in accordance with industry standard referenced for specific material or procedure unless other criteria are specified. In the absence of a referenced standard, perform inspections in accordance with generally accepted industry standards.

E. Failure to detect defective work or materials shall in no way prevent later rejection if defective work or materials are discovered.

### 1.3 SCHEDULE OF SPECIAL INSPECTIONS

A. Required Special Inspections are described on the Drawings.



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## 1.4 DEFINITIONS

A. Testing: Evaluation of systems, primarily requiring physical manipulation and analysis of materials, in accordance with approved standards.

B. Inspection: Evaluation of systems, primarily requiring observation and judgment.

C. Special Inspection: Special Inspection herein includes items required by the current State Building Code, and other items which in the professional judgment of the Structural Engineer of Record, are critical to the integrity of the building structure.

D. Structural Engineer of Record (SER): The Licensed Engineer in responsible charge of the structural design for the project.

E. Testing Agency (TA):

1. Testing Agency: Approved independent materials testing agency acceptable to the Owner, Architect, and SER.

F. Special Inspector (SI): A licensed professional engineer responsible for administering and performing all Special Inspections required by the Statement of Special Inspections.

G. Agents of Special Inspection (AI): Individual inspectors performing specific Special Inspections on behalf of the Special Inspector.

H. Building Official: The Officer or duly authorized representative charged with the administration and enforcement of the State Building Code.

## 1.5 QUALIFICATIONS

A. The Special Inspector shall be a licensed Professional Engineer (licensed in state in which project is located) experienced with the type of work requiring Special Inspections, who is approved by the Owner, Structural Engineer of Record (SER) and Building Official.

B. Required inspector’s qualifications for the Special Inspector and Agents of the Special Inspector are described in the attached Statement of Special Inspection.

## 1.6 SUBMITTALS

A. The Special Inspector shall submit to the Owner for review a copy of their qualifications which shall include the names and qualifications of each of the agents of Special Inspection who will be performing inspections.



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## 1.7 PAYMENT

A. The Owner shall engage and pay for the services of the Special Inspector and Agents of the Special Inspector.

B. The Contractor and/or Construction Manager shall be responsible for the cost of any re-inspection of work which fails to comply with the requirements of the Contract Documents.

## 1.8 RESPONSIBILITIES/AUTHORITY

A. Special Inspection:

1. Special Inspector and Agents of Special Inspections:

    a. Sign the Statement of Special Inspection in conjunction with other responsible parties prior to commencing construction.
    b. Inspect the work assigned for conformance with the contract documents and applicable material and workmanship provisions of the code. Perform inspection in a timely manner to avoid delay of work.
    c. Bring nonconforming items to the immediate attention of the Contractor and/or Construction Manager for correction, then, if uncorrected after a reasonable period of time, to the attention of the Structural Engineer of Record, the Building Official, and to the Owner.
    d. Submit inspection reports to the Contractor and/or Construction Manager, the Structural Engineer of Record, Owner, and other designated persons in accordance with the Statement of Special Inspection.
    e. Submit a final signed report stating whether the work requiring Special Inspection was, to the best of the Special Inspector's knowledge, in conformance with the contract documents and the applicable workmanship provisions of the code.

2. Architect:

    a. Expedite resolution of construction issues.

3. Structural Engineer of Record:

    a. Identify items requiring Special Inspection and define qualifications of Special Inspector required for work.
    b. Prepare and sign the Statement of Special Inspection in conjunction with other responsible parties prior to commencing construction.
    c. Review reports issued by Special Inspector.
    d. Assist in resolution of construction issues identified by Special Inspector.

4. Testing Agency:



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a. When engaged as a Special Inspector, provide Special Inspection services as noted in Item 1.8.A.1.
b. Copy Special Inspector on all materials testing reports.

5. Contractor/Construction Manager:

a. Arrange and attend all pre-construction meetings to review scope of Special Inspection. Include the Building Official, Owner, Architect, Structural Engineer of Record, Special Inspector, Testing Agency, and other parties concerned.
b. Post or make available the Statement of Special Inspection within the project site office. Provide timely notification to those parties designated on the schedule so they may properly prepare for and schedule their work.
c. Provide Special Inspector access to the approved plans and specifications at the project site.
d. Review all reports issued by Special Inspector.
e. Retain at the project site all reports submitted by the Special Inspector for review by the building official upon request.
f. Correct, in a timely manner, deficiencies identified in inspection reports.
g. Provide safe access to the work requiring inspection.
h. Provide labor and facilities to provide access to the work and to facilitate inspection.
i. Sign the Contractor's Statement of Responsibility, if required, prior to commencing construction.

6. Fabricator/Supplier:

a. Submit one copy of all material certificates and other quality assurance documents as required in the Statement of Special Inspections to the Special Inspector.

7. Building Official:

a. Accept and sign completed Statement of Special Inspection.
b. Review the final report submitted by Special Inspector.
c. Determine work, which, in the Building Official's opinion, involves unusual hazards or conditions (IBC 1705.1.1 – Special Cases).

8. Owner:

a. Provide and pay cost of Special Inspection services.
b. Provide Special Inspector with Contract Documents and accepted shop drawings.
c. Provide Special Inspector with full access to the site at all times.
d. Sign the Statement of Special Inspection in conjunction with other responsible parties prior to commencing construction.



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## 1.9 INSPECTION NOTES

A. Contractor and/or Construction Manager provide minimum of 24 hours' notice for all items requiring inspection. Do not construct items requiring inspection services until testing and inspection services are available. Do not enclose or obscure items requiring inspection services until inspection services are performed.

## 1.10 LIMITS ON AUTHORITY

A. The Special Inspector may not release, revoke, alter, or increase the requirements of the Contract Documents.

B. The Special Inspector will not have control over the Contractor and/or Construction Manager means or methods of construction.

C. The Special Inspector shall not be responsible for construction site safety.

D. The Special Inspector has no authority to stop the work.

## 1.11 DAILY RECORDS AND REPORTS

A. Detailed daily reports shall be prepared by Special Inspector and Agents of Special Inspection of each inspection and submitted to the Special Inspector. Reports shall include, but not be limited to:

1. Date of inspection.
2. Name of inspector or agent.
3. Location of specific areas inspected.
4. Description of inspection and results.
5. Applicable ASTM standard.
6. Weather conditions.
7. Identification of product and specification section.

B. Any discrepancies from the Contract Documents found during a Special Inspection shall be immediately reported to the Contractor and/or Construction Manager. If the discrepancies are not corrected, the Special Inspector shall notify the Structural Engineer of Record and Owner. Reports shall document all discrepancies identified and the corrective action taken.

C. The Testing Company/Testing Laboratory shall immediately notify the Special Inspector of any test results which fail to comply with the requirements of the Contract Documents.



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## 1.12 MONTHLY REPORTS

A. Monthly reports shall be prepared by the Special Inspector. Reports shall include, but not be limited to:

1. Summary of elements inspected during that month.
2. Copies of all discrepancies noted during that month.
3. Report of status of discrepancies including resolution of discrepancies.
4. Summary of all material certifications and quality assurance documents collected and reviewed during that month.

## 1.13 FINAL REPORT OF SPECIAL INSPECTIONS

A. The Final Report of Special Inspections shall be completed by the Special Inspector and submitted to the Structural Engineer of Record, Owner, Contractor and/or Construction Manager, and Building Official prior to the issuance of a Certificate of Use and Occupancy.

B. The Final Report of Special Inspections will certify that all required inspections have been performed and will itemize any discrepancies and how those discrepancies were resolved.

**END OF SECTION**



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# SECTION 01 73 00

# EXECUTION

## PART 1 GENERAL

### 1.1 SUMMARY

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

### 1.2 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.

B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

### 1.3 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 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.

## 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.
   1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

## PART 3 EXECUTION

### 3.1 EXAMINATION

A. 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.

B. 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.

C. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

## 3.2 PREPARATION

A. Existing Utility Information: Furnish information to local utility 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. 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.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. 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 in accordance with requirements in Section 01 31 00 "Project Management and Coordination."

## 3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks and existing conditions. If discrepancies are discovered, notify Architect promptly.

B. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

C. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

D. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect [ and Construction Manager].

## 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.

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.

## 3.5 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. 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.

C. Temporary Support: Provide temporary support of Work to be cut.

D. 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.

E. 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 10 00 "Summary."

F. 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 prevent interruption to occupied areas.

G. 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. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
   4. 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.
   5. Proceed with patching after construction operations requiring cutting are complete.

H. 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.

I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

## 3.6 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.
   3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, in accordance with regulations.
      a. Use containers intended for holding waste materials of type to be stored.
   4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.

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 in accordance with 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 [Section 01 50 00 "Temporary Facilities and Controls."]

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.

## 3.7 STARTING AND ADJUSTING

A. Coordinate startup and adjusting of equipment and operating components with requirements in Section 01 91 13 "General Commissioning Requirements."

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 40 00 "Quality Requirements."

## 3.8 PROTECTION 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. 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.

C. Comply with manufacturer's written instructions for temperature and relative humidity.

## 3.9 CORRECTION OF THE WORK

A. Repair or remove and replace damaged, defective, or nonconforming Work. Restore damaged substrates and finishes.
   1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.

C. Restore permanent facilities used during construction to their specified condition.

D. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

E. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

F. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

**END OF SECTION**

# SECTION 01 77 00

# CLOSEOUT PROCEDURES

## PART 1 GENERAL

### 1.1 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. List of incomplete items.
   4. Submittal of Project warranties.
   5. Final cleaning.

### 1.2 DEFINITIONS

A. List of Incomplete Items: 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.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of cleaning agent.

B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.

C. Certified List of Incomplete Items: Final submittal at Final Completion.

### 1.4 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

C. Field Report: For pest-control inspection.

### 1.5 MAINTENANCE MATERIAL SUBMITTALS

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

## 1.6 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 Section 01 29 00 "Payment Procedures."
   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 will 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 pest-control final inspection report.
   5. 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 Construction Manager] 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.

## 1.7 LIST OF INCOMPLETE ITEMS

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, 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. Name of Architect .
      d. Name of Contractor.
      e. Page number.
   4. Submit list of incomplete items in the following format:
      a. MS Excel Electronic File: Architect will return annotated file.
      b. PDF Electronic File: Architect will return annotated file.
      c. Web-Based Project Software Upload: Utilize software feature for creating and updating list of incomplete items (punch list).

### 1.8 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. 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.
   1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

## 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 in accordance with manufacturer's instructions.
      i. Vacuum and mop concrete.
      j. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean in accordance with manufacturer's instructions 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 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.
         1) Clean HVAC system in compliance with NADCA ACR. Provide written report on completion of cleaning.
      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 Section 01 50 00 "Temporary Facilities and Controls."

## 3.2 CORRECTION OF THE WORK

A. Complete repair and restoration operations required by "Correction of the Work" Article in Section 01 73 00 "Execution" before requesting inspection for determination of Substantial Completion.

**END OF SECTION**

# SECTION 01 78 23

# 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 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. Enable reviewer comments on draft submittals.

C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect 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 will return copy with comments.
   1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's comments and prior to commencing demonstration and training.

## 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.

## 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.
   7. Name and contact information for Architect.
   8. Name and contact information for Commissioning Authority.

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**

# SECTION 01 79 00

# DEMONSTRATION AND TRAINING

## PART 1 GENERAL

### 1.1 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.
   2. Demonstration and training video recordings.

### 1.2 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.
   1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

B. Attendance Record: For each training module, submit list of participants and length of instruction time.

C. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

### 1.3 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.

## 1.4 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.

## 1.5 INSTRUCTION

A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
   1. Architect will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
   2. Owner will furnish an instructor to describe Owner's operational philosophy.
   3. Owner will furnish Contractor with names and positions of participants.

B. 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 Architect,] and [, through Construction Manager,] with at least [seven] days' advance notice.

C. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of [an oral], [a written], and [a demonstration] performance-based test.

D. Cleanup: Collect used and leftover educational materials and [remove from Project site] and [give to Owner]. 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**

# SECTION 03 10 00 - CONCRETE FORMING 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 SUMMARY

A. Section Includes:

1. Form-facing material for cast-in-place concrete.
2. Form liners.
3. Shoring, bracing, and anchoring.

B. Related Requirements:

1. Section 321313 "Concrete Paving" for formwork related to concrete pavement and walks.

### 1.3 DEFINITIONS

A. Form-Facing Material: Temporary structure or mold for the support of concrete while the concrete is setting and gaining sufficient strength to be self-supporting.

B. Formwork: The total system of support of freshly placed concrete, including the mold or sheathing that contacts the concrete, as well as supporting members, hardware, and necessary bracing.

### 1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review the following:

a. Special inspection and testing and inspecting agency procedures for field quality control.
b. Construction, movement, contraction, and isolation joints



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c. Forms and form-removal limitations.
d. Shoring and reshoring procedures.
e. Anchor rod and anchorage device installation tolerances.

## 1.5 ACTION SUBMITTALS

A. Product Data: For each of the following:

1. Exposed surface form-facing material.
2. Concealed surface form-facing material.
3. Forms for cylindrical columns.
4. Form liners.
5. Form ties.
6. Waterstops.
7. Form-release agent.

B. Shop Drawings: Prepared by, and signed and sealed by, a qualified professional engineer responsible for their preparation, detailing fabrication, assembly, and support of forms.

1. For exposed vertical concrete walls, indicate dimensions and form tie locations.
2. Indicate dimension and locations of construction and movement joints required to construct the structure in accordance with ACI 301.

    a. Location of construction joints is subject to approval of the Architect.

3. Indicate location of waterstops.
4. Indicate form liner layout and form line termination details.
5. Indicate proposed schedule and sequence of stripping of forms, shoring removal, and reshoring installation and removal.

## 1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing and inspection agency.

B. Research Reports: For insulating concrete forms indicating compliance with International Code Council Acceptance Criteria AC353.

C. Field quality-control reports.

D. Minutes of preinstallation conference.



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## 1.7 QUALITY ASSURANCE

A. Testing and Inspection Agency Qualifications: An independent agency qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

## 1.8 DELIVERY, STORAGE, AND HANDLING

A. Form Liners: Store form liners under cover to protect from sunlight.

B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

# PART 2 - PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

A. Concrete Formwork: Design, engineer, erect, shore, brace, and maintain formwork, shores, and reshores in accordance with ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.

1. Design wood panel forms in accordance with APA's "Concrete Forming Design/Construction Guide."
2. Design formwork to limit deflection of form-facing material to 1/240 of center-to-center spacing of supports.

B. Design, engineer, erect, shore, brace, and maintain insulating concrete forms in accordance with ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.

1. Design cross ties to transfer the effects of the following loads to the cast-in-place concrete core:

    a. Wind Loads: As indicated on Drawings.

        1) Horizontal Deflection Limit: Not more than 1/240 of the wall height.

## 2.2 FORM-FACING MATERIALS

A. As-Cast Surface Form-Facing Material:



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1. Provide continuous, true, and smooth concrete surfaces.
2. Furnish in largest practicable sizes to minimize number of joints.
3. Acceptable Materials: As required to comply with Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete, and as follows:

    a. Plywood, metal, or other approved panel materials.
    b. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:

        1) APA Structural 1 Plyform, B-B or better; mill oiled and edge sealed.
        2) APA Plyform Class I, B-B or better; mill oiled and edge sealed.

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

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

C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class.

1. Provide forms with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

D. Form Liners:

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

    a. Architectural Polymers, Inc.
    b. Fitzgerald Formliners.
    c. Sika Corporation.
    d. Spec Formliners, Inc.

2. Face Pattern: Smooth.

## 2.3 WATERSTOPS

A. Flexible Rubber Waterstops: U.S. Army Corps of Engineers CRD-C 513, for embedding in concrete to prevent passage of fluids through joints, with factory fabricated corners, intersections, and directional changes.

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



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a. Williams Products, Inc.

2. Profile: Flat dumbbell with center bulb.
3. Dimensions: 4 inches by 3/16 inch thick; nontapered.

B. Flexible PVC Waterstops: U.S. Army Corps of Engineers CRD-C 572, for embedding in concrete to prevent passage of fluids through joints, with factory fabricate corners, intersections, and directional changes.

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

a. BoMetals, Inc.
b. Sika Corporation.
c. Vinylex Waterstop & Accessories.

2. Profile: Flat dumbbell with center bulb.
3. Dimensions: 4 inches by 3/16 inch thick; nontapered.

C. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch.

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

a. Carlisle Coatings & Waterproofing Inc.
b. CETCO, a Minerals Technologies company.
c. Concrete Sealants Inc.
d. Sika Corporation.

D. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free hydrophilic polymer-modified chloroprene rubber, for adhesive bonding to concrete, 3/8 by 3/4 inch.

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

a. Adeka Corporation.
b. CETCO, a Minerals Technologies company.
c. GCP Applied Technologies Inc.
d. Sika Corporation.



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## 2.4 RELATED MATERIALS

A. Reglets: Fabricate reglets of not less than 0.022-inch- thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

B. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034-inch- thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

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

D. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

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

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

F. Form Ties: Factory-fabricated, removable or snap-off, glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
2. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.
3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

# PART 3 - EXECUTION

## 3.1 INSTALLATION OF FORMWORK

A. Comply with ACI 301.

B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 and to comply with the Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete" for as-cast finishes.

C. Limit concrete surface irregularities as follows:



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1. Surface Finish-1.0: ACI 117 Class D, 1 inch.
2. Surface Finish-2.0: ACI 117 Class B, 1/4 inch.
3. Surface Finish-3.0: ACI 117 Class A, 1/8 inch.

D. Construct forms tight enough to prevent loss of concrete mortar.

1. Minimize joints.
2. Exposed Concrete: Symmetrically align joints in forms.

E. Construct removable forms for easy removal without hammering or prying against concrete surfaces.

1. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces.
2. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
3. Install keyways, reglets, recesses, and other accessories, for easy removal.

F. Do not use rust-stained, steel, form-facing material.

G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces.

1. Provide and secure units to support screed strips
2. Use strike-off templates or compacting-type screeds.

H. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible.

1. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar.
2. Locate temporary openings in forms at inconspicuous locations.

I. Chamfer exterior corners and edges of permanently exposed concrete.

J. At construction joints, overlap forms onto previously placed concrete not less than 12 inches.

K. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.

1. Determine sizes and locations from trades providing such items.
2. Obtain written approval of Architect prior to forming openings not indicated on Drawings.

L. Construction and Movement Joints:



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1. Construct joints true to line with faces perpendicular to surface plane of concrete.
2. Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
3. Place joints perpendicular to main reinforcement.
4. Locate joints for beams, slabs, joists, and girders in the middle third of spans.

    a. 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.

    a. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.

M. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.

1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
2. Close temporary ports and openings with tight-fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.

N. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

O. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

P. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

## 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.



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3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
4. Install dovetail anchor slots in concrete structures, as indicated on Drawings.
5. Clean embedded items immediately prior to concrete placement.

## 3.3 INSTALLATION OF WATERSTOPS

A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm.

1. Install in longest lengths practicable.
2. Locate waterstops in center of joint unless otherwise indicated on Drawings.
3. Allow clearance between waterstop and reinforcing steel of not less than 2 times the largest concrete aggregate size specified in Section 033000 "Cast-In-Place Concrete."
4. Secure waterstops in correct position at 12 inches on center.
5. Field fabricate joints in accordance with manufacturer's instructions using heat welding.

    a. Miter corners, intersections, and directional changes in waterstops.
    b. Align center bulbs.

6. Clean waterstops immediately prior to placement of concrete.
7. Support and protect exposed waterstops during progress of the Work.

B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated on Drawings, according to manufacturer's written instructions, by adhesive bonding, mechanically fastening, and firmly pressing into place.

1. Install in longest lengths practicable.
2. Locate waterstops in center of joint unless otherwise indicated on Drawings.
3. Protect exposed waterstops during progress of the Work.

## 3.4 REMOVING AND REUSING FORMS

A. Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.



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1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work.

1. Split, frayed, delaminated, or otherwise damaged form-facing material are unacceptable for exposed surfaces.
2. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints.

1. Align and secure joints to avoid offsets.
2. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

## 3.5 SHORING AND RESHORING INSTALLATION

A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.

1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.

C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

## 3.6 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Inspections:

1. Inspect formwork for shape, location, and dimensions of the concrete member being formed.



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2. Inspect insulating concrete forms for shape, location, and dimensions of the concrete member being formed.

**END OF SECTION**



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# SECTION 03 20 00 - CONCRETE REINFORCING

## 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 reinforcement bars.
2. Welded-wire reinforcement.

B. Related Requirements:

1. Section 034100 "Precast Structural Concrete" for reinforcing used in precast structural concrete.
2. Section 321313 "Concrete Paving" for reinforcing related to concrete pavement and walks.

### 1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review the following:

a. Special inspection and testing and inspecting agency procedures for field quality control.
b. Construction contraction and isolation joints.
c. Steel-reinforcement installation.

### 1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Each type of steel reinforcement.
2. Bar supports.
3. Mechanical splice couplers.



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B. Shop Drawings: Comply with ACI SP-066:

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

C. Construction Joint Layout: Indicate proposed construction joints required to build the structure.

1. Location of construction joints is subject to approval of the Architect.

## 1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1. Reinforcement To Be Welded: Welding procedure specification in accordance with AWS D1.4/D1.4M

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

1. Steel Reinforcement:

a. For reinforcement to be welded, mill test analysis for chemical composition and carbon equivalent of the steel in accordance with ASTM A706/A706M.

2. Mechanical splice couplers.

C. Field quality-control reports.

D. Minutes of preinstallation conference.

## 1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

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



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## 1.7 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

1. Store reinforcement to avoid contact with earth.

# PART 2 - PRODUCTS

## 2.1 STEEL REINFORCEMENT

A. Recycled Content of Steel Products: Post-consumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent.

B. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.

C. Low-Alloy Steel Reinforcing Bars: ASTM A706/A706M, deformed.

D. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn steel wire into flat sheets.

## 2.2 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A615/A615M, 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. Mechanical Splice Couplers: ACI 318 Type 1, same material of reinforcing bar being spliced; tension-compression type.

D. Steel Tie Wire: ASTM A1064/A1064M, annealed steel, not less than 0.0508 inch in diameter.

1. Finish: Plain.



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## 2.3 FABRICATING REINFORCEMENT

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

## PART 3 - EXECUTION

## 3.1 PREPARATION

A. Protection of In-Place Conditions:

1. Do not cut or puncture vapor retarder.
2. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

## 3.2 INSTALLATION OF STEEL REINFORCEMENT

A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.

B. Accurately position, support, and secure reinforcement against displacement.

1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
2. Do not tack weld crossing reinforcing bars.

C. Preserve clearance between bars of not less than 1 inch, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.

D. Provide concrete coverage in accordance with ACI 318.

E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

F. Splices: Lap splices as indicated on Drawings.

1. Bars indicated to be continuous, and all vertical bars shall be lapped not less than 36 bar diameters at splices, or 24 inches, whichever is greater.
2. Stagger splices in accordance with ACI 318.
3. Mechanical Splice Couplers: Install in accordance with manufacturer's instructions.
4. Weld reinforcing bars in accordance with AWS D1.4/D 1.4M, where indicated on Drawings.

G. Install welded-wire reinforcement in longest practicable lengths.



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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.
3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
4. Lace overlaps with wire.

## 3.3 JOINTS

A. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement.
2. Continue reinforcement across construction joints unless otherwise indicated.
3. Do not continue reinforcement through sides of strip placements of floors and slabs.

B. Doweled 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.

## 3.4 INSTALLATION TOLERANCES

A. Comply with ACI 117.

## 3.5 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Inspections:

1. Steel-reinforcement placement.
2. Steel-reinforcement mechanical splice couplers.

**END OF SECTION**



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# SECTION 03 30 00 - 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, placement procedures, and finishes.

B. Related Requirements:

1. Section 031000 "Concrete Forming and Accessories" for form-facing materials, form liners, insulating concrete forms, and waterstops.
2. Section 032000 "Concrete Reinforcing" for steel reinforcing bars and welded-wire reinforcement.
3. Section 312000 "Earth Moving" for drainage fill under slabs-on-ground.
4. Section 321313 "Concrete Paving" for concrete pavement and walks.

### 1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with fly ash.

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.



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2. Review the following:

    a. Special inspection and testing and inspecting agency procedures for field quality control.
    b. Construction joints, control joints, isolation joints, and joint-filler strips.
    c. Semirigid joint fillers.
    d. Vapor-retarder installation.
    e. Anchor rod and anchorage device installation tolerances.
    f. Cold and hot weather concreting procedures.
    g. Concrete finishes and finishing.
    h. Curing procedures.
    i. Forms and form-removal limitations.
    j. Shoring and reshoring procedures.
    k. Methods for achieving specified floor and slab flatness and levelness.
    l. Floor and slab flatness and levelness measurements.
    m. Concrete repair procedures.
    n. Concrete protection.
    o. Initial curing and field curing of field test cylinders (ASTM C31/C31M.)
    p. Protection of field cured field test cylinders.

## 1.5 ACTION SUBMITTALS

A. Product Data: For each of the following.

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

    a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.

5. Vapor retarders.
6. Floor and slab treatments.
7. Liquid floor treatments.
8. Curing materials.
9. Joint fillers.
10. Repair materials.

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

1. Mixture identification.
2. Minimum 28-day compressive strength.
3. Durability exposure class.



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

C. Shop Drawings:

1. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.

    a. Location of construction joints is subject to approval of the Engineer of Record.

D. Concrete Schedule: For each location of each Class of concrete indicated in "Concrete Mixtures" Article, including the following:

1. Concrete Class designation.
2. Location within Project.
3. Exposure Class designation.
4. Formed Surface Finish designation and final finish.
5. Final finish for floors.
6. Curing process.
7. Floor treatment if any.

## 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 agency: Include copies of applicable ACI certificates.

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

1. Cementitious materials.
2. Admixtures.
3. Curing compounds.
4. Floor and slab treatments.
5. Bonding agents.
6. Adhesives.
7. Vapor retarders.



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8. Semirigid joint filler.
9. Joint-filler strips.
10. Repair materials.

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

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

D. Floor surface flatness and levelness measurements report, indicating compliance with specified tolerances.

E. Research Reports:

1. For concrete admixtures in accordance with ICC's Acceptance Criteria AC198.
2. For sheet vapor retarder/termite barrier, showing compliance with ICC AC380.

F. Minutes of preinstallation conference.

## 1.7 QUALITY ASSURANCE

A. 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.

1. Post-Installed Concrete Anchors Installers: ACI-certified Adhesive Anchor Installer.

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

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

## 1.8 DELIVERY, STORAGE, AND HANDLING

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

## 1.9 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 301 and ACI 306.1 and as follows.



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1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
2. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
3. Do not use frozen materials or materials containing ice or snow.
4. Do not place concrete in contact with surfaces less than 35 deg F, other than reinforcing steel.
5. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:

1. Maintain concrete temperature at time of discharge to not exceed 95 deg F.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

## PART 2 - PRODUCTS

### 2.1 CONCRETE, GENERAL

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

### 2.2 CONCRETE MATERIALS

A. Regional Materials: Concrete shall be manufactured within 100 miles of Project site from aggregates and cementitious materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.

B. 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.

C. Cementitious Materials:

1. Portland Cement: ASTM C150/C150M, Type I/II, gray.
2. Portland-Limestone Cement: ASTM C595, Type 1L, gray.
3. Fly Ash: ASTM C618, Class C or F.



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

1. Alkali-Silica Reaction: Comply with one of the following:

a. Expansion Result of Aggregate: Not more than 0.04 percent at one-year when tested in accordance with ASTM C1293.
b. Expansion Results of Aggregate and Cementitious Materials in Combination: Not more than 0.10 percent at an age of 16 days when tested in accordance with ASTM C1567.
c. Alkali Content in Concrete: Not more than 4 lb./cu. yd. for moderately reactive aggregate or 3 lb./cu. yd. for highly reactive aggregate, when tested in accordance with ASTM C1293 and categorized in accordance with ASTM C1778, based on alkali content being calculated in accordance with ACI 301.

2. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
3. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

E. Lightweight Aggregate: ASTM C330/C330M, 3/4-inch nominal maximum aggregate size.

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

G. 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/C494M, Type A.
2. Retarding Admixture: ASTM C494/C494M, Type B.
3. Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.

H. Water and Water Used to Make Ice: ASTM C94/C94M, potable.

## 2.3 VAPOR RETARDERS

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

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

a. Barrier-Bac; Inteplast Group.
b. ISI Building Products.



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c. Poly-America, L.P.
d. Reef Industries, Inc.
e. Stego Industries, LLC.
f. Tex-Trude.
g. W.R. Meadows, Inc.

## 2.4 LIQUID FLOOR TREATMENTS

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

a. BASF Corporation.
b. ChemMasters, Inc.
c. ChemTec International.
d. Concrete Sealers USA.
e. Dayton Superior.
f. Euclid Chemical Company (The); an RPM company.
g. Kaufman Products, Inc.
h. Laticrete International, Inc.
i. Nox-Crete Products Group.
j. PROSOCO, Inc.
k. SpecChem, LLC.
l. US SPEC, Division of US MIX Company.
m. Vexcon Chemicals Inc.
n. V-Seal Concrete Sealers & Specialty Coatings.
o. W.R. Meadows, Inc.

2. Products shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

## 2.5 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

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

a. BASF Corporation.
b. Bon Tool Co.
c. ChemMasters, Inc.



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d. Dayton Superior.
e. Euclid Chemical Company (The); an RPM company.
f. Kaufman Products, Inc.
g. Lambert Corporation.
h. Laticrete International, Inc.
i. Metalcrete Industries.
j. Nox-Crete Products Group.
k. Sika Corporation.
l. SpecChem, LLC.
m. TK Products.
n. Vexcon Chemicals Inc.
o. W.R. Meadows, Inc.

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.

D. Clear, Waterborne, Membrane-Forming, Non-dissipating Curing Compound: ASTM C309, Type 1, Class B, certified by curing compound manufacturer to not interfere with bonding of floor covering.

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

a. Anti-Hydro International, Inc.
b. BASF Corporation.
c. ChemMasters, Inc.
d. Dayton Superior.
e. Euclid Chemical Company (The); an RPM company.
f. Kaufman Products, Inc.
g. Lambert Corporation.
h. Laticrete International, Inc.
i. Metalcrete Industries.
j. Nox-Crete Products Group.
k. SpecChem, LLC.
l. TK Products.
m. Vexcon Chemicals Inc.
n. W.R. Meadows, Inc.

E. Clear, Waterborne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A.



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

    a. ChemMasters, Inc.
    b. Concrete Sealers USA.
    c. Dayton Superior.
    d. Euclid Chemical Company (The); an RPM company.
    e. Kaufman Products, Inc.
    f. Lambert Corporation.
    g. Laticrete International, Inc.
    h. Metalcrete Industries.
    i. Nox-Crete Products Group.
    j. Right Pointe.
    k. SpecChem, LLC.
    l. TK Products.
    m. Vexcon Chemicals Inc.
    n. W.R. Meadows, Inc.

2. Products shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

## 2.6 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber.

B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 in accordance with ASTM D2240.

C. Bonding Agent: ASTM C1059/C1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

## 2.7 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand, as recommended by underlayment manufacturer.



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4. Compressive Strength: Not less than 4,100 psi at 28 days when tested in accordance with ASTM C109/C109M.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.

1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5,000 psi at 28 days when tested in accordance with ASTM C109/C109M.

## 2.8 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: 25 percent by mass.

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

1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete for parking structure slabs, and concrete with a w/cm below 0.50.

## 2.9 CONCRETE MIXTURES

A. Class A: Normal-weight concrete used for footings, grade beams, and tie beams.

1. Exposure Class: ACI 318 F0, S0, W0, C0.
2. Minimum Compressive Strength: 4,000 psi at 28 days.
3. Maximum w/cm: 0.55.



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4. Slump Limit: 4 inches, plus or minus 1 inch, before adding high-range water-reducing or plasticizing admixtures at the Project site (8 inches, plus or minus 1 inch thereafter).
5. Air Content: 2.0 percent, plus or minus 1.5 percent at point of delivery for concrete containing 3/4 inch nominal maximum aggregate size.
6. Limit water-soluble, chloride-ion content in hardened concrete to 1.00 percent by weight of cement.

B. Class B: Normal-weight concrete used for foundation walls.

1. Exposure Class: ACI 318 F1, S0, W0, C0.
2. Minimum Compressive Strength: 4,500 psi at 28 days.
3. Maximum w/cm: 0.45.
4. Slump Limit: 4 inches, plus or minus 1 inch, before adding high-range water-reducing or plasticizing admixtures at the Project site (8 inches, plus or minus 1 inch thereafter).
5. Air Content:

    a. Exposure Class F1: 5.0 percent, plus or minus 1.5 percent at point of delivery for concrete containing 3/4-inch nominal maximum aggregate size.

6. Limit water-soluble, chloride-ion content in hardened concrete to 1.00 percent by weight of cement.

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

1. Exposure Class: ACI 318 F0, S0, W0, C0.
2. Minimum Compressive Strength: 3,000 psi at 28 days.
3. Maximum w/cm: 0.55.
4. Minimum Cementitious Materials Content: 540 lb/cu. yd.
5. Slump Limit:4 inches, plus or minus 1 inch, before adding high-range water-reducing or plasticizing admixtures at the Project site (8 inches, plus or minus 1 inch thereafter).
6. 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.
7. Limit water-soluble, chloride-ion content in hardened concrete to 1.00 percent by weight of cement.

D. Class E: Structural lightweight concrete used for interior suspended slabs and concrete toppings/pads over suspended slabs.

1. Exposure Class: ACI 318 F0, S0, W0, C0.
2. Minimum Compressive Strength: 4,000 psi at 28 days.
3. Calculated Equilibrium Unit Weight: 118 lb/cu. ft., plus or minus 3 lb/cu. ft. as determined by ASTM C567/C567M.



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4. Slump Limit:3 inches, plus or minus 1 inch, before adding high-range water-reducing or plasticizing admixtures at the Project site (8 inches, plus or minus 1 inch thereafter).
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. Limit water-soluble, chloride-ion content in hardened concrete to 1.00 percent by weight of cement.

E. Class F: Normal-weight concrete used for exterior slabs-on-ground, concrete toppings/pads over slabs-on-ground, exterior pads, and balcony topping slabs.

1. Exposure Class: ACI 318 F2, S0, W1, C0.
2. Minimum Compressive Strength: 4,500 psi at 28 days.
3. Maximum w/cm: 0.45.
4. Minimum Cementitious Materials Content: 540 lb/cu. yd.
5. Slump Limit: 4 inches, plus or minus 1 inch.
6. Air Content:

    a. Exposure Classes F2 and F3: 6 percent, plus or minus 1.5 percent at point of delivery for concrete containing 3/4-inch nominal maximum aggregate size.

7. Limit water-soluble, chloride-ion content in hardened concrete to 1.00 percent by weight of cement.

F. Class I: Normal-weight concrete used for interior metal pan stairs and landings:

1. Exposure Class: ACI 318 F0, S0, W0, C0.
2. Minimum Compressive Strength: 2,500 psi at 28 days.
3. Maximum w/cm: 0.65.
4. Minimum Cementitious Materials Content: 470 lb/cu. yd.
5. Maximum Size Aggregate: 1/2 inch.
6. Slump Limit: 2.5 inches, plus or minus 1.5 inches.
7. Air Content: 0 percent, plus or minus 0.5 percent at point of delivery.
8. Limit water-soluble, chloride-ion content in hardened concrete to 1.00 percent by weight of cement.
9. Retarding Admixture: Not allowed.
10. Accelerating Admixture: Not allowed.

## 2.10 CONCRETE MIXING

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



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## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Verification of Conditions:

1. Before placing concrete, verify that installation of concrete forms, accessories, and reinforcement, and embedded items is complete and that required inspections have been performed.
2. Do not proceed until unsatisfactory conditions have been corrected.

### 3.2 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.

### 3.3 INSTALLATION OF EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining Work that is attached to or supported by cast-in-place concrete.

1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.
3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

### 3.4 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.



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2. Face laps away from exposed direction of concrete pour.
3. Lap vapor retarder over footings and grade beams not less than 6 inches, sealing vapor retarder to concrete.
4. Lap joints 6 inches and seal with manufacturer's recommended tape.
5. Terminate vapor retarder at the top of floor slabs, grade beams, and pile caps, sealing entire perimeter to floor slabs, grade beams, foundation walls, or pile caps.
6. Seal penetrations in accordance with vapor retarder manufacturer's instructions.
7. Protect vapor retarder during placement of reinforcement and concrete.

    a. Repair damaged areas by patching with vapor retarder material, overlapping damages area by 6 inches on all sides, and sealing to vapor retarder.

## 3.5 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 the Engineer of Record.
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-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. 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



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cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks.

D. Isolation Joints in Slabs-on-Ground: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated on Drawings.
2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface, where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

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. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.

B. Notify Engineer of Record and testing and inspection agencies 24 hours prior to commencement of concrete placement.

C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Engineer of Record in writing, but not to exceed the amount indicated on the concrete delivery ticket.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301, but not to exceed the amount indicated on the concrete delivery ticket.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.



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E. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.

1. If a section cannot be placed continuously, provide construction joints as indicated.
2. Deposit concrete to avoid segregation.
3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.

    a. Do not use vibrators to transport concrete inside forms.
    b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
    c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
    d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

F. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

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

## 3.7 FINISHING FORMED SURFACES

A. As-Cast Surface Finishes:

1. ACI 301 Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.

    a. Patch voids larger than 1-1/2 inches wide or 1/2 inch deep.
    b. Remove projections larger than 1 inch.
    c. Tie holes do not require patching.
    d. Surface Tolerance: ACI 117 Class D.
    e. Apply to concrete surfaces not exposed to public view.



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2. ACI 301 Surface Finish SF-2.0: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.

    a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
    b. Remove projections larger than 1/4 inch.
    c. Patch tie holes.
    d. Surface Tolerance: ACI 117 Class B.
    e. Locations: Apply to concrete surfaces as indicated.

3. ACI 301 Surface Finish SF-3.0:

    a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
    b. Remove projections larger than 1/8 inch.
    c. Patch tie holes.
    d. Surface Tolerance: ACI 117 Class A.
    e. Locations: Apply to concrete surfaces as indicated.

B. Rubbed Finish: Apply the following to as cast surface finishes where indicated on Drawings:

1. Smooth-Rubbed Finish:

    a. Perform no later than one day after form removal.
    b. Moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture.
    c. If sufficient cement paste cannot be drawn from the concrete by the rubbing process, use a grout made from the same cementitious materials used in the in-place concrete.
    d. Maintain required patterns or variances as shown on Drawings or to match field sample panels.

2. Grout-Cleaned Rubbed Finish:

    a. Clean concrete surfaces after contiguous surfaces are completed and accessible.
    b. Do not clean concrete surfaces as Work progresses.
    c. Mix 1 part portland cement to 1-1/2 parts fine sand, complying with ASTM C144 or ASTM C404, by volume, with sufficient water to produce a mixture with the consistency of thick paint. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces.
    d. Wet concrete surfaces.
    e. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap, and keep surface damp by fog spray for at least 36 hours.



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f. Maintain required patterns or variances as shown on Drawings or to match field sample panels.

3. Cork-Floated Finish:

a. Mix 1 part portland cement to 1 part fine sand, complying with ASTM C144 or ASTM C404, by volume, with sufficient water to produce a mixture with the consistency of thick paint.
b. Mix 1 part portland cement and 1 part fine sand with sufficient water to produce a mixture of stiff grout. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces.
c. Wet concrete surfaces.
d. Compress grout into voids by grinding surface.
e. In a swirling motion, finish surface with a cork float.
f. Maintain required patterns or variances as shown on Drawings or to match field sample panels.

4. Scrubbed Finish: After concrete has achieved a compressive strength of from 1,000 to 1,500 psi, apply scrubbed finish.

a. Wet concrete surfaces thoroughly and scrub with stiff fiber or wire brushes, using water freely, until top mortar surface is removed and aggregate is uniformly exposed.
b. Rinse scrubbed surfaces with clean water.
c. Maintain continuity of finish on each surface or area of Work.
d. Remove only enough concrete mortar from surfaces to match field sample panels.

C. 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. Scratch Finish:

1. While still plastic, texture concrete surface that has been screeded and bull-floated or darbied.
2. Use stiff brushes, brooms, or rakes to produce a profile depth of 1/4 inch in one direction.



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3. Apply scratch finish to surfaces to receive concrete floor toppings and to receive mortar setting beds for bonded cementitious floor finishes.

C. 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 (ACI A117M) tolerances for conventional concrete.
3. Apply float finish to surfaces to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

D. 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 surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
7. Finish surfaces to the following tolerances, in accordance with ASTM E1155, for a randomly trafficked floor surface:

    a. Slabs on Ground:

        1) Specified overall values of flatness, $F_F$ 35; and of levelness, $F_L$ 25; with minimum local values of flatness, $F_F$ 24; and of levelness, $F_L$ 17.

    b. Suspended Slabs:

        1) Specified overall values of flatness, $F_F$ 35; and of levelness, $F_L$ 20; with minimum local values of flatness, $F_F$ 24; and of levelness, $F_L$ 15. Levelness requirements may be waived for slabs on metal deck.

E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thinset method. While concrete is still plastic, slightly scarify surface with a fine broom perpendicular to main traffic route.



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

F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and locations indicated on Drawings.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.
2. Coordinate required final finish with Architect before application.

## 3.9 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 Bases and Foundations:

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. Minimum Compressive Strength: As indicated herein.
4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
6. Prior to pouring concrete, place and secure anchorage devices.

    a. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
    b. Cast anchor-bolt insert into bases.
    c. Install anchor bolts to elevations required for proper attachment to supported equipment.

D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items.



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1. Cast-in inserts and accessories, as shown on Drawings.
2. Reinforce interior stairs that use concrete fill for the landings and/or treads with either microsynthetic monofilament fibers (at a minimum dosage rate of 1.0 lbs/cy) or 4x4-W1.4xW1.4 welded wire fabric.
3. Screed, tamp, and trowel finish concrete surfaces.

## 3.10 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: Comply with ACI 308.1 as follows:

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, as follows:

    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.
    d. Water-Retention Sheeting Materials: Cover exposed concrete surfaces with sheeting material, taping, or lapping seams.
    e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.

        1) Recoat areas subject to heavy rainfall within three hours after initial application.
        2) Maintain continuity of coating and repair damage during curing period.

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

1. Begin curing immediately after finishing concrete.
2. Interior Concrete Floors:

    a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:



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1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.

    a) Lap edges and ends of absorptive cover not less than 12-inches.
    b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.

2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.

    a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
    b) Cure for not less than seven days.

3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:

    a) Water.
    b) Continuous water-fog spray.

b. Floors to Receive Penetrating Liquid Floor Treatments: Contractor has option of the following:

1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.

    a) Lap edges and ends of absorptive cover not less than 12 inches.
    b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.

2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.

    a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
    b) Cure for not less than seven days.

3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:



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a) Water.
b) Continuous water-fog spray.

c. Floors to Receive Polished Finish: Contractor has option of the following:

1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.

a) Lap edges and ends of absorptive cover not less than 12 inches.
b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.

2) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:

a) Water.
b) Continuous water-fog spray.

d. Floors to Receive Curing Compound:

1) Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
2) Recoat areas subjected to heavy rainfall within three hours after initial application.
3) Maintain continuity of coating, and repair damage during curing period.
4) Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.

e. Floors to Receive Curing and Sealing Compound:

1) Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller in accordance with manufacturer's written instructions.
2) Recoat areas subjected to heavy rainfall within three hours after initial application.
3) Repeat process 24 hours later and apply a second coat. Maintain continuity of coating, and repair damage during curing period.

## 3.11 TOLERANCES

A. Conform to ACI 117.



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## 3.12 APPLICATION OF LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatment: 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.
2. Do not apply to concrete that is less than seven days' old.
3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing.
4. Rinse with water; remove excess material until surface is dry.
5. Apply a second coat in a similar manner if surface is rough or porous.

## 3.13 JOINT FILLING

A. Prepare, clean, and install joint filler in accordance with manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least one month.
2. Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints.

D. Overfill joint, and trim joint filler flush with top of joint after hardening.

## 3.14 CONCRETE SURFACE REPAIRS

A. Defective Concrete:

1. Repair and patch defective areas when approved by Architect.
2. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.



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1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete.

    a. Limit cut depth to 3/4 inch.
    b. Make edges of cuts perpendicular to concrete surface.
    c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
    d. Fill and compact with patching mortar before bonding agent has dried.
    e. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement, so that, when dry, patching mortar matches surrounding color.

    a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
    b. Compact mortar in place and strike off slightly higher than surrounding surface.

3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces:

1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.

    a. Correct low and high areas.
    b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

2. Repair finished surfaces containing surface defects, including spalls, popouts, honeycombs, rock pockets, crazing, and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
3. After concrete has cured at least 14 days, correct high areas by grinding.
4. Correct localized low areas during, or immediately after, completing surface-finishing operations by cutting out low areas and replacing with patching mortar.

    a. Finish repaired areas to blend into adjacent concrete.

5. Correct other low areas scheduled to remain exposed with repair topping.

    a. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations.



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b. Prepare, mix, and apply repair topping and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete.

   a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a 3/4-inch clearance all around.
   b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.
   c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
   d. Place, compact, and finish to blend with adjacent finished concrete.
   e. Cure in same manner as adjacent concrete.

7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar.

   a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
   b. Dampen cleaned concrete surfaces and apply bonding agent.
   c. Place patching mortar before bonding agent has dried.
   d. Compact patching mortar and finish to match adjacent concrete.
   e. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

## 3.15 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: Owner will 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/C31M.
2. Testing agency shall immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.



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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/C31M, ASTM C39/C39M, and ACI 301, including the following as applicable to each test and inspection:

        1) Project name.
        2) Name of testing agency.
        3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
        4) Name of concrete manufacturer.
        5) Date and time of inspection, sampling, and field testing.
        6) Date and time of concrete placement.
        7) Location in Work of concrete represented by samples.
        8) Date and time sample was obtained.
        9) Truck and batch ticket numbers.
        10) Design compressive strength at 28 days.
        11) Concrete mixture designation, proportions, and materials.
        12) Field test results.
        13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
        14) Type of fracture and compressive break strengths at seven days and 28 days.

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. Headed bolts and studs.
2. Verification of use of required design mixture.
3. Concrete placement, including conveying and depositing.
4. Curing procedures and maintenance of curing temperature.
5. 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 172/C 172M shall be performed in accordance with the following requirements:



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1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.

    a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C143/C143M:

    a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
    b. Perform additional tests when concrete consistency appears to change.

3. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete; ASTM C173/C173M volumetric method, for structural lightweight concrete.

    a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

4. Concrete Temperature: ASTM C1064/C1064M:

    a. One test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.

5. Unit Weight: ASTM C567/C567M fresh unit weight of structural lightweight concrete.

    a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

6. Compression Test Specimens: ASTM C31/C31M:

    a. Cast and laboratory cure two sets of four 6-inch by 12-inch or 4-inch by 8-inch cylinder specimens for each composite sample.

7. Compressive-Strength Tests: ASTM C39/C39M.

    a. Test one set of two laboratory-cured specimens at seven days and three sets of two specimens at 28 days.
    b. 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.

8. 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.



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9. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi if specified compressive strength is 5,000 psi, or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5,000 psi.
10. 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.
11. 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 byEngineer of Record.
    b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed byEngineer of Record.

        1) Acceptance criteria for concrete strength shall be in accordance with ACI 301, section 1.6.6.3.

12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
13. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

F. Measure floor and slab flatness and levelness in accordance with ASTM E1155 within 24 hours of completion of floor finishing and promptly report test results to Architect.

## 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**



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# SECTION 03 30 00.15

# CONCRETE ADMIXTURE

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes: Furnishing of all labor, materials, services and equipment necessary for the supply and installation of crystalline waterproofing additive to concrete.
   1. Locations indicated on Drawings or indicated by Architect.

B. Provide waterstops as recommended by manufacturer.

C. Coordinate with Section 03 30 00 - Cast-in-Place Concrete for adding to concrete mix.

### 1.2 REFERENCES

A. Applicable Standards: The following standards are referenced herein.
   1. American Society for Testing and Materials (ASTM)
   2. Army Corps of Engineers (CRD)
   3. American Concrete Institute (ACI)
   4. American National Standards Institute (ANSI)
   5. NSF International

### 1.3 SYSTEM DESCRIPTION

A. Crystalline Waterproofing Additive: Concrete waterproofing and protection system shall be of the crystalline type that chemically controls and permanently fixes a non-soluble crystalline structure within the pores and capillary tracts of the concrete. This crystalline system causes the concrete to become sealed against the penetration of liquids from any direction, and protects the concrete from deterioration due to harsh environmental conditions. The system is used for above or below-grade walls and slabs, including liquid retaining structures and where enhanced chemical resistance is required.

### 1.4 SYSTEM PERFORMANCE REQUIREMENTS

A. Testing Requirements: Crystalline waterproofing system shall have been be tested in accordance with the following standards and conditions, and the testing results shall

meet or exceed the performance requirements as specified herein.

B. Independent Laboratory: Testing shall have been performed by an accredited independent laboratory meeting the requirements of ASTM E 329 or other applicable international standard for certification of testing laboratories. Testing laboratory shall have obtained all control and treated concrete samples.

C. Crystalline Formation: Crystallizing capability of waterproofing system shall be evidenced by independent SEM (Scanning Electron Microscope) photographs showing crystalline formations within the concrete matrix.

D. Potable Water Approval: Waterproof material shall have a current, valid approval certificate from NSF (NSF 61), DWI, or other recognized certification agency.

## 1.5 SUBMITTALS

A. General: Submit listed submittals in accordance with conditions of the Contract and with Division 1 Submittal Procedures Section.

B. Product Data: Submit product data, including manufacturer's specifications, installation instructions, and general recommendations for waterproofing applications.

C. Shop Drawings: Provide details of how joints will be managed, installed, and repaired. Show waterstop locations and details for installation. Provide details from manufacturer's recommended and endorsed details and written recommendations.

D. Test Reports: Submit, for acceptance, complete test reports from approved independent testing laboratories certifying that waterproofing system conforms to performance characteristics and testing requirements specified herein.

E. Manufacturer’s Certification: Provide document signed by manufacturer or manufacturer's representative certifying that the materials to be installed comply with the requirements of this specification.

## 1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer to be ISO 9001 registered, and to have no less than 10 years experience in manufacturing the crystalline waterproofing additive for the required work. Manufacturer must be capable of providing field service representation during construction phase. Manufacturers who cannot provide ongoing field support or who cannot provide the performance test data specified herein will not be considered for the project.

B. Installer: Ready-mix supplier and/or installer of crystalline waterproofing additive shall be approved by the manufacturer or manufacturer's representative in writing.

C. Pre-Installation Conference: Prior to installation of waterproofing system, conduct meeting with Architect/Engineer, owner's representative, concrete supplier, concrete placer and waterproofing manufacturer's representative to verify and review the following:
   1. Project requirements for waterproofing as set out in Contract Documents.
   2. Manufacturer's product data including mixing and installation instructions.

D. Technical Consultation: The waterproofing manufacturer's representative shall provide technical consultation on waterproofing applications and shall provide on-site support as needed.

## 1.7 DELIVERY, STORAGE AND HANDLING

A. Ordering: Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.

B. Delivery: Deliver packaged waterproofing materials to project site in original undamaged containers, with manufacturer's labels and seals intact.

C. Storage: Store waterproofing materials in dry, enclosed location, at a minimum temperature of 45 °F (7 °C).

## 1.8 WARRANTY

A. Project Warranty: Refer to conditions of the Contract for project warranty provisions.

B. Manufacturer’s Warranty: Manufacturer shall provide standard product warranty executed by authorized company official.

# PART 2 PRODUCTS

## 2.1 MATERIALS

A. Basis-of-Design Manufacturer:
   1. Xypex Chemical Corporation; Admix C-500 / C-500NF.
      a. 13731 Mayfield Place, Richmond, B.C., Canada V6V 2G9
      b. Tel: 800 961.4477 or 604 273.5265 Fax: 604 270.0451
      c. E-mail: info@xypex.com Website: www.xypex.com
   2. Other Manufacturers: Subject to compliance with requirements of this Section, other manufacturers include the following:
      a. Euclid Chemical; Eucon Vandex AM-10.
      b. Master Builders Solutions; MasterLife 300.
      c. Sika; WT-240 P.

B. Use of Basis-of-Design manufacturer and product is provided for the purpose of describing the standard of quality, performance, and characteristics desire and is not

intended to limit competition.

C. Source Quality: Obtain all proprietary crystalline waterproofing products from a single manufacturer.

## 2.2 MATERIAL PROPERTIES

A. Permeability: Independent testing shall be performed according to a U.S. Army Corps of Engineers CRD-C48 (Mod.) "Permeability of Concrete". Concrete samples shall be pressure tested to 150 psi (350 foot head of water) or 1.05 MPa (106 m head of water). After 5 days the untreated samples shall leak and the treated samples shall exhibit no measurable leakage.

B. Compressive Strength: ASTM C 39, “Compressive Strength of Cylindrical Concrete Specimens”, Kleinfelder Laboratories, San Francisco, USA. At 28 days, the compressive strength test of the concrete containing Admixture measured 7160 psi / 49.5 MPa as compared to the reference sample at 6460 psi / 44.5 MPa (a 10% increase).

C. Crack Sealing: Portland, blast furnace slag and slag-modified Portland concrete samples, treated with 2.5% Admixture, were evaluated for self-healing capabilities. Microcracks were induced by loading to 90% of ultimate compressive strength. Cracked samples were then immersed in water to trigger self-healing after 28, 56 and 84 days. Strength and ultra- sonic pulse velocity tests were used to determine mechanical recovery; sorptivity and rapid chloride permeability were used to evaluate watertightness recovery. Results substantiated the ability of Admix to provide self-healing of cracked concrete.

D. Chemical Resistance: “Sulfuric Acid Resistance Test”; Concrete containing Admixture at different dosage rates including 3% specimens were tested against untreated control samples for sulfuric acid resistance. After immersion in the sulfuric acid, each sample was tested for weight loss on a daily basis until a weight loss of 50% or a definite response trend was obtained. The percentage weight loss of the samples containing Admixture tested significantly lower than the control samples.

E. Scanning Electron Microscopy: Slag and fly ash blended cement samples were treated with Admix and examined for evidence of crystalline growth at ages ranging from 8 months to 2 years. Samples were sliced and/or split and examined at magnifications between 500x and 5000x. Characteristic crystalline growth was observable on all Admixture treated samples, providing evidence of crystalline reactions with fly ash and slag blended cements.

F. Freeze/Thaw Durability: Per ASTM C666, after 300 freeze/thaw cycles, admixture-treated samples indicated 94 percent relative durability.

## 2.3 DOSAGE

A. General: Xypex Admix must be added to concrete mix at time of batching.

B. Dosage Rate: Under normal conditions, the crystalline waterproofing powder shall be added to the concrete mix at the following rates:
   1. Per manufacturer's instructions.

C. Note: For enhanced chemical protection or for meeting specific project requirements or where the concrete mix design contains higher than 25% type F fly ash content or includes a portland cement/slag cement/type C fly ash blend, consult with manufacturer or its authorized representative to determine appropriate dosage rates.

## PART 3 EXECUTION

### 3.1 MANUFACTURER'S INSTRUCTIONS

A. Compliance: Comply with manufacturer's product data regarding installation, including technical bulletins, product catalogue, installation instructions and product packaging labels.

### 3.2 PROJECT CONDITIONS

A. Crack Control: All reinforcement shall be in accordance with applicable standards. Concrete elements shall be designed and constructed to minimize and control cracking.

B. Setting Time and Strength: Some delay of set may occur when using Xypex Admix products. The amount of set delay will depend upon the concrete mix design, the particular Admix product used, dosage rate of the Admix, temperature of the concrete and climatic conditions. Concrete containing a Xypex Admix product may develop higher ultimate strengths than plain concrete. Conduct trial mixes under project conditions to determine setting time and strength of the concrete. Consult with manufacturer or manufacturer's representative regarding concrete mix design, project conditions and proper dosage rate.

C. Weather Conditions: For mixing, transporting and placing concrete under conditions of high temperature or low temperature, follow concrete practices such as those referred to n ACI 305R (Hot Weather Concreting) and ACI 306R (Cold Weather Concreting) or other applicable standards.

### 3.3 APPLICATION

A. General: Xypex Admix is added to the concrete at the time of batching. It is important to obtain a homogeneous mixture of Xypex Admix with the concrete. Do not add dry Admix powder directly to wet mixed concrete as this could cause clumping and thorough dispersion may not occur.

B. Concrete Batching & Mixing: Procedures for addition of Xypex Admix will vary according to type of batch plant operation and equipment.

C. Addition to Coarse Aggregate Belt: Add Xypex Admix powder directly to the course aggregate conveyor belt manually or through computer controlled mass batching system. Account for worker health and safety issues relating to moving belts and wind-blown dust.

D. Addition to Ready Mixed Truck at Plant: Add Xypex Admix in bulk powder or soluble bag form to the drum of the ready-mix truck immediately prior to driving the truck under the batch plant. Then add the balance of the materials or the premixed concrete in accordance with standard concrete batching practices. Take measures to ensure that soluble bags are dispersed properly. Such measures can include: a) adding the bags as far forward in the drum as possible, b) adding a small amount of batch water along with the bags, and c) spinning the drum prior to adding remaining components. Avoid delays in adding other components and utilize high speed mixing to ensure homogeneity of mix. Where there may be insufficient water for thorough dispersion of the bulk powder, mix the Admix powder with water to form a slurry and add to the truck mixer drum prior to batching. Account for added water in the mix design and slump.

E. Addition to Central Mixer: Load the Xypex Admix in bulk powder form or in soluble bags along with the other components. Mix in accordance with standard batching practices to ensure thorough dispersion and a homogeneous mixture. Account for worker safety issues when accessing the equipment.

F. Precast Batch Plant - Pan Type Mixer: Add Xypex Admix to the rock and sand, then mix thoroughly for 2 - 3 minutes before adding the cement and water. The total concrete mass shall be blended using standard practices.

G. Construction and Cold Joints: In addition to specified waterstops apply one coat of Xypex Concentrate slurry at a rate of 2 lb./sq. yd. (1 kg/m2) to joint surfaces between concrete pours. Moisten surfaces prior to slurry application. Apply slurry and keep moist for 12 hours then allow slurry to set or dry. Where joint surfaces are not accessible prior to pouring new concrete, contact Xypex Technical Services Representative for assistance.

H. Inclusion, type and position of waterstops are at the discretion of the engineer and verified by Architect. Expanding waterstops may be placed on Xypex after it has dried or before Xypex slurry application. Xypex slurry may only be applied over waterstop if approved by waterstop manufacturer.

I. Sealing Strips: Where hydrostatic conditions exist, sealing strips shall also be applied at construction joints by filling grooves that are created along the joints. Dimensions of the grooves shall be 1 inch (25 mm) wide and 1.5 inches (37 mm) deep. If grooves are not been pre-formed then chip grooves to those dimensions. Fill the groves as follows:
   1. Apply slurry coat of Xypex Concentrate to slot in accordance with manufacturer’s instructions or recommendations.
   2. While slurry coat is still tacky, fill slot with Xypex Concentrate Dry-Pac.
   3. Compact tightly using pneumatic packer or hammer and block.
   4. Wet Dry-Pac surface lightly with water, then apply a slurry coat of Xypex

Concentrate at a coverage rate of 1.5 - 2 lb./sq. yd. (0.8 - 1 kg/m2) over sealing strip and extending to 6” (150 mm) on either side.

J. Form Tie Holes: Form tie holes shall be waterproofed in accordance with manufacturer’s technical literature including relevant Method Statements (www.xypex.com/technical/statements). Procedures are generally as follows:
   1. Prepare the tie hole to create a straight sided void with a profile of at least ICRI CSP-3. For through element ties holes such as those created by taper ties the prepared void is to be at least 5” (125 mm) deep. For cone ties the void is to be to the bottom of the cone.
   2. Clean and profile the area to a 6 inch (150 mm) diameter around the tie hole to an ICRI CSP-3 profile.
   3. For through-element tie holes create a solid plug of material at the bottom of the profiled hole using Xypex Patch’n Plug leaving at least 4” (100 mm) of empty tie hole from the top of the plug to the surface of the concrete element.
   4. Apply a coat of Xypex Concentrate slurry at a rate of 1.5 lb./sq. yd. (0.8 kg/m2) to the inside of the tie hole and to a 12” (300 mm) diameter area around the hole.
   5. Fill and compact the tie hole with Xypex Concentrate Dry-Pac.
   6. Wet Dry-Pac surface lightly with water, then apply a slurry coat of Xypex Concentrate at a coverage rate of 1.5 - 2 lb. /sq. yd. (0.8 - 1 kg/m2) over the repaired area to a 12” (300 mm) diameter area around the filled void.

K. Repair of Defects: Concrete defects shall be repaired in accordance with manufacturer’s technical literature including relevant Method Statements (www.xypex.com/technical/statements). Procedures are generally as follows:
   1. Cracks and Faulty Construction Joints:
   2. Chip out cracks, faulty construction joints and other defects to a depth of 1.5 inches (37 mm) and a width of one inch (25 mm). A “V” shaped slot is not acceptable. The slot may be saw cut instead of chipped but ensure that the slot is dovetailed or otherwise shaped such that there will be mechanical interlock of materials placed into the slot at a later stage.
   3. Clean slot of debris and dust. Soak area with water and remove excess surface water. Apply a slurry coat of Xypex Concentrate at the rate of 1.5 lb./sq. yd. (0.8 kg/m2) to the slot.
   4. While slurry coat is still tacky, fill cavity with Dry-Pac. Compress tightly into cavity using pneumatic packer or block and hammer.
   5. Wet Dry-Pac surface lightly with water, then apply a slurry coat of Xypex Concentrate at a coverage rate of 1.5 - 2 lb./sq. yd. (0.8 - 1 kg/m2) over the repaired area to 6” (150 mm) on either side of slot.
   6. Rock Pockets, Honeycombing or other defective concrete: All areas of poor concrete consolidation (honeycomb or rock pockets) shall be repaired.
   7. Note: Where there is active water-flow see Method Statements or contact Xypex Technical Services Representative for assistance.

## 3.4 PLACING

A. Concrete Placement: Concrete placement shall be in accordance with “309R: Guide for Consolidation of Concrete" or other applicable standard. Special attention is to be

given to consolidation at joints, penetrations and other potential leakage locations.

## 3.5 CURING

A. General: Concrete containing Xypex Admix shall be moist cured in accordance with ACI 308, "Standard Practice for Curing Concrete" or other applicable standard.

B. Curing Compounds: Curing compounds may be used in the event that project requirements or conditions prevent moist curing. Curing compounds shall comply with ASTM C-309 or other applicable standard.

## 3.6 PROTECTION

A. Protection: Protect installed product and finished surfaces from damage during construction.

## 3.7 FIELD QUALITY CONTROL

A. Examination for Defects: Do not conceal Xypex treated concrete before it has been observed by Architect/Engineer, waterproofing manufacturer's representative or other designated entities. Concrete shall be examined for structural defects such as honeycombing, rock pockets, tie holes, faulty construction joints, cold joints and cracks larger than 1/64” (0.4 mm). Such defects to be repaired in accordance with manufacturer's repair procedures as noted above.

B. Testing for Tanks and Foundation Works
   1. Testing: Fill tanks or, for foundation works, shut off dewatering system as soon as practical so that the structure shall be exposed to it’s normal service conditions. Examine for leaks.

C. Monitoring:
   1. Actively leaking cracks and joints shall be left to self-heal for as long as practical. Depending on job site and ambient conditions crack healing can be expected to take several days to weeks.
   2. Any crack or joints that do not heal in the allowable time frame shall be repaired.
   3. Moving cracks shall be repaired using polyurethane injection or other appropriate method.
   4. Repair: Use Xypex repair procedures to seal any static crack or joint that does not self-heal. See Method Statements (www.xypex.com/technical/statements) or contact Xypex Technical Services Representative for appropriate repair procedures.
   5. Note: Lower temperatures will extend the times for crystalline development.

## 3.8 INTERACTION WITH OTHER MATERIALS

A. Backfilling: Normal backfilling procedures may be used after concrete has been

cured.

B. Paint, Epoxy, Grout, Cement Parge Coat, Plaster or Stucco: Xypex Admix treatment of concrete does not adversely affect the bond of subsequently applied materials. Follow surface preparation and other relevant directions of the coating or parge material manufacturer.

C. Responsibility to Ensure Compatibility: Xypex Admix products are compatible with most admixtures used in the production of quality concrete. However, Xypex Chemical Corporation makes no representations or warranties regarding such compatibility of Xypex Admix products with other additives or admixtures. It shall be the responsibility of the concrete contractor to take whatever measures are necessary, including testing, to ensure compatibility of the Xypex Admix with other additives or admixtures being used in the concrete mix, and it shall be the responsibility of the installer of the surface-applied material that is to be applied over the Xypex treated concrete to take whatever measures are necessary, including testing, to ensure acceptance by or adhesion to the Xypex treated concrete.

**END OF SECTION**

# SECTION 04 20 00 - 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.
2. Clay face brick.
3. Mortar and grout.
4. Steel reinforcing bars.
5. Masonry-joint reinforcement.
6. Ties and anchors.
7. Embedded flashing.
8. Miscellaneous masonry accessories.

B. Products Installed but not Furnished under This Section:

1. Cast-stone trim in unit masonry.
2. Steel lintels in unit masonry.
3. Steel shelf angles for supporting unit masonry.
4. Cavity wall insulation.

C. Related Requirements:

1. Section 031000 "Concrete Forms and Accessories" for installing dovetail slots for masonry anchors.
2. Section 071900 "Water Repellents" for water repellents applied to unit masonry assemblies.
3. Section 072100 "Thermal Insulation" for cavity wall insulation.
4. Section 076200 "Sheet Metal Flashing and Trim" for exposed sheet metal flashing and for furnishing manufactured reglets installed in masonry joints.
5. Section 089516 "Wall Vents" for wall vents (brick vents).

### 1.3 ALLOWANCES

A. Face brick is part of the Face Brick Allowance.



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## 1.4 DEFINITIONS

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

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

## 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. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

C. Samples for Verification: For each type and color of the following:

1. Accessories embedded in masonry.

## 1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Material Certificates: For each type and size of the following:

1. Masonry units.

a. Include material test reports substantiating compliance with requirements.
b. For brick, include size-variation data verifying that actual range of sizes falls within specified tolerances.
c. For exposed brick, include test report for efflorescence according to ASTM C67.
d. For surface-coated brick, include test report for durability of surface appearance after 50 cycles of freezing and thawing according to ASTM C67.
e. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.



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2. Integral water repellent used in CMUs.
3. Cementitious materials. Include name of manufacturer, brand name, and type.
4. Mortar admixtures.
5. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
6. Grout mixes. Include description of type and proportions of ingredients.
7. Reinforcing bars.
8. Joint reinforcement.
9. Anchors, ties, and metal accessories.

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/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.
2. Include test reports, according to ASTM C1019, for grout mixes required to comply with compressive strength requirement.

D. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to TMS 602/ACI 530.1/ASCE 6.

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

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockups for typical exterior wall in sizes approximately 96 inches long by 72 inches high by full thickness, including face and backup wythes and accessories.

a. Include a sealant-filled joint at least 16 inches long in each mockup.
b. Include lower corner of window opening at upper corner of exterior wall mockup. Make opening approximately 12 inches wide by 16 inches high.
c. Include through-wall flashing installed for a 24-inch length in corner of exterior wall mockup approximately 16 inches down from top of mockup, with a 12-inch length of flashing left exposed to view (omit masonry above half of flashing).
d. Include metal or wood studs, sheathing, water-resistive barrier, sheathing joint-and-penetration treatment, air barrier, veneer anchors, flashing, cavity drainage material, and weep holes in exterior masonry-veneer wall mockup.



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2. Where masonry is to match existing, erect mockups adjacent and parallel to existing surface.
3. Clean one-half of exposed faces of mockups with masonry cleaner as indicated.
4. Protect accepted mockups from the elements with weather-resistant membrane.
5. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.

    a. Approval of mockups is also for other material and construction qualities specifically approved by Architect in writing.
    b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

6. 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. 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.



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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 602/ACI 530.1/ASCE 6.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

## 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.



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## 2.2 PERFORMANCE REQUIREMENTS

A. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days.

1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to TMS 602/ACI 530.1/ASCE 6.

## 2.3 UNIT MASONRY, GENERAL

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

B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work.

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

1. Where fire-resistance-rated construction is indicated, units shall be listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.

## 2.4 CONCRETE MASONRY UNITS

A. Regional Materials: CMUs shall be manufactured within 100 miles of Project site from aggregates and cement that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.

B. 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 square-edged units for outside corners unless otherwise indicated.

C. Integral Water Repellent: Provide units made with integral water repellent where indicated.

1. Integral Water Repellent: 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/E514M 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.



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

1) ACM Chemistries.
2) BASF Corporation.
3) Euclid Chemical Company (The); an RPM company.
4) GCP Applied Technologies Inc.

**D. CMUs: ASTM C90.**

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2,150 psi.
2. Density Classification: Light weight.
3. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
4. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.
5. Faces to Receive Plaster: Where units are indicated to receive a direct application of plaster, provide textured-face units made with gap-graded aggregates.

## 2.5 CONCRETE AND MASONRY LINTELS

A. General: Provide one of the following:

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

C. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs matching adjacent CMUs in color, texture, and density classification, with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

## 2.6 MORTAR AND GROUT MATERIALS

A. Regional Materials: Aggregate for mortar and grout, cement, and lime shall be manufactured within 100 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.

B. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. 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.

C. Hydrated Lime: ASTM C207, Type S.



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D. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

E. Masonry Cement: ASTM C91/C91M.

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

a. Cemex S.A.B. de C.V.
b. Essroc.
c. Holcim (US) Inc.
d. Lafarge North America Inc.
e. Lehigh Hanson; HeidelbergCement Group.

F. Mortar Cement: ASTM C1329/C1329M.

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

a. Lafarge North America Inc.

G. Aggregate for Mortar: ASTM C144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4-inch-thick, use aggregate graded with 100 percent passing the No. 16 sieve.
3. White-Mortar Aggregates: Natural white sand or crushed white stone.
4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

H. Aggregate for Grout: ASTM C404.

I. Cold-Weather Admixture: Non-chloride, noncorrosive, accelerating admixture complying with ASTM C494/C494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

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

a. BASF Corporation.
b. Euclid Chemical Company (The); an RPM company.
c. GCP Applied Technologies Inc.

J. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs containing integral water repellent from same manufacturer.



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

    a. ACM Chemistries.
    b. BASF Corporation.
    c. Euclid Chemical Company (The); an RPM company.
    d. GCP Applied Technologies Inc.

K. Water: Potable.

## 2.7 REINFORCEMENT

A. Uncoated-Steel Reinforcing Bars: ASTM A615/A615M or ASTM A996/A996M, Grade 60.

B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.

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

    a. Dur-O-Wal; a Hohmann & Barnard company.
    b. Heckmann Building Products, Inc.
    c. Hohmann & Barnard, Inc.
    d. Wire-Bond.

C. Masonry-Joint Reinforcement, General: ASTM A951/A951M.

1. Interior Walls: Hot-dip galvanized carbon steel.
2. Exterior Walls: Hot-dip galvanized carbon steel.
3. Wire Size for Side Rods: 0.148-inch diameter.
4. Wire Size for Cross Rods: 0.148-inch diameter.
5. Wire Size for Veneer Ties: 0.148-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.

D. Masonry-Joint Reinforcement for Single-Wythe Masonry: Ladder type with single pair of side rods.

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

    a. Wire-Bond.

E. Masonry-Joint Reinforcement for Multiwythe Masonry:



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

    a. Wire-Bond.

2. Ladder type with one side rod at each face shell of hollow masonry units more than 4 inches wide, plus one side rod at each wythe of masonry 4 inches wide or less.
3. Tab type, either ladder or truss design, with one side rod at each face shell of backing wythe and with rectangular tabs sized to extend at least halfway through facing wythe, but with at least 5/8-inch cover on outside face.
4. Adjustable (two-piece) type, either ladder or truss 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.

## 2.8 MASONRY CLEANERS

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

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

    a. EaCo Chem, Inc.
    b. PROSOCO, Inc.

## 2.9 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Use portland cement-lime mortar unless otherwise indicated.
3. For exterior masonry, use portland cement-lime, masonry cement, or mortar cement mortar.
4. For reinforced masonry, use portland cement-lime mortar.
5. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.



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

C. Mortar for Unit Masonry: Comply with ASTM C270, Property Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.

1. For masonry below grade or in contact with earth, use Type M.
2. For reinforced masonry, use Type S.
3. For mortar parge coats, use Type S.
4. For exterior, above-grade, load bearing and non-load bearing walls and parapet walls; for interior load bearing walls; for interior non-load bearing partitions; and for other applications where another type is not indicated, use Type N.
5. For interior non-load bearing partitions, Type O may be used instead of Type N.

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

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi.
3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C143/C143M.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

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

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
2. Verify that foundations are within tolerances specified.
3. Verify that reinforcing dowels are properly placed.
4. Verify that substrates are free of substances that impair mortar bond.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

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



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## 3.2 INSTALLATION, GENERAL

A. 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.

B. Build chases and recesses to accommodate items specified in this and other Sections.

C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.

D. 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.

E. 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.

F. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.

G. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested according to ASTM C67. Allow units to absorb water so they are damp but not wet at time of laying.

## 3.3 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.



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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-inch 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.

## 3.4 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. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4 inches. Bond and interlock each course of each wythe at corners. Do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

D. 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.

E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.



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F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

G. 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.

H. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

I. Build non-load 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. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch clearance between end of anchor rod and end of tube. Space anchors 48 inches o.c. unless otherwise indicated.
3. Wedge non-load bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 078443 "Joint Firestopping."

## 3.5 MORTAR BEDDING AND JOINTING

A. Lay hollow brick and 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 and hollow brick with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.



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E. Cut joints flush where indicated to receive waterproofing, cavity wall insulation, or air barriers unless otherwise indicated.

## 3.6 ANCHORED MASONRY VENEERS

A. Anchor masonry veneers to wall framing and concrete and masonry backup with masonry-veneer anchors to comply with the following requirements:

1. Fasten screw-attached anchors through sheathing to wall framing and to concrete and masonry backup with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
2. Embed tie sections in masonry joints.
3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
4. Space anchors as indicated, but not more than 18 inches o.c. vertically and 24 inches o.c. horizontally, with not less than one anchor for each 2 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 8 inches, around perimeter.

B. Provide not less than 2 inches of airspace between back of masonry veneer and face of insulation.

1. Keep airspace clean of mortar droppings and other materials during construction. Bevel beds away from airspace, to minimize mortar protrusions into airspace. Do not attempt to trowel or remove mortar fins protruding into airspace.

## 3.7 MASONRY-JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.

1. Space reinforcement not more than 16 inches o.c.
2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

E. Cut and bend reinforcing units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures, and other special conditions.



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## 3.8 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.

## 3.9 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.
4. Install temporary foam-plastic filler in head joints, and remove filler when unit masonry is complete for application of sealant.

C. Form expansion joints in brick as follows:

1. Build flanges of metal expansion strips into masonry. Lap each joint 4 inches in direction of water flow. Seal joints below grade and at junctures with horizontal expansion joints if any.
2. Build flanges of factory-fabricated, expansion-joint units into masonry.
3. Build in compressible joint fillers where indicated.
4. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch for installation of sealant and backer rod specified in Section 079200 "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 079200 "Joint Sealants," but not less than 3/8 inch.



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1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

## 3.10 LINTELS

A. Install steel lintels where indicated.

B. Provide concrete or masonry lintels where shown and where openings of more than 12 inches for brick-size units and 24 inches for block-size units are shown without structural steel or other supporting lintels.

C. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

## 3.11 REINFORCED UNIT MASONRY

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and that of other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
2. Limit height of vertical grout pours to not more than 60 inches.

## 3.12 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.



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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. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.

E. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C140 for compressive strength.

F. Mortar Test (Property Specification): For each mix provided, according to ASTM C780. Test mortar for mortar air content and compressive strength.

G. Grout Test (Compressive Strength): For each mix provided, according to ASTM C1019.

## 3.13 PARGING

A. Parge exterior faces of below-grade masonry walls, where indicated, in two uniform coats to a total thickness of 3/4 inch. Dampen wall before applying first coat, and scarify first coat to ensure full bond to subsequent coat.

B. Use a steel-trowel finish to produce a smooth, flat, dense surface with a maximum surface variation of 1/8 inch per foot. Form a wash at top of parging and a cove at bottom.

C. Damp-cure parging for at least 24 hours and protect parging until cured.

## 3.14 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:



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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 non-masonry 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 brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
6. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.
7. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
8. Clean stone trim to comply with stone supplier's written instructions.
9. Clean limestone units to comply with recommendations in ILI's "Indiana Limestone Handbook."

## 3.15 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. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.

1. Crush masonry waste to less than 4 inches in each dimension.
2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Section 312000 "Earth Moving."
3. Do not dispose of masonry waste as fill within 18 inches of finished grade.

C. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.

D. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

**END OF SECTION**



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# SECTION 04 26 13

# MASONRY VENEER

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Brick.
   2. Mortar materials.
   3. Ties and anchors.
   4. Embedded flashing.
   5. Accessories.

### 1.2 DEFINITIONS

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

### 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 the following:
   1. Masonry Units: Indicate sizes, profiles, coursing, and locations of special shapes.
   2. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

C. Samples for Verification: For each type and color of the following:
   1. Clay face brick, in the form of straps of five or more bricks.
   2. Special brick shapes.
   3. Pigmented and colored-aggregate mortar. Make Samples using same sand and mortar ingredients to be used on Project.
   4. Weep/cavity vents.
   5. Cavity drainage material.

## 1.5 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each type and size of the following:
   1. Cementitious materials. Include name of manufacturer, brand name, and type.
   2. Anchors, ties, and metal accessories.

B. Mix Designs: For each type of mortar. Include description of type and proportions of ingredients.
   1. Include test reports for mortar mixes required to comply with property specification. Test in accordance with ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.

## 1.6 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.

## 1.7 FIELD CONDITIONS

A. Protection of Masonry: During construction, cover tops of veneer, 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 face of veneer, and hold cover securely in place.

B. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry. Immediately remove grout, mortar, and soil that come in contact with 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.

## PART 2 PRODUCTS

### 2.1 UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 602, except as modified by requirements in the Contract Documents.

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

C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.
   1. Where fire-resistance-rated construction is indicated, use the equivalent thickness method for masonry units in accordance with ACI 216.1.

### 2.2 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 corners, movement joints, bond beams, sashes, and lintels.

B. Clay Face Brick: Facing brick complying with ASTM C216, Grade SW, Type FBS.
   1. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute when tested in accordance with ASTM C67/C67M.
   2. Efflorescence: Provide brick that has been tested in accordance with ASTM C67/C67M and is rated "not effloresced."
   3. Application: Use where brick is exposed unless otherwise indicated.
   4. Color and Texture: Match Architect's samples.

### 2.3 MORTAR MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
   1. Alkali content will not be more than 0.1 percent when tested in accordance with 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. Colored Cement Products: Packaged blend made from portland cement and hydrated lime and mortar pigments, all complying with specified requirements, and containing no other ingredients.
   1. Colored Portland Cement-Lime Mix:
      a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         1) Argos USA LLC.
         2) Heidelberg Materials.
         3) Holcim (US) Inc.
   2. Colored Masonry Cement:
      a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         1) Argos USA LLC.
         2) Cemex S.A.B. de C.V.
         3) Fairborn Cement Company.
         4) Heidelberg Materials.
         5) Holcim (US) Inc.
         6) Lafarge North America Inc.
   3. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.
   4. Pigments do not exceed 10 percent of portland cement by weight.

E. Water: Potable.

F. Integral Water Repellent (IWR) Mortar Additives: Meets ASTM C270 requirements.
   1. Basis-of-Design: SpecMix, IWR Mortar.
   2. Application Locations: As shown on Drawings

## 2.4 TIES AND ANCHORS

A. General: Ties and anchors extend at least 1-1/2 inches into veneer but with at least a 5/8-inch cover on outside face.

B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:
   1. Stainless Steel Wire: ASTM A580/A580M, Type 304.

C. 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, stainless steel wire.
   2. Tie Section: Triangular-shaped wire tie made from 0.25-inch- diameter, stainless steel wire.

D. Adjustable Masonry-Veneer Anchors:
   1. General: Provide anchors that allow vertical adjustment but resist a 100 lbf load in both tension and compression perpendicular to plane of wall without deforming or developing play in excess of 1/16 inch.
   2. Fabricate sheet metal anchor sections and other sheet metal parts from 0.1094-inch- thick, stainless steel sheet.
   3. Fabricate wire ties from 0.25-inch- diameter, stainless steel wire unless otherwise indicated.
   4. Contractor's Option: Unless otherwise indicated, provide any of the adjustable masonry-veneer anchors specified.
   5. Masonry-Veneer Anchors; Seismic-Pintle Plate: Rib-stiffened, sheet metal anchor section with screw holes at top and bottom, projecting leg with slotted hole for vertical leg of seismic pintle tie. Tie is rib-stiffened, sheet metal bent plate with down-turned leg to fit in anchor slot and with integral tabs to hold continuous wire in veneer.
   6. Stainless Steel Drill Screws for Steel Studs: ASTM C954 except manufactured with hex washer head and neoprene or EPDM washer, No. 10 diameter by length required to penetrate steel stud flange with not less than three exposed threads; either made from Type 410 stainless steel or made with a carbon-steel drill point and 300 Series stainless steel shank.

## 2.5 EMBEDDED FLASHING

A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:
   1. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.016 inch thick.
   2. Fabricate continuous flashings in sections 96 inches long minimum, but not exceeding 12 ft. Provide splice plates at joints of formed, smooth metal flashing.
   3. Fabricate through-wall metal flashing embedded in masonry from stainless steel, with ribs at 3-inch intervals along length of flashing to provide an integral mortar bond.
      a. HYPERLINK "http://www.specagent.com/LookUp/?ulid=1324&mf=04&src=wd" Manufacturers: Subject to compliance with requirements, provide one of the following:
         1) Cheney Flashing Company.
         2) Hohmann & Barnard, Inc.
         3) Keystone Flashing Company, Inc.
   4. Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive counterflashing.
   5. Fabricate through-wall flashing with drip edge unless otherwise indicated. Fabricate by extending flashing 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
   6. Fabricate through-wall flashing with sealant stop unless otherwise indicated. Fabricate by bending metal back on itself 3/4 inch at exterior face of wall and down into joint 1/4 inch to form a stop for retaining sealant backer rod.
   7. Fabricate metal drip edges from stainless steel. Extend at least 3 inches into wall and 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
   8. Fabricate metal sealant stops from stainless steel. Extend at least 3 inches into

wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch and down into joint 1/4 inch to form a stop for retaining sealant backer rod.
9. Fabricate metal expansion-joint strips from stainless steel to shapes indicated.
10. Solder metal items at corners.
11. Provide pre-formed 1 piece corners.

B. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

## 2.6 ACCESSORIES

A. Weep/Vent Products: Use one of the following unless otherwise indicated:
1. Cellular Plastic Weep/Vent: 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, in color selected from manufacturer's standard.

B. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.
1. Mortar Deflector: Strips, full depth of cavity 2 inches and 16 inches high, with dovetail-shaped notches that prevent clogging with mortar droppings.
a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1) Hohmann & Barnard, Inc.
2) Mortar Net Solutions.
3) Wire-Bond.
4) York Manufacturing, Inc.

# PART 3 EXECUTION

## 3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

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

## 3.2 INSTALLATION, GENERAL

A. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

B. 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.

C. 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.

D. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.

E. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested in accordance with ASTM C67/C67M. Allow units to absorb water so they are damp but not wet at time of laying.

## 3.3 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 ft., 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 ft., 1/4 inch in 20 ft., or 1/2-inch maximum.
   3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 ft., 3/8 inch in 20 ft., 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 ft., 1/4 inch in 20 ft., or 1/2-inch maximum.
   5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 ft., 3/8 inch in 20 ft., 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 ft., or 1/2-inch 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.

## 3.4 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. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in bond pattern indicated on Drawings; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

C. 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.

D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

E. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

## 3.5 MORTAR BEDDING AND JOINTING

A. Lay 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.

B. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
   1. For glazed masonry units, use a nonmetallic jointer 3/4 inch or more in width.

## 3.6 ANCHORED MASONRY VENEERS

A. Anchor masonry veneers to wall framing and concrete and masonry backup with seismic masonry-veneer anchors to comply with the following requirements:
   1. Fasten seismic anchors through sheathing to wall framing and to concrete and

masonry backup with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
2. Embed connector sections and continuous wire in masonry joints.
3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
4. Space anchors as indicated, but not more than 18 inches o.c. vertically and 24 inches o.c. horizontally, with not less than one anchor for each 2 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 8 inches, around perimeter.

B. Provide not less than 2 inches of airspace between back of masonry veneer and face of sheathing.
1. Keep airspace clean of mortar droppings and other materials during construction. Bevel beds away from airspace, to minimize mortar protrusions into airspace. Do not attempt to trowel or remove mortar fins protruding into airspace.

## 3.7 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 2 inches 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.

## 3.8 EXPANSION JOINTS

A. General: Install expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span expansion joints without provision to allow for in-plane wall or partition movement.

B. Provide horizontal, pressure-relieving joints by either leaving an airspace or inserting a compressible filler of width required for installing sealant and backer rod specified in Section 07 92 00 "Joint Sealants," but not less than 3/8 inch.
1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

## 3.9 LINTELS

A. Install steel lintels where indicated.

B. Provide offset angle supports where indicate and where openings of more than 12 inches for brick-size units and 24 inches for block-size units are indicated without structural steel or other supporting lintels.

C. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

## 3.10 FLASHING, WEEP HOLES, AND 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. Install vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.

B. Install flashing as follows unless otherwise indicated:
   1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
   2. Extend flashing through veneer, across airspace behind veneer, and up face of sheathing at least 8 inches; with upper edge tucked under air barrier, lapping at least 4 inches. Fasten upper edge of flexible flashing to sheathing through termination bar.
   3. Install metal drip edges and sealant stops with sawtooth sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Section 07 92 00 "Joint Sealants" for application indicated.
   4. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal drip edge.
   5. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal flashing termination.
   6. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.

C. Install reglets and nailers for flashing and other related construction where they are indicated to be built into masonry.

D. Install weep holes in veneers in head joints of first course of masonry immediately above embedded flashing.
   1. Use specified weep/cavity vent products or open-head joints to form weep holes.
   2. Use wicking material to form weep holes above flashing under brick sills. Turn wicking down at lip of sill to be as inconspicuous as possible.
   3. Space weep holes 24 inches o.c. unless otherwise indicated.
   4. Cover cavity side of weep holes with plastic insect screening at cavities insulated with loose-fill insulation.
   5. Trim wicking material flush with outside face of wall after mortar has set.

E. Place cavity drainage material in airspace behind veneers to comply with configuration requirements for cavity drainage material in "Accessories" Article.

F. Install vents in head joints in exterior wythes at spacing indicated. Use specified weep/cavity vent products or open-head joints to form vents.
   1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

## 3.11 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 brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
   6. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.

## 3.12 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. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
   1. Crush masonry waste to less than 4 inches in each dimension.
   2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Section 31 20 00 "Earth Moving."

3. Do not dispose of masonry waste as fill within 18 inches of finished grade.

C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

**END OF SECTION**

# SECTION 05 12 00 - STRUCTURAL STEEL FRAMING

## 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. Structural steel.
2. Shear stud connectors.
3. Shrinkage-resistant grout.

B. Related Requirements:

1. Section 051213 "Architecturally Exposed Structural Steel Framing" for additional requirements for architecturally exposed structural steel.
2. Section 053100 "Steel Decking" for field installation of shear stud connectors through deck.
3. Section 055000 "Metal Fabrications" for miscellaneous steel fabrications and other steel items not defined as structural steel.
4. Section 099600 "High-Performance Coatings" for painting requirements.

### 1.3 DEFINITIONS

A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303 “Code of Standard Practice for Steel Buildings and Bridges”.

### 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.



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## 1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

## 1.6 ACTION SUBMITTALS

A. Product Data:

1. Structural-steel materials.
2. High-strength, bolt-nut-washer assemblies.
3. Shear stud connectors.
4. Anchor rods.
5. Threaded rods.
6. Shop primer.
7. Shrinkage-resistant grout.

B. 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.

C. Delegated-Design Submittal: For structural-steel connections indicated on Drawings 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:

1. For Fabricator, see either 1.8.A.1 or 1.8.A.2 for informational submittals needed to satisfy qualification requirements.
2. For Erector, see either 1.8.B.1 or 1.8.B.2 for informational submittals needed to satisfy qualification requirements.

B. Welding certificates, as used by either the Fabricator or the Erector.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

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



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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.

## 1.8 QUALITY CONTROL

A. Fabricator Qualifications: The Fabricator must meet at least one of the two following requirements.

1. A 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 (Accreditation Criteria 172). The Fabricator shall also have a minimum of 5 years of experience in fabricating structural steel like that indicated for this project (with a record of successful service performance) and sufficient capacity to fabricate the structural steel without delaying the work. Qualification requirements shall be satisfied by submittal of the following:

   a. Completed project history for Fabricator, specifically focused on projects whose structural steel is like that for this project. Project history shall include Owner and Structural Engineer (as well as primary contacts) for each project listed. This qualification requirement shall be submitted as part of the bidding process.
   b. Current AISC or IAS certification documents.

2. A Fabricator that has an established and maintained quality control program to ensure that the work is performed in accordance with the requirements in ANSI/AISC 303 “Code of Standard Practice for Steel Buildings and Bridges”, ANSI/AISC 360 “Specification for Structural Steel Buildings”, and the Contract Documents. Program shall at a minimum address inspection of the items noted in ANSI/AISC 360 N2. The Fabricator shall also have a minimum of 5 years of experience in fabricating structural steel like that indicated for this project (with a record of successful service performance) and sufficient capacity to fabricate the structural steel without delaying the work. Qualification requirements shall be satisfied by submittal of the following:

   a. Completed project history for Fabricator, specifically focused on projects whose structural steel is like that for this project. Project history shall include Owner and Structural Engineer (as well as primary contacts) for each project listed. This qualification requirement shall be submitted as part of the bidding process.
   b. A written quality control manual that shall include (at a minimum) procedures for material control, inspection, and non-conformances.



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c. Quality Control Inspector (QCI) qualifications.

B. Erector Qualifications: The Erector must meet at least one of the two following requirements.

1. An Erector who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE. The Erector shall also have a minimum of 5 years of experience in erecting structural steel like that indicated for this project (with a record of successful service performance) and sufficient capacity to erect the structural steel without delaying the work. Qualification requirements shall be satisfied by submittal of the following:

   a. Completed project history for Erector, specifically focused on projects whose structural steel is like that for this project. Project history shall include Owner and Structural Engineer (as well as primary contacts) for each project listed. This qualification requirement shall be submitted as part of the bidding process.
   b. Current AISC certification documents.

2. An Erector that has an established and maintained quality control program to ensure that the work is performed in accordance with the requirements in ANSI/AISC 303 “Code of Standard Practice for Steel Buildings and Bridges”, ANSI/AISC 360 “Specification for Structural Steel Buildings”, and the Contract Documents. Program shall at a minimum address inspection of the items noted in ANSI/AISC 360 N2. The Erector shall also have a minimum of 5 years of experience in erecting structural steel like that indicated for this project (with a record of successful service performance) and sufficient capacity to erect the structural steel without delaying the work. Qualification requirements shall be satisfied by submittal of the following:

   a. Completed project history for Erector, specifically focused on projects whose structural steel is like that for this project. Project history shall include Owner and Structural Engineer (as well as primary contacts) for each project listed. This qualification requirement shall be submitted as part of the bidding process.
   b. A written quality control manual that shall include (at a minimum) procedures for material control, inspection, and non-conformances.
   c. Quality Control Inspector (QCI) qualifications.

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

## 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



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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 re-lubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125/F3125M, 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/AISC 303 “Code of Standard Practice for Steel Buildings and Bridges”.
2. ANSI/AISC 360 “Specification for Structural Steel Buildings”.
3. RCSC's "Specification for Structural Joints Using High-Strength Bolts".

B. Connection Design Information:

1. Design connections and final configuration of member reinforcement at connections in accordance with ANSI/AISC 303 by fabricator's qualified professional engineer.

a. Use Load and Resistance Factor Design; data are given at factored-load level.

C. Moment Connections: Type PR, partially restrained.

D. Construction: As indicated.

### 2.2 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A992/A992M.

B. Channels, Angles: ASTM A36/A36M.



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C. Plate and Bar: ASTM A36/A36M, and ASTM A572/A572M, Grade 50 as indicated.

D. Cold-Formed Hollow Structural Sections: ASTM A500/A500M, Grade B structural tubing.

E. Steel Pipe: ASTM A500/A500M, Grade B.

1. Weight Class: Standard, or as indicated.
2. Finish: Black except where indicated to be galvanized.

F. Welding Electrodes: Comply with AWS requirements.

## 2.3 BOLTS AND CONNECTORS

A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.

B. High-Strength A490 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A490, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all 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, or Grades 55 and 105 as indicated on the Drawings.

1. Configuration: Straight.
2. Nuts: ASTM A563 heavy-hex carbon steel.
3. Plate Washers: ASTM A36/A36M carbon steel.
4. Washers: ASTM F436, Type 1, hardened carbon steel.
5. Finish: Hot-dip zinc coating, ASTM A153/A153M, Class C.

B. Headed Anchor Rods: ASTM F1554, Grade 36, or Grades 55 and 105 as indicated on the Drawings.

1. Configuration: Straight.
2. Nuts: ASTM A563 heavy-hex carbon steel.
3. Plate Washers: ASTM A36/A36M carbon steel.
4. Washers: ASTM F436, Type 1, hardened carbon steel.
5. Finish: Hot-dip zinc coating, ASTM A153/A153M, Class C.



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C. Threaded Rods: ASTM A36/A36M.

1. Nuts: ASTM A 63 heavy-hex carbon steel.
2. Washers: ASTM F436, Type 1, hardened carbon steel.
3. Finish: Hot-dip zinc coating, ASTM A153/A153M, Class C.

## 2.5 PRIMER

A. Steel Primer:

1. Fabricator's standard lead- and chromate-free, non-asphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

B. Galvanized-Steel Primer: MPI#134.

1. Etching Cleaner: MPI#25, for galvanized steel.
2. Galvanizing Repair Paint: ASTM A780/A780M.

## 2.6 SHRINKAGE-RESISTANT GROUT

A. Non-metallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, non-metallic aggregate grout, non-corrosive and non-staining, mixed with water to consistency suitable for application and a 30-minute working time.

## 2.7 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 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/A6M 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/D1.1M.

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



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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.

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/D1.1M and manufacturer's written instructions.

G. Steel Wall-Opening Framing: Select true and straight members for fabricating steel wall-opening framing to be attached to structural-steel frame. Straighten as required to provide uniform, square, and true members in completed wall framing. Build up welded framing, weld exposed joints continuously, and grind smooth.

H. 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. Do not thermally cut bolt holes or enlarge holes by burning.
2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

I. Inspection Requirements: Quality control inspection tasks shall be performed by the Fabricator's QCI in accordance with ANSI/AISC 360 N5.4 (Inspection of Welding), N5.6 (Inspection of High-Strength Bolting), and N5.7 (Inspection of Galvanized Structural Steel Main Members). Tasks in Tables N5.4-1 through N5.4-3 and Tables N5.6-1 through N5.6-3 listed for quality control (QC) are those inspections performed by the QCI(s) to ensure that the work is performed in accordance with the Contract Documents.

1. Non-destructive testing (NDT) of welded joints provided during fabrication shall be performed by either an independent and qualified testing agency or the qualified QCI(s). All testing reports shall be submitted to the Owner for review.

a. Conduct NDT of <u>all</u> welded joints primarily supporting gravity loads (i.e. cantilevers). Reduction in the rate of NDT per N5.5e is prohibited.
b. For Risk Category II structures, conduct NDT of 10% of remaining CJP groove welds for materials 5/16" thick and greater per ANSI/AISC 360 N5.5b.
c. For Risk Category III and IV structures, conduct NDT of <u>all</u> remaining CJP groove welds for materials 5/16" thick and greater per ANSI/AISC 360 N5.5b.
d. Conduct NDT of <u>all</u> welded joints subject to fatigue, where required by ANSI/AISC 360 Appendix 3, Table A-3.1. Reduction in the rate of NDT per N5.5e is prohibited.



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J. Special Inspections: Where special inspections are required by the Contract Documents, the Owner will engage the Special Inspector to perform an audit of the fabrication and quality control practices employed by the Fabricator. Where the Fabricator is qualified through the option noted in 1.8.A.1, the requirement for this audit during fabrication shall be waived.

1. The Fabricator shall meet all requirements of ANSI/AISC 303 8.5 to accommodate an audit of the fabrication shop.
2. Prior to the commencement of fabrication, the Special Inspector shall submit to the Owner for review a written plan identifying the frequency and extent of visits to the fabrication shop.
3. At a minimum, the audit by the Special Inspector shall include review of the following:

    a. The Fabricator’s quality control manual and procedures for material control, inspection, and non-conformances.
    b. Material test reports for all members, fasteners, and consumables.
    c. The steel fabrication process including member fit-up, material selection, welding procedures and personnel, etc. Records need to be maintained for all material sources, members using the noted materials, consumables used, welder(s) employed, dates of completion, and when the QCI completed the inspection.
    d. Inspections representing a sampling of the before, during, and after QA tasks noted in ANSI/AISC 360 N5.5, N5.6, and N5.8.

K. At the completion of fabrication, the Fabricator shall submit a certificate of compliance to the Owner stating that the materials supplied and work performed by the Fabricator are in accordance with the Contract Documents. All testing/inspection reports generated as part of 2.7.I or 2.7.J shall also be submitted for review at the completion of fabrication.

## 2.8 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.

1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M 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.



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## 2.9 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel in accordance with ASTM A123/A123M.

1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
2. Galvanize items as indicated on the Drawings.

## 2.10 SHOP PRIMING

A. 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.
4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
5. Galvanized surfaces.

B. 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 2.
2. SSPC-SP 3.

C. Priming: Immediately after surface preparation, apply primer in accordance with manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

# 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.

1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.

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



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## 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.

1. Do not remove temporary shoring supporting composite deck construction and structural-steel framing until cast-in-place concrete has attained its design compressive strength.

## 3.3 ERECTION

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

B. Base Plates, 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 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/AISC 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.



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

H. Inspection Requirements: Quality control inspection tasks shall be performed by the Erector's QCI in accordance with ANSI/AISC 360 N5.4 (Inspection of Welding), N5.6 (Inspection of High-Strength Bolting), and N5.7 (Inspection of Galvanized Structural Steel Main Members). Tasks in Tables N5.4-1 through N5.4-3 and Tables N5.6-1 through N5.6-3 listed for quality control (QC) are those inspections performed by the QCI(s) to ensure that the work is performed in accordance with the Contract Documents.

1. Non-destructive testing (NDT) of welded joints provided during erection shall be performed by an independent and qualified testing agency (see 3.3.J). All testing reports shall be submitted to the Owner for review.

    a. Conduct NDT of all welded joints primarily supporting gravity loads (i.e. cantilevers). Reduction in the rate of NDT per N5.5e is prohibited.
    b. For Risk Category II structures, conduct NDT of 10% of remaining CJP groove welds for materials 5/16" thick and greater per ANSI/AISC 360 N5.5b.
    c. For Risk Category III and IV structures, conduct NDT of all remaining CJP groove welds for materials 5/16" thick and greater per ANSI/AISC 360 N5.5b.
    d. Conduct NDT of all welded joints subject to fatigue, where required by ANSI/AISC 360 Appendix 3, Table A-3.1. Reduction in the rate of NDT per N5.5e is prohibited.

I. Special Inspections: Where special inspections are required by the Contract Documents, the Owner will engage a Special Inspector to perform the tasks noted in the Statement of Special Inspections during erection. These inspections shall be considered to satisfy the quality assurance requirements of ANSI/AISC 360 Chapter N.

J. Testing Agency: The Owner will engage an independent and 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/D1.1M. Non-destructive testing (NDT) methods (as required) are as follows:

    a. Liquid Penetrant Inspection: ASTM E165/E165M.
    b. Magnetic Particle Inspection: ASTM E709, performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not acceptable.
    c. Ultrasonic Inspection: ASTM E164.
    d. Radiographic Inspection: ASTM E94/E94M.



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K. At the completion of erection, the approved Erector shall submit a certificate of compliance to the Owner stating that the materials supplied and work performed by the Erector are in accordance with the Contract Documents.

## 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 type specified.

1. Joint Type: Snug tightened.

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

1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
2. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

## 3.5 PROTECTION

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing, and repair galvanizing to comply with ASTM A780/A780M.

B. Touchup Painting: 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.

1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

C. Touchup Priming: Cleaning and touchup priming are specified in Section 099600 "High-Performance Coatings."

**END OF SECTION**



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# SECTION 05 12 00 - STRUCTURAL STEEL FRAMING

## 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. Structural steel.
2. Shear stud connectors.
3. Shrinkage-resistant grout.

B. Related Requirements:

1. Section 051213 "Architecturally Exposed Structural Steel Framing" for additional requirements for architecturally exposed structural steel.
2. Section 053100 "Steel Decking" for field installation of shear stud connectors through deck.
3. Section 055000 "Metal Fabrications" for miscellaneous steel fabrications and other steel items not defined as structural steel.
4. Section 099600 "High-Performance Coatings" for painting requirements.

### 1.3 DEFINITIONS

A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303 “Code of Standard Practice for Steel Buildings and Bridges”.

### 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.



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## 1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

## 1.6 ACTION SUBMITTALS

A. Product Data:

1. Structural-steel materials.
2. High-strength, bolt-nut-washer assemblies.
3. Shear stud connectors.
4. Anchor rods.
5. Threaded rods.
6. Shop primer.
7. Shrinkage-resistant grout.

B. 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.

C. Delegated-Design Submittal: For structural-steel connections indicated on Drawings 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:

1. For Fabricator, see either 1.8.A.1 or 1.8.A.2 for informational submittals needed to satisfy qualification requirements.
2. For Erector, see either 1.8.B.1 or 1.8.B.2 for informational submittals needed to satisfy qualification requirements.

B. Welding certificates, as used by either the Fabricator or the Erector.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

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



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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.

## 1.8 QUALITY CONTROL

A. Fabricator Qualifications: The Fabricator must meet at least one of the two following requirements.

1. A 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 (Accreditation Criteria 172). The Fabricator shall also have a minimum of 5 years of experience in fabricating structural steel like that indicated for this project (with a record of successful service performance) and sufficient capacity to fabricate the structural steel without delaying the work. Qualification requirements shall be satisfied by submittal of the following:

   a. Completed project history for Fabricator, specifically focused on projects whose structural steel is like that for this project. Project history shall include Owner and Structural Engineer (as well as primary contacts) for each project listed. This qualification requirement shall be submitted as part of the bidding process.
   b. Current AISC or IAS certification documents.

2. A Fabricator that has an established and maintained quality control program to ensure that the work is performed in accordance with the requirements in ANSI/AISC 303 “Code of Standard Practice for Steel Buildings and Bridges”, ANSI/AISC 360 “Specification for Structural Steel Buildings”, and the Contract Documents. Program shall at a minimum address inspection of the items noted in ANSI/AISC 360 N2. The Fabricator shall also have a minimum of 5 years of experience in fabricating structural steel like that indicated for this project (with a record of successful service performance) and sufficient capacity to fabricate the structural steel without delaying the work. Qualification requirements shall be satisfied by submittal of the following:

   a. Completed project history for Fabricator, specifically focused on projects whose structural steel is like that for this project. Project history shall include Owner and Structural Engineer (as well as primary contacts) for each project listed. This qualification requirement shall be submitted as part of the bidding process.
   b. A written quality control manual that shall include (at a minimum) procedures for material control, inspection, and non-conformances.



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c. Quality Control Inspector (QCI) qualifications.

B. Erector Qualifications: The Erector must meet at least one of the two following requirements.

1. An Erector who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE. The Erector shall also have a minimum of 5 years of experience in erecting structural steel like that indicated for this project (with a record of successful service performance) and sufficient capacity to erect the structural steel without delaying the work. Qualification requirements shall be satisfied by submittal of the following:

   a. Completed project history for Erector, specifically focused on projects whose structural steel is like that for this project. Project history shall include Owner and Structural Engineer (as well as primary contacts) for each project listed. This qualification requirement shall be submitted as part of the bidding process.
   b. Current AISC certification documents.

2. An Erector that has an established and maintained quality control program to ensure that the work is performed in accordance with the requirements in ANSI/AISC 303 “Code of Standard Practice for Steel Buildings and Bridges”, ANSI/AISC 360 “Specification for Structural Steel Buildings”, and the Contract Documents. Program shall at a minimum address inspection of the items noted in ANSI/AISC 360 N2. The Erector shall also have a minimum of 5 years of experience in erecting structural steel like that indicated for this project (with a record of successful service performance) and sufficient capacity to erect the structural steel without delaying the work. Qualification requirements shall be satisfied by submittal of the following:

   a. Completed project history for Erector, specifically focused on projects whose structural steel is like that for this project. Project history shall include Owner and Structural Engineer (as well as primary contacts) for each project listed. This qualification requirement shall be submitted as part of the bidding process.
   b. A written quality control manual that shall include (at a minimum) procedures for material control, inspection, and non-conformances.
   c. Quality Control Inspector (QCI) qualifications.

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

## 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



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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 re-lubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125/F3125M, 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/AISC 303 “Code of Standard Practice for Steel Buildings and Bridges”.
2. ANSI/AISC 360 “Specification for Structural Steel Buildings”.
3. RCSC's "Specification for Structural Joints Using High-Strength Bolts".

B. Connection Design Information:

1. Design connections and final configuration of member reinforcement at connections in accordance with ANSI/AISC 303 by fabricator's qualified professional engineer.

a. Use Load and Resistance Factor Design; data are given at factored-load level.

C. Moment Connections: Type PR, partially restrained.

D. Construction: As indicated.

### 2.2 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A992/A992M.

B. Channels, Angles: ASTM A36/A36M.



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C. Plate and Bar: ASTM A36/A36M, and ASTM A572/A572M, Grade 50 as indicated.

D. Cold-Formed Hollow Structural Sections: ASTM A500/A500M, Grade B structural tubing.

E. Steel Pipe: ASTM A500/A500M, Grade B.

1. Weight Class: Standard, or as indicated.
2. Finish: Black except where indicated to be galvanized.

F. Welding Electrodes: Comply with AWS requirements.

## 2.3 BOLTS AND CONNECTORS

A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.

B. High-Strength A490 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A490, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all 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, or Grades 55 and 105 as indicated on the Drawings.

1. Configuration: Straight.
2. Nuts: ASTM A563 heavy-hex carbon steel.
3. Plate Washers: ASTM A36/A36M carbon steel.
4. Washers: ASTM F436, Type 1, hardened carbon steel.
5. Finish: Hot-dip zinc coating, ASTM A153/A153M, Class C.

B. Headed Anchor Rods: ASTM F1554, Grade 36, or Grades 55 and 105 as indicated on the Drawings.

1. Configuration: Straight.
2. Nuts: ASTM A563 heavy-hex carbon steel.
3. Plate Washers: ASTM A36/A36M carbon steel.
4. Washers: ASTM F436, Type 1, hardened carbon steel.
5. Finish: Hot-dip zinc coating, ASTM A153/A153M, Class C.



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C. Threaded Rods: ASTM A36/A36M.

1. Nuts: ASTM A 63 heavy-hex carbon steel.
2. Washers: ASTM F436, Type 1, hardened carbon steel.
3. Finish: Hot-dip zinc coating, ASTM A153/A153M, Class C.

## 2.5 PRIMER

A. Steel Primer:

1. Fabricator's standard lead- and chromate-free, non-asphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

B. Galvanized-Steel Primer: MPI#134.

1. Etching Cleaner: MPI#25, for galvanized steel.
2. Galvanizing Repair Paint: ASTM A780/A780M.

## 2.6 SHRINKAGE-RESISTANT GROUT

A. Non-metallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, non-metallic aggregate grout, non-corrosive and non-staining, mixed with water to consistency suitable for application and a 30-minute working time.

## 2.7 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 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/A6M 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/D1.1M.

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



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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.

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/D1.1M and manufacturer's written instructions.

G. Steel Wall-Opening Framing: Select true and straight members for fabricating steel wall-opening framing to be attached to structural-steel frame. Straighten as required to provide uniform, square, and true members in completed wall framing. Build up welded framing, weld exposed joints continuously, and grind smooth.

H. 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. Do not thermally cut bolt holes or enlarge holes by burning.
2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

I. Inspection Requirements: Quality control inspection tasks shall be performed by the Fabricator's QCI in accordance with ANSI/AISC 360 N5.4 (Inspection of Welding), N5.6 (Inspection of High-Strength Bolting), and N5.7 (Inspection of Galvanized Structural Steel Main Members). Tasks in Tables N5.4-1 through N5.4-3 and Tables N5.6-1 through N5.6-3 listed for quality control (QC) are those inspections performed by the QCI(s) to ensure that the work is performed in accordance with the Contract Documents.

1. Non-destructive testing (NDT) of welded joints provided during fabrication shall be performed by either an independent and qualified testing agency or the qualified QCI(s). All testing reports shall be submitted to the Owner for review.

a. Conduct NDT of <u>all</u> welded joints primarily supporting gravity loads (i.e. cantilevers). Reduction in the rate of NDT per N5.5e is prohibited.
b. For Risk Category II structures, conduct NDT of 10% of remaining CJP groove welds for materials 5/16" thick and greater per ANSI/AISC 360 N5.5b.
c. For Risk Category III and IV structures, conduct NDT of <u>all</u> remaining CJP groove welds for materials 5/16" thick and greater per ANSI/AISC 360 N5.5b.
d. Conduct NDT of <u>all</u> welded joints subject to fatigue, where required by ANSI/AISC 360 Appendix 3, Table A-3.1. Reduction in the rate of NDT per N5.5e is prohibited.



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J. Special Inspections: Where special inspections are required by the Contract Documents, the Owner will engage the Special Inspector to perform an audit of the fabrication and quality control practices employed by the Fabricator. Where the Fabricator is qualified through the option noted in 1.8.A.1, the requirement for this audit during fabrication shall be waived.

1. The Fabricator shall meet all requirements of ANSI/AISC 303 8.5 to accommodate an audit of the fabrication shop.
2. Prior to the commencement of fabrication, the Special Inspector shall submit to the Owner for review a written plan identifying the frequency and extent of visits to the fabrication shop.
3. At a minimum, the audit by the Special Inspector shall include review of the following:

    a. The Fabricator’s quality control manual and procedures for material control, inspection, and non-conformances.
    b. Material test reports for all members, fasteners, and consumables.
    c. The steel fabrication process including member fit-up, material selection, welding procedures and personnel, etc. Records need to be maintained for all material sources, members using the noted materials, consumables used, welder(s) employed, dates of completion, and when the QCI completed the inspection.
    d. Inspections representing a sampling of the before, during, and after QA tasks noted in ANSI/AISC 360 N5.5, N5.6, and N5.8.

K. At the completion of fabrication, the Fabricator shall submit a certificate of compliance to the Owner stating that the materials supplied and work performed by the Fabricator are in accordance with the Contract Documents. All testing/inspection reports generated as part of 2.7.I or 2.7.J shall also be submitted for review at the completion of fabrication.

## 2.8 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.

1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M 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.



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## 2.9 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel in accordance with ASTM A123/A123M.

1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
2. Galvanize items as indicated on the Drawings.

## 2.10 SHOP PRIMING

A. 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.
4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
5. Galvanized surfaces.

B. 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 2.
2. SSPC-SP 3.

C. Priming: Immediately after surface preparation, apply primer in accordance with manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

# 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.

1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.

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



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## 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.

1. Do not remove temporary shoring supporting composite deck construction and structural-steel framing until cast-in-place concrete has attained its design compressive strength.

## 3.3 ERECTION

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

B. Base Plates, 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 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/AISC 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.



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

H. Inspection Requirements: Quality control inspection tasks shall be performed by the Erector's QCI in accordance with ANSI/AISC 360 N5.4 (Inspection of Welding), N5.6 (Inspection of High-Strength Bolting), and N5.7 (Inspection of Galvanized Structural Steel Main Members). Tasks in Tables N5.4-1 through N5.4-3 and Tables N5.6-1 through N5.6-3 listed for quality control (QC) are those inspections performed by the QCI(s) to ensure that the work is performed in accordance with the Contract Documents.

1. Non-destructive testing (NDT) of welded joints provided during erection shall be performed by an independent and qualified testing agency (see 3.3.J). All testing reports shall be submitted to the Owner for review.

    a. Conduct NDT of all welded joints primarily supporting gravity loads (i.e. cantilevers). Reduction in the rate of NDT per N5.5e is prohibited.
    b. For Risk Category II structures, conduct NDT of 10% of remaining CJP groove welds for materials 5/16" thick and greater per ANSI/AISC 360 N5.5b.
    c. For Risk Category III and IV structures, conduct NDT of all remaining CJP groove welds for materials 5/16" thick and greater per ANSI/AISC 360 N5.5b.
    d. Conduct NDT of all welded joints subject to fatigue, where required by ANSI/AISC 360 Appendix 3, Table A-3.1. Reduction in the rate of NDT per N5.5e is prohibited.

I. Special Inspections: Where special inspections are required by the Contract Documents, the Owner will engage a Special Inspector to perform the tasks noted in the Statement of Special Inspections during erection. These inspections shall be considered to satisfy the quality assurance requirements of ANSI/AISC 360 Chapter N.

J. Testing Agency: The Owner will engage an independent and 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/D1.1M. Non-destructive testing (NDT) methods (as required) are as follows:

    a. Liquid Penetrant Inspection: ASTM E165/E165M.
    b. Magnetic Particle Inspection: ASTM E709, performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not acceptable.
    c. Ultrasonic Inspection: ASTM E164.
    d. Radiographic Inspection: ASTM E94/E94M.



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K. At the completion of erection, the approved Erector shall submit a certificate of compliance to the Owner stating that the materials supplied and work performed by the Erector are in accordance with the Contract Documents.

## 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 type specified.

1. Joint Type: Snug tightened.

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

1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
2. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

## 3.5 PROTECTION

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing, and repair galvanizing to comply with ASTM A780/A780M.

B. Touchup Painting: 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.

1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

C. Touchup Priming: Cleaning and touchup priming are specified in Section 099600 "High-Performance Coatings."

**END OF SECTION**



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# SECTION 05 12 13 - ARCHITECTURALLY EXPOSED STRUCTURAL STEEL FRAMING

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Architecturally exposed structural steel (AESS).
2. Section 051200 "Structural Steel Framing" requirements that also apply to AESS.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for steel lintels and shelf angles not attached to structural-steel frame, miscellaneous steel fabrications and other metal items not defined as structural steel.

### 1.2 DEFINITIONS

A. AESS: Architecturally exposed structural steel.

B. Category AESS 1: Structural steel that is categorized by ANSI/AISC 303, Section 10, as AESS 1 and may be designated AESS 1 or Category AESS 1 in the Contract Documents.

C. Category AESS 2: Structural steel that is categorized by ANSI/AISC 303, Section 10, as AESS 2 and is designated as AESS 2 or Category AESS 2 in the Contract Documents.

D. Category AESS C: Structural steel with custom characteristics that is categorized by ANSI/AISC 303, Section 10, as AESS C and is designated as AESS C or Category AESS C in the Contract Documents.

E. SEAC/RMSCA Guide Specification: SEAC/RMSCA's "Sample Specification, Section 05 02 13: Architecturally Exposed Structural Steel."

### 1.3 COORDINATION

A. Coordinate surface preparation requirements for shop-primed items.

B. 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.



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## 1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site .

## 1.5 ACTION SUBMITTALS

A. Product Data:

1. Tension-control, high-strength, bolt-nut-washer assemblies.
2. Corrosion-resisting (weathering steel), tension-control, high-strength, bolt-nut-washer assemblies.
3. Filler.
4. Primer.
5. Galvanized-steel primer.
6. Etching cleaner.
7. Galvanized repair paint.

B. Shop Drawings: Show fabrication of AESS components. Shop Drawings for structural steel may be used for AESS.

1. Identify AESS category for each steel member and connection, including transitions between AESS categories and between AESS and non-AESS.
2. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
3. Include embedment Drawings.
4. Indicate orientation of mill marks and HSS seams.
5. 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. Indicate grinding, finish, and profile of welds**.**
6. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections. Indicate orientation and location of bolt heads.
7. Indicate exposed surfaces and edges and surface preparation being used.
8. Indicate special tolerances and erection requirements.
9. Indicate weep holes for HSS and vent holes for galvanized HSS.
10. Indicate surface preparation, primer, and coating requirements, including systems specified in other Sections.

C. Samples: Submit Samples to set quality standards for AESS.

1. Two steel plates, 3/8 by 8 by 4 inches (9.5 by 200 by 100 mm), with long edges joined by a groove weld and with weld ground smooth.
2. Steel plate, 3/8 by 8 by 8 inches (9.5 by 200 by 200 mm), with one end of a short length of rectangular steel tube, 4 by 6 by 3/8 inches (100 by 150 by 9.5 mm),



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welded to plate with a continuous fillet weld[ and with weld ground smooth and blended].

3. Round steel tube or pipe, minimum 8 inches (200 mm) in diameter, with end of another round steel tube or pipe, approximately 4 inches (100 mm) in diameter, welded to its side at a 45-degree angle with a continuous fillet weld and with weld ground smooth and blended.

## 1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and fabricator.

B. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

## 1.7 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 (AC 172) and is experienced in fabricating AESS similar to that indicated on this Project.

B. Installer Qualifications: A qualified Installer who participates in the AISC Quality Certification Program, is designated an AISC-Certified Erector, Category ACSE Category CSE, and is experienced in erecting AESS similar to that indicated on this Project.

C. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement P1 or SSPC-QP 3.

D. Mockups: Build mockups of AESS to set quality standards for fabrication and installation.

1. Build mockup of typical portion of AESS as shown on Drawings.
2. Coordinate painting requirements with Section 099113 "Exterior Painting." Section 099123 "Interior Painting."
3. Coordinate high-performance coatings requirements with Section 099600 "High-Performance Coatings."
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

## 1.8 DELIVERY, STORAGE, AND HANDLING

A. Use special care in handling AESS to prevent twisting, warping, nicking, and other damage during fabrication, delivery, and erection. Store materials to permit easy access for inspection and identification. Keep AESS members off ground and spaced by using



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pallets, dunnage, or other supports and spacers. Protect AESS members and packaged materials from corrosion and deterioration.

1. Do not store AESS 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.

## 1.9 FIELD CONDITIONS

A. Field Measurements: Where AESS is indicated to fit against other construction, verify actual dimensions by field measurements before fabrication.

# PART 2 - PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

A. Comply with requirements of ANSI/AISC 303, Sections 1 through 9 and as modified in Section 10, "Architecturally Exposed Structural Steel."

## 2.2 BOLTS, CONNECTORS, AND ANCHORS

A. Tension-Control, High-Strength, Bolt-Nut-Washer Assemblies: ASTM F3125/F3125M, Grade F1852, Type 1, round-head assemblies consisting of steel structural bolts with splined ends; ASTM A563, Grade DH, (ASTMA563M, Class 10S) heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.

1. Finish: Plain.

B. Corrosion-Resisting (Weathering) Steel, Tension-Control, High-Strength, Bolt-Nut-Washer Assemblies: ASTM F3125/F3125M, Grade F1852, Type 3, round-head assemblies consisting of steel structural bolts with splined ends; ASTM A563, Grade DH3, (ASTM A563M, Class 10S3) heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 3, hardened carbon-steel washers.

## 2.3 FILLER

A. Polyester filler intended for use in repairing dents in automobile bodies.

## 2.4 PRIMER

A. Steel Primer:



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1. Comply with Section 099123 Interior Painting**.** SSPC-Paint 23 below requires SSPC-SP 6(WAB)/NACE WAB-3 surface preparation or better and 24 hours' drying before recoating. SSPC recommends two primer coats before exposing steel to exterior, and one or two topcoats.
2. SSPC-Paint 23, latex primer.
3. Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

B. Galvanized-Steel Primer: MPI#26 .

1. Etching Cleaner: MPI#25, for galvanized steel.
2. Galvanizing Repair Paint: MPI#18.

## 2.5 FABRICATION

A. Shop fabricate and assemble AESS to the maximum extent possible. Locate field joints at concealed locations if possible. Detail assemblies to minimize handling and to expedite erection.

1. Use special care handling and fabricating AESS before and after shop painting to minimize damage to shop finish.

### B. Category AESS 1:

1. Comply with overall profile dimensions of AWS D1.1/D1.1M for welded built-up members. Keep appearance and quality of welds consistent. Maintain true alignment of members without warp exceeding specified tolerances.
2. Prepare surfaces according to Part 2 "Shop Priming" Article and SSPC-SP 6 (WAB)/NACE WAB-3.
3. Grind sheared, punched, and flame-cut edges to remove burrs and provide smooth surfaces and eased edges.
4. Make intermittent welds appear continuous, using filler or additional welding.
5. Seal weld open ends of hollow structural sections with 3/8-inch (9.5-mm) closure plates.
6. Limit butt and plug weld projections to 1/16 inch (1.6 mm).
7. Install bolt heads on the same side of each connection and maintain orientation consistently from one connection to another.
8. Remove weld spatter, slivers, and similar surface discontinuities.
9. Remove blemishes and surface irregularities resulting from temporary braces or fixtures by filling or grinding, before cleaning, treating, and shop priming.
10. Grind tack welds smooth unless incorporated into final welds.
11. Remove backing and runoff tabs, and grind welds smooth.

### C. Category AESS 2:



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1. Comply with overall profile dimensions of AWS D1.1/D1.1M for welded built-up members. Keep appearance and quality of welds consistent. Maintain true alignment of members without warp exceeding specified tolerances.
2. Prepare surfaces according to Part 2 "Shop Priming" Article and SSPC-SP 6 (WAB)/NACE WAB-3.
3. Grind sheared, punched, and flame-cut edges to remove burrs and provide smooth surfaces and eased edges.
4. Make intermittent welds appear continuous, using filler or additional welding.
5. Seal weld open ends of hollow structural sections with 3/8-inch (9.5-mm) closure plates.
6. Limit butt and plug weld projections to 1/16 inch (1.6 mm).
7. Install bolt heads on the same side of each connection and maintain orientation consistently from one connection to another.
8. Remove weld spatter, slivers, and similar surface discontinuities.
9. Remove blemishes and surface irregularities resulting from temporary braces or fixtures by filling or grinding, before cleaning, treating, and shop priming.
10. Grind tack welds smooth unless incorporated into final welds.
11. Remove backing and runoff tabs, and grind welds smooth.
12. Limit as-fabricated straightness tolerance to one-half that permitted for structural-steel materials in ANSI/AISC 303.
13. Limit as-fabricated curved structural steel tolerance to that permitted for structural-steel materials in ANSI/AISC 303.
14. Limit as-fabricated straightness tolerance of welded built-up members to one-half that permitted by AWS D1.1/D1.1M.
15. Conceal fabrication and erection markings from view in the completed structure.
16. Make welds uniform and smooth.

D. Erection marks, painted marks, and other marks are permitted on galvanized- corrosion-resisting (weathering)] steel surfaces of completed structure.

E. Cleaning Corrosion-Resisting (Weathering) AESS: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 6 (WAB)/NACE WAB-3.

## 2.6 SHOP CONNECTIONS

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

1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.



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## 2.7 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A123/A123M.

1. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.
2. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
3. Galvanize AESS lintels attached to structural-steel frame and located in exterior walls.

## 2.8 SHOP PRIMING

A. 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 (50 mm).
2. Surfaces to be field welded.
3. Surfaces to be high-strength bolted with slip-critical connections.
4. Corrosion-resisting (weathering) steel surfaces.
5. Galvanized surfaces unless indicated to be painted.

B. Surface Preparation: Clean nongalvanized surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:

1. SSPC-SP 2.
2. SSPC-SP 3.
3. SSPC-SP 7 (WAB)/NACE WAB-4.
4. SSPC-SP 14 (WAB)/NACE WAB-8.
5. SSPC-SP 11.
6. SSPC-SP 6 (WAB)/NACE WAB-3.
7. SSPC-SP 10 (WAB)/NACE WAB-2.
8. SSPC-SP 5 (WAB)/NACE WAB-1.
9. SSPC-SP 8.

C. Preparing Galvanized Steel for Shop Priming: After galvanizing, thoroughly clean steel of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner or according to SSPC-SP 16.

D. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Stripe paint corners, crevices, bolts, welds, and eased edges.



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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.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

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

1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments, showing dimensions, locations, angles, and elevations.

B. Examine AESS for twists, kinks, warping, gouges, and other imperfections before erecting.

C. 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 AESS 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.

### 3.3 ERECTION

A. Take special care during erection to avoid marking or distorting the AESS and to minimize damage to shop painting. Set AESS accurately in locations and to elevations indicated and according to ANSI/AISC 303 and ANSI/AISC 360.

1. Remove welded tabs that were used for attaching temporary bracing and safety cabling and that are exposed to view in the completed Work. Take care to avoid any blemishes, holes, or unsightly surfaces resulting from the use or removal of temporary elements.
2. Grind tack welds smooth.
3. Remove backing and runoff tabs, and grind welds smooth.
4. Orient bolt heads on the same side of each connection and maintain orientation consistently from one connection to another.
5. Conceal fabrication and erection markings from view in the completed structure.

B. In addition to ANSI/AISC 303, Section 10 requirements, comply with the following.



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1. Erection of Category AESS 1 and Category AESS 2:

    a. Erect AESS to the standard frame tolerances specified in ANSI/AISC 303 for non-AESS.
    b. Comply with AWS D1.1/D1.1M. Keep appearance and quality of welds consistent. Maintain true alignment of members without warp exceeding specified tolerances.
    c. Remove weld spatter, slivers, and similar surface discontinuities.
    d. Grind off butt and plug weld projections larger than 1/16 inch (1.6 mm).
    e. Continuous welds are to be of uniform size and profile.
    f. Ream holes that must be enlarged. Use of drift pins or burning is not permitted. Replace misaligned connection plates where holes cannot be aligned with acceptable appearance.
    g. Splice members only where indicated on Drawings.
    h. No torch cutting or field fabrication is permitted.

## 3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.

    1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

## 3.5 REPAIR

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and touchup galvanizing to comply with ASTM A780/A780M.

B. Touchup Painting:

    1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting, to comply with SSPC-PA 1 for touching up shop-painted surfaces.

        a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

    2. Cleaning and touchup painting are specified in Section 099113 "Exterior Painting." Section 099123 "Interior Painting." Section 099600 "High-Performance Coatings."

C. Touchup Priming: Cleaning and touchup priming are specified in Section 099600 "High-Performance Coatings."



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## 3.6 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to inspect AESS as specified in Section 051200 "Structural Steel Framing." The testing agency is not responsible for enforcing requirements relating to aesthetic effect.

B. Architect will observe AESS in place to determine acceptability relating to aesthetic effect.

**END OF SECTION**



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# SECTION 05 21 00 - STEEL JOIST FRAMING

## 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. K-series steel joists.
2. KCS-type K-series steel joists.
3. K-series steel joist substitutes.
4. Steel joist accessories.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for installing bearing plates in concrete.
2. Section 042000 "Unit Masonry" for installing bearing plates in unit masonry.

### 1.3 DEFINITIONS

A. SJI's "Specifications": Steel Joist Institute's "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders."

B. Special Joists: Steel joists or joist girders requiring modification by manufacturer to support nonuniform, unequal, or special loading conditions that invalidate load tables in SJI's "Specifications."

### 1.4 ACTION SUBMITTALS

A. Product Data: For each type of joist, accessory, and product.

B. Shop Drawings:

1. Include layout, designation, number, type, location, and spacing of joists.
2. Include joining and anchorage details; bracing, bridging, and joist accessories; splice and connection locations and details; and attachments to other construction.



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3. Indicate locations and details of bearing plates to be embedded in other construction.

## 1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

B. Welding certificates.

C. Manufacturer certificates.

D. Mill Certificates: For each type of bolt.

E. Comprehensive engineering analysis of special joists signed and sealed by the qualified professional engineer responsible for its preparation.

F. Field quality-control reports.

## 1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables in SJI's "Specifications."

1. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.

B. Welding Qualifications: Qualify field-welding procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

## 1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle joists as recommended in SJI's "Specifications."

B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

## 1.8 SEQUENCING

A. Deliver steel bearing plates to be built into cast-in-place concrete and masonry construction.



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## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

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

1. Canam Steel Corporation; Canam Group, Inc.
2. CMC Joist & Deck.
3. Gooder-Henrichsen Co.
4. New Millennium Building Systems, LLC.
5. Structures of U.S.A., Inc.
6. Valley Joist.
7. Vulcraft; Nucor Vulcraft Group.

### 2.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide special joists and connections capable of withstanding design loads indicated on Drawings.

1. Use LRFD; data are given at factored-load level.
2. Design special joists to withstand design loads with live-load deflections no greater than the following:
   a. Roof Joists: Vertical deflection of 1/240 of the span.

### 2.3 STEEL JOISTS

A. K-Series Steel Joist: Manufactured steel joists of type indicated according to "Standard Specification for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.

1. Joist Type: K-series steel joists and KCS-type K-series steel joists.
2. K-Series Steel Joist Substitutes: Manufacture according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle or -channel members.
3. Provide holes in chord members for connecting and securing other construction to joists.
4. Top-Chord Extensions: Extend top chords of joists with SJI's Type S top-chord extensions where indicated on Drawings, complying with SJI's "Specifications."
5. Extended Ends: Extend bearing ends of joists with SJI's Type R extended ends where indicated on Drawings, complying with SJI's "Specifications."
6. Camber joists according to SJI's "Specifications."
7. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.



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## 2.4 PRIMERS

A. Primer:

1. SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15.

## 2.5 STEEL JOIST ACCESSORIES

A. Bridging:

1. Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.

B. Fabricate steel bearing plates from ASTM A36/A36M steel with integral anchorages of sizes and thicknesses indicated on Drawings. Hot-dip zinc coat according to ASTM A123/A123M.

C. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.

1. Finish: Plain.

D. Welding Electrodes: Comply with AWS standards.

E. Galvanizing Repair Paint: ASTM A780/A780M.

F. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.

## 2.6 CLEANING AND SHOP PAINTING

A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by hand-tool cleaning, SSPC-SP 2 or power-tool cleaning, SSPC-SP 3.

B. Do not prime paint joists and accessories to receive sprayed fire-resistive materials.

C. Apply one coat of shop primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil thick.



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## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine supporting substrates, embedded bearing plates, 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 INSTALLATION

A. Do not install joists until supporting construction is in place and secured.

B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications,"joist manufacturer's written instructions, and requirements in this Section.

1. Before installation, splice joists delivered to Project site in more than one piece.
2. Space, adjust, and align joists accurately in location before permanently fastening.
3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
4. Delay rigidly connecting bottom-chord extensions to columns or supports until dead loads are applied.

C. Field weld joists to supporting steel bearing plates and framework. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

D. Bolt joists to supporting steel framework using high-strength structural bolts. Comply with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for high-strength structural bolt installation and tightening requirements.

E. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

### 3.3 REPAIRS

A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

B. Touchup Painting:



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1. Immediately after installation, clean, prepare, and prime or re-prime field connections, rust spots, and abraded surfaces of prime-painted joists, bearing plates, abutting structural steel, and accessories.

    a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
    b. Apply a compatible primer of same type as primer used on adjacent surfaces.

## 3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Visually inspect field welds according to AWS D1.1/D1.1M.

C. Visually inspect bolted connections.

D. Prepare test and inspection reports.

**END OF SECTION**



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# SECTION 05 31 00 - STEEL DECKING

## 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. Roof deck.
2. Composite floor deck.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for normal-weight and lightweight structural concrete fill over steel deck.
2. Section 051200 "Structural Steel Framing" for shop- and field-welded shear connectors.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated.

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. Product Certificates: For each type of steel deck.

C. 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.

## 1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3/D1.3M, "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. 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."

B. 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.

C. Recycled Content of Steel Products: Post-consumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent.

## 2.2 ROOF DECK

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

1. Canam Steel Corporation; Canam Group, Inc.
2. Cordeck.
3. DACS, Inc.
4. Epic Metals Corporation.
5. Marlyn Steel Decks, Inc.
6. New Millennium Building Systems, LLC.
7. Nucor Corp.
8. Roof Deck, Inc.
9. Valley Joist.

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/A653M, Structural Steel (SS), Grade 33, G60 zinc coating.
2. Deck Profile: As indicated.
3. Profile Depth: As indicated.
4. Design Uncoated-Steel Thickness: As indicated.
5. Span Condition: As indicated.
6. Side Laps: Overlapped or interlocking seam at Contractor's option.

## 2.3 COMPOSITE FLOOR DECK

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

1. Canam Steel Corporation; Canam Group, Inc.
2. Cordeck.
3. DACS, Inc.
4. Epic Metals Corporation.
5. Marlyn Steel Decks, Inc.
6. New Millennium Building Systems, LLC.
7. Nucor Corp.
8. Roof Deck, Inc.

B. Composite Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:

1. Galvanized-Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade 50, G60 zinc coating.
2. Profile Depth: As indicated.
3. Design Uncoated-Steel Thickness: As indicated.
4. Span Condition: As indicated.

## 2.4 ACCESSORIES

A. General: 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 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.

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, 0.0747 inch thick, with factory-punched hole of 3/8-inch minimum diameter.

I. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.

J. Galvanizing Repair Paint: ASTM A780/A780M.

K. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

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

### 3.2 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.

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

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

D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

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

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

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

H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

## 3.3 ROOF DECK INSTALLATION

A. Fasten roof deck panels to steel supporting members as indicated.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports as indicated.

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 or butted at Contractor's option.

D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and mechanically fasten flanges to top of deck. Space mechanical fasteners not more than 12 inches apart with at least one fastener at each corner.

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

E. Miscellaneous Roof Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Mechanically fasten 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 FLOOR DECK INSTALLATION

A. Fasten floor deck panels to steel supporting members as indicated.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports as indicated.

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 or butted at Contractor's option.

D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations unless otherwise indicated.

E. Floor Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

## 3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Field welds will be subject to inspection.

C. Prepare test and inspection reports.

## 3.6 PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

**END OF SECTION**

# SECTION 05 40 00 - 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 Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section Includes:

1. Load bearing wall framing.
2. Exterior non-load bearing wall framing.
3. Interior non-load bearing wall framing exceeding height limitations of standard, non-structural metal framing.
4. Soffit framing.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for miscellaneous steel shapes, masonry shelf angles, and connections used with cold-formed metal framing.
2. Section 092116.23 "Gypsum Board Shaft Wall Assemblies" for interior non-load bearing, metal-stud-framed, shaft-wall assemblies, with height limitations.
3. Section 092216 "Non-Structural Metal Framing" for standard, interior non-load bearing, metal-stud framing, with height limitations and ceiling-suspension assemblies.

### 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:

1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.



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2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

C. Delegated-Design Submittal: For cold-formed steel framing.

## 1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Welding certificates.

C. Product Certificates: For each type of code-compliance certification for studs and tracks.

D. Product Test Reports: For each listed product, for tests performed by a qualified testing agency.

1. Steel sheet.
2. Expansion anchors.
3. Power-actuated anchors.
4. Mechanical fasteners.
5. Vertical deflection clips.
6. Horizontal drift deflection clips
7. Miscellaneous structural clips and accessories.

E. Evaluation Reports: For non-standard cold-formed steel framing post-installed anchors and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

## 1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.

B. 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.

C. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud Association or the Steel Stud Manufacturers Association.

D. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."



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## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

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

1. AllSteel & Gypsum Products, Inc.
2. ClarkDietrich.
3. Craco Manufacturing, Inc.
4. Custom Stud.
5. Formetal Co. Inc. (The).
6. Jaimes Industries.
7. MarinoWARE.
8. MBA Building Supplies.
9. MRI Steel Framing, LLC.
10. Nuconsteel, A Nucor Company.
11. Southeastern Stud & Components, Inc.
12. State Building Products, Inc.
13. Steel Construction Systems.
14. Steel Structural Systems.
15. Super Stud Building Products Inc.
16. Telling Industries.
17. The Steel Network, Inc.
18. United Steel Deck, Inc.

### 2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "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: Design framing systems to withstand design loads without deflections greater than the following:

    a. Exterior Load bearing Wall Framing: Horizontal deflection of 1/240 of the wall height. Increase limit to 1/600 of the wall height at locations backing up brick façade.
    b. Interior Load bearing Wall Framing: Horizontal deflection of 1/240 of the wall height under a horizontal load of 5 lbf/sq. ft.
    c. Exterior Non-Load bearing Framing: Horizontal deflection of 1/240 of the wall height. Increase limit to 1/600 of the wall height at locations backing up brick façade.



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d. Interior Non-Load bearing Framing: Horizontal deflection of 1/240 of the wall height under a horizontal load of 5 lbf/sq. ft.

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 80 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.

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.

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/A1003M, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:

1. Grade: As required by structural performance.
2. Coating: G60, A60, AZ50, or GF30.

B. Steel Sheet for Vertical Deflection Clips: ASTM A653/A653M, structural steel, zinc coated, of grade and coating as follows:

1. Grade: As required by structural performance.
2. Coating: G60.



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## 2.4 LOAD BEARING 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: 0.0428 inch.
2. Flange Width: 1-5/8 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: 0.0428 inch.
2. Flange Width: 1-1/4 inches.

C. Steel Box or Back-to-Back Headers: Manufacturer's standard C-shapes used to form header beams, of web depths indicated, unpunched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0428 inch.
2. Flange Width: 1-5/8 inches.

## 2.5 EXTERIOR NON-LOAD BEARING 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: 0.0428 inch.
2. Flange Width: 1-5/8 inches.

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

1. Minimum Base-Metal Thickness: 0.0428 inch.
2. Flange Width: 1-1/4 inches.

C. Vertical Deflection Clips: Manufacturer's standard bypass or head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.

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

a. AllSteel & Gypsum Products, Inc.
b. ClarkDietrich.
c. MarinoWARE.
d. Simpson Strong-Tie Co., Inc.
e. Steel Construction Systems.
f. The Steel Network, Inc.



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D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:

1. Minimum Base-Metal Thickness: 0.0428 inch.
2. Flange Width: 1 inch plus the design gap for one-story structures.

E. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

## 2.6 INTERIOR NON-LOAD BEARING 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: 0.0329 inch.
2. Flange Width: 1-3/8 inches.

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

1. Minimum Base-Metal Thickness: 0.0329 inch.
2. Flange Width: 1-1/4 inches.

C. Vertical Deflection Clips: Manufacturer's standard head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.

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

a. AllSteel & Gypsum Products, Inc.
b. ClarkDietrich.
c. MarinoWARE.
d. Simpson Strong-Tie Co., Inc.
e. The Steel Network, Inc.

D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:

1. Minimum Base-Metal Thickness: 0.0428 inch.
2. Flange Width: 1 inch plus the design gap for one-story structures.



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E. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

## 2.7 SOFFIT FRAMING

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

1. Minimum Base-Metal Thickness: 0.0428 inch.
2. Flange Width: 1-5/8 inches, minimum.

## 2.8 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from ASTM A1003/A1003M, 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, bridging, and solid blocking.
3. Web stiffeners.
4. Anchor clips.
5. End clips.
6. Foundation clips.
7. Gusset plates.
8. Stud kickers and knee braces.
9. Joist hangers and end closures.
10. Hole-reinforcing plates.
11. Backer plates.

## 2.9 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A36/A36M, zinc coated by hot-dip process according to ASTM A123/A123M.

B. Anchor Bolts: ASTM F1554, Grade 36, threaded carbon-steel hex-headed bolts, carbon-steel nuts, and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A153/A153M, Class C.

C. Post-Installed Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having



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jurisdiction, based on 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. Type: Screw or adhesive anchor.
3. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.
4. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F593, and nuts, ASTM F594.

D. Power-Actuated Anchors: Fastener systems 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 AC70.

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.

## 2.10 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: ASTM A780/A780M or SSPC-Paint 20.

B. Non-metallic, Non-shrink Grout: Factory-packaged, non-metallic, non-corrosive, non-staining grout, complying with ASTM C1107/C1107M, and with a fluid consistency and 30-minute working time.

C. Shims: Load bearing, high-density, multi-monomer, non-leaching plastic; or cold-formed steel of same grade and metallic coating as framing members supported by shims.

D. Sealer Gaskets: Closed-cell neoprene foam, 1/4-inch-thick, selected from manufacturer's standard widths to match width of bottom track or rim track members as required.

## 2.11 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.



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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. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.

B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of



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fire-resistive materials below that required to obtain fire-resistance ratings indicated. Protect remaining fire-resistive materials from damage.

C. 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.

D. Install sealer gaskets at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

## 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.



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G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.

H. Install insulation, specified in Section 072100 "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 LOAD BEARING WALL INSTALLATION

A. 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:

1. Anchor Spacing: As shown on Shop Drawings.

B. 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. Fasten both flanges of studs to top and bottom tracks. Space studs as follows:

1. Stud Spacing: As indicated on Drawings.

C. Set studs plumb, except as needed for diagonal bracing or required for non-plumb walls or warped surfaces and similar configurations.

D. Align studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.

E. Align floor and roof framing over studs according to AISI S200, Section C1. Where framing cannot be aligned, continuously reinforce track to transfer loads.

F. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure.

G. 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.

1. Frame wall openings with not less than a double stud at each jamb of frame. Fasten jamb members together to uniformly distribute loads.
2. 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.



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H. 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.

I. Install horizontal bridging in stud system, spaced vertically as 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 with a minimum of two screws into each flange of the clip angle for framing members up to 6 inches deep.
2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges, and secure solid blocking to stud webs or flanges.
3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

J. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

## 3.5 EXTERIOR NON-LOAD BEARING WALL INSTALLATION

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.

B. Fasten both flanges of studs to bottom track unless otherwise indicated. Space studs as follows:

1. Stud Spacing: As indicated on Drawings.

C. Set studs plumb, except as needed for diagonal bracing or required for non-plumb walls or warped surfaces and similar requirements.

D. Isolate non-load bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

1. Install single deep-leg deflection tracks and anchor to building structure.
2. Connect vertical deflection clips to bypassing studs and anchor to building structure.
3. Connect drift clips to cold-formed steel framing and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.



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1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.

1. Install solid blocking at centers indicated on Shop Drawings.

G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

## 3.6 INTERIOR NON-LOAD BEARING WALL INSTALLATION

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.

B. Fasten both flanges of studs to bottom track unless otherwise indicated. Space studs as follows:

1. Stud Spacing: As indicated on Drawings.

C. Set studs plumb, except as needed for diagonal bracing or required for non-plumb walls or warped surfaces and similar requirements.

D. Isolate non-load bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

1. Install single deep-leg deflection tracks and anchor to building structure.
2. Connect vertical deflection clips to studs and anchor to building structure.
3. Connect drift clips to cold-formed steel metal framing and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.

1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs.



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Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.

3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.

1. Install solid blocking at centers indicated on Shop Drawings.

G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

## 3.7 ERECTION 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.

## 3.8 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Cold-formed steel framing will be considered defective if it does not pass tests and inspections.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

## 3.9 REPAIRS AND PROTECTION

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/A780M and manufacturer's written instructions.



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B. 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**



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# SECTION 05 50 00

# METAL FABRICATIONS

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Miscellaneous framing and supports.
   2. Shelf angles.
   3. Wall mount equipment for monitors.
   4. Metal ladders.
   5. Elevator pit sump covers.

B. Products furnished, but not installed, under this Section include the following:
   1. Loose steel lintels.
   2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.

### 1.2 COORDINATION

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

B. 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.

### 1.3 ACTION SUBMITTALS

A. Product Data:
   1. Fasteners.
   2. Shrinkage-resisting grout.
   3. Slotted channel framing.
   4. Manufactured metal ladders.

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. Provide Shop Drawings for the following:
   1. Miscellaneous framing and supports for applications where framing and supports are not specified in other Sections.
   2. Steel shapes for supporting elevator door sills.
   3. Shelf angles.
   4. Metal ladders.
   5. Metal ships' ladders and pipe crossovers.
   6. Elevator pit sump covers.

C. Delegated Design Submittals: For ladders, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

## 1.4 INFORMATIONAL SUBMITTALS

A. Mill Certificates: Signed by stainless steel manufacturers, certifying that products furnished comply with requirements.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

D. Research Reports: For post-installed anchors.

E. Delegated design engineer qualifications.

## 1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following welding codes:
   1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
   2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
   3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

## 1.6 FIELD CONDITIONS

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

## PART 2 PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design ladders.

B. Structural Performance of Aluminum Ladders: Ladders, including landings, are to withstand the effects of loads and stresses within limits and under conditions specified in ANSI/ASC A14.3.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
   1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

### 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. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

C. Stainless Steel Sheet, Strip, and Plate: ASTM A240/A240M or ASTM A666, Type 304.

D. Stainless Steel Bars and Shapes: ASTM A276/A276M, Type 304.

E. Rolled-Steel Floor Plate: ASTM A786/A786M, rolled from plate complying with ASTM A36/A36M or ASTM A283/A283M, Grade C or D.

F. Steel Tubing: ASTM A500/A500M, cold-formed steel tubing.

G. Steel Pipe: ASTM A53/A53M, Standard Weight (Schedule 40) unless otherwise indicated.

H. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
   1. Size of Channels: [1-5/8 by 1-5/8 inches].
   2. Galvanized Steel: ASTM A653/A653M, commercial steel, Type B, with G90 coating; 0.079-inch nominal thickness.
   3. Cold-Rolled Steel: ASTM A1008/A1008M, commercial steel, Type B; 0.0677-inch minimum thickness; hot-dip galvanized after fabrication.

I. Aluminum Plate and Sheet: ASTM B209, Alloy 6061-T6.

J. Aluminum Extrusions: ASTM B221, Alloy 6063-T6.

## 2.3 FASTENERS

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/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
   1. Provide stainless steel fasteners for fastening stainless steel.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.

C. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 3, heavy-hex steel structural bolts; ASTM A563, Grade DH3, heavy-hex carbon-steel nuts; and where indicated, flat washers.

D. 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.

E. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563; and, where indicated, flat washers.
   1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

F. Anchors, General: 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/E488M, conducted by a qualified independent testing agency.

G. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches by length indicated with anchor straps or studs not less than 3 inches long at not more than 8 inches o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B633, Class Fe/Zn 5, as needed for fastening to inserts.

## 2.4 MISCELLANEOUS MATERIALS

A. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
   1. Use primer that contains pigments that make it easily distinguishable from zinc-rich primer.

B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

D. Shrinkage-Resistant Grout: Factory-packaged, nonmetallic, nonstaining,

noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

## 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: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. 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.
   1. Fabricate units from slotted channel framing where indicated.
   2. Furnish inserts for units installed after concrete is placed.

C. Fabricate supports for operable partitions from continuous steel beams of sizes recommended by partition manufacturer with attached bearing plates, anchors, and braces as recommended by partition manufacturer. Drill or punch bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.

D. Galvanize miscellaneous framing and supports where indicated.

## 2.7 SHELF ANGLES

A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch bolts, spaced not more than 6 inches from ends and 24 inches o.c., unless otherwise indicated.
   1. Provide mitered and welded units at corners.
   2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches larger than expansion or control joint.

B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.

C. Galvanize and prime shelf angles located in exterior walls.

D. Prime shelf angles located in exterior walls with zinc-rich primer.

E. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

## 2.8 WALL MOUNT EQUIPMENT FOR MONITORS

A. Refer to Sheet TA501 for Display Schedules and Sizes.

B. Wall-Mounts for Display Equipment: :
   1. Basis-of-Design Product: The design for flat panel wall mount systems for audio-visual equipment is based on the Tempo Flat Panel Wall Mount System manufactured by Legrand, 6436 City West Parkway, Eden Prairie, MN 55344; toll-free 1-866-977-3901; Web Site: www.legrandav.com.
      a. Flat Panel Wall Mount System: All-in-one configurable wall mounting system;

wall plate and sliding interface design simplifies centering display in right position; shallow installation depth facilities ADA compliance when display depth is less than 2 inches; movable storage plates along mounting rail facilitates placement of components; positioning of power and data sources and in-wall storage simplified by open wall plate.

1) Display Sizes Accommodated: 49-86 inch.5. Acceptable Wall Substrates: Steel studs, wood studs, concrete, and masonry.
2) Maximum Weight Capacity: 200lbs [90.7 kg].
3) Maximum Display Mounting Pattern: 38 by 18 inches.
4) Mount System Dimensions: 42.03 by 19.75 by 1.96 inches.
5) Post-Installation Leveling Limit: One inch.
6) Lateral Shift Capable: Yes.
7) Tilt Capability: -10 degrees/+0 degrees; 2.5 degree increments.
8) Service Depth: 12.61 inches.
9) Color: Black.

C. For locations where displays are mounted back to back and require a deeper wall for the access display backbox that will be on both sides, provide the following:
   1. Basis-of-Design: Legrand Chief PAC501-T display backbox.
      a. Provide trim kit.
      b. Large conduit knockouts for easier cable integration are compatible with metal single gang boxes.
      c. Suitable for Chief on-wall arm to create un ultra low profile.
         1) Compatible with Chief PNRIW, PWRIW, and MWRIW Swing Arms.

## 2.9 METAL LADDERS

A. General:
   1. Comply with ANSI A14.3, except for elevator pit ladders.
   2. For elevator pit ladders, comply with ASME A17.1/CSA B44.

B. Steel Ladders:
   1. Space siderails 18 inches apart unless otherwise indicated.
   2. Siderails: Continuous, 1/2-by-2-1/2-inch steel flat bars, with eased edges.
   3. Rungs: 1-inch- square, steel bars.
   4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
   5. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
   6. Nonslip Surfaces for Steel Ladders: Provide nonslip surfaces on top of each rung by coating with abrasive material metallically bonded to rung.
   7. Provide platforms as indicated fabricated from welded or pressure-locked steel bar grating, supported by steel angles. Limit openings in gratings to no more than 1/2 inch in least dimension.
   8. Support each ladder at top and bottom and not more than 60 inches>o.c. with welded or bolted steel brackets.
   9. Galvanize and prime ladders, including brackets.

C. Aluminum Ladders:
   1. Source Limitations: Obtain aluminum ladders from single source from single manufacturer.
   2. Space siderails 18 inches apart unless otherwise indicated.
   3. Siderails: Continuous extruded-aluminum channels or tubes, not less than 2-1/2 inches deep, 3/4 inch wide, and 1/8 inch thick.
   4. Rungs: Extruded-aluminum tubes, not less than 3/4 inch deep and not less than 1/8 inch thick, with ribbed tread surfaces.
   5. Fit rungs in centerline of siderails; fasten by welding or with stainless steel fasteners or brackets and aluminum rivets.
   6. Support each ladder at top and bottom and not more than 60 inches o.c. with welded or bolted aluminum brackets.
   7. Provide minimum 72-inch- high, hinged security door with padlock hasp at foot of ladder to prevent unauthorized ladder use.

## 2.10 ELEVATOR PIT SUMP COVERS

A. Fabricate from 1/8-inch abrasive-surface floor plate with four 1-inch- diameter holes for water drainage and for lifting.

B. Provide steel angle supports unless otherwise indicated.

## 2.11 STRUCTURAL-STEEL DOOR FRAMES

A. Fabricate structural-steel door frames from steel shapes, plates, and bars of size and to dimensions indicated, fully welded together, with 5/8-by-1-1/2-inch steel channel stops, unless otherwise indicated. Plug-weld built-up members and continuously weld exposed joints. Secure removable stops to frame with countersunk machine screws, uniformly spaced at not more than 10 inches o.c. Reinforce frames and drill and tap as necessary to accept finish hardware.
   1. Provide with integrally welded steel strap anchors for securing door frames into adjoining concrete or masonry.

B. Extend bottom of frames to floor elevation indicated with steel angle clips welded to frames for anchoring frame to floor with expansion shields and bolts.

## 2.12 MISCELLANEOUS STEEL TRIM

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

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

C. Prime exterior miscellaneous steel trim with zinc-rich primer.

## 2.13 LOOSE STEEL LINTELS

A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.

B. Size loose lintels to provide bearing length at each side of openings equal to one-twelfth of clear span, but not less than 8 inches unless otherwise indicated.

C. Galvanize and prime loose steel lintels located in exterior walls.

## 2.14 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.

## 2.15 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.
   1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean galvanized surfaces of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.

C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
   1. Shop prime with universal shop primer unless primers specified in Section 09 96 00 "High-Performance Coatings" are indicated.

D. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."

E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
   1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

## 2.16 ALUMINUM FINISHES

A. As-Fabricated Finish: AA-M12.

B. Clear Anodic Finish: AAMA 611, Class I, AA-M12C22A41.

# 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. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
   1. Cast Aluminum: Heavy coat of bituminous paint.
   2. Extruded Aluminum: Two coats of clear lacquer.

## 3.2 INSTALLATION OF MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated

on Shop Drawings.

B. Anchor supports for operable partitions securely to, and rigidly brace from, building structure.

C. Anchor shelf angles securely to existing construction with through bolts.

## 3.3 INSTALLATION OF SHELF ANGLES

A. Install shelf angles as required to keep masonry level, at correct elevation, and flush with vertical plane.

## 3.4 INSTALLATION OF METAL LADDERS

A. Secure ladders to adjacent construction with the clip angles attached to the stringer.

B. Install brackets as required for securing of ladders welded or bolted to structural steel or built into masonry or concrete.

## 3.5 INSTALLATION OF ELEVATOR PIT SUMP COVERS

A. Install tops of elevator sump pit cover plates and frames flush with finished surface. Adjust as required to avoid lippage that could present a tripping hazard.

## 3.6 INSTALLATION OF MISCELLANEOUS STEEL TRIM

A. Anchor to concrete construction to comply with manufacturer's written instructions.

## 3.7 INSTALLATION OF LOOSE BEARING AND LEVELING PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.

B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with shrinkage-resistant grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

## 3.8 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 2.0-mil dry film thickness.
   2. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 09 91 13 "Exterior Painting."

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

**END OF SECTION**

# SECTION 05 51 13

# METAL PAN STAIRS

## PART 1 GENERAL

### 1.1 SECTION INCLUDES

A. Stairs with concrete treads.

B. Stairs with metal treads.

C. Stairs with grating treads.

D. Structural steel stair framing and supports.

E. Handrails.

### 1.2 DEFINITIONS

A. Guard: A building component or a system of building components located at or near the open sides of elevated walking surfaces that minimizes the possibility of a fall from the walking surface to a lower level. (Source: IBC 2015, Section 202 Definitions).
   1. Guards, IBC Requirements: Reference IBC Section 1015 - Guards for IBC requirements.

B. Handrail: A horizontal or sloping rail intended for grasping by the hand for guidance or support. (Source: IBC 2015, Section 202 Definitions).
   1. Handrails, IBC Requirements: Reference IBC Section 1014 - Handrails for IBC requirements.

C. Rail: Rail is not defined in the IBC, but it is used in context of "guards". See IBC 2015 Section 1015.

D. Stair: A change in elevation, consisting of one or more risers. (Source: IBC 2015, Section 202 Definitions).

E. Stairway: One or more flights of stairs, either exterior or interior, with the necessary landings and platforms connecting them, to form a continuous and uninterrupted passage from one level to another. (Source: IBC 2015, Section 202 Definitions).

### 1.3 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible

Design; 2010.

B. AISC 207 - Standard for Certification Programs; 2023.

C. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

D. ASTM A6/A6M - Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling; 2019.

E. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.

F. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2018.

G. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

H. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.

I. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.

J. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2021.

K. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2014.

L. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.

M. ASTM A786/A786M - Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates; 2015.

N. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2020.

O. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2018a.

P. ASTM E985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings; 2000 (Reapproved 2006).

Q. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2012.

R. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020.

S. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

T. NAAMM AMP 510 - Metal Stairs Manual; 1992.

U. NAAMM MBG 531 - Metal Bar Grating Manual; 2017.

V. NAAMM MBG 532 - Heavy Duty Metal Bar Grating Manual; 2009.

W. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 1999 (Ed. 2004).

X. SSPC-SP 2 - Hand Tool Cleaning; 1982, with Editorial Revision (2004).

## 1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the selection of shop primers with topcoats to be applied over primers.

B. Preinstallation Meeting: Conduct a preinstallation meetingone week prior to the start of the work of this section; require attendance by all affected installers.

C. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

## 1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.
   1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
   2. Include the design engineer's seal and signature on each sheet of shop drawings.

C. Design Data: As required by authorities having jurisdiction.

D. Designer's Qualification Statement.

E. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is certified under AISC 207.

## 1.6 QUALITY ASSURANCE

A. Structural Designer Qualifications: Professional Structural Engineer experienced in

design of this work and licensed in the State in which the Project is located, or personnel under direct supervision of such an engineer.

B. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and dated no more than 12 months before start of scheduled welding work.

C. Fabricator Qualifications:
   1. A qualified steel fabricator that is certified by the American Institute for Steel Construction (AISC) under AISC 207.
   2. A company specializing in fabricating products specified in this section, with not less than five years minimum ofdocumented experience.

## PART 2 PRODUCTS

### 2.1 METAL STAIRS - PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer to design stairs and railings including attachment to building structure.

B. Metal Stairs: Provide stairs of the design specified, complete with landing platforms, vertical and horizontal supports, railings, and guards, fabricated accurately for anchorage to each other and to building structure.
   1. Regulatory Requirements: Provide stairs and railings that comply with most stringent requirements of local, state, and federal regulations; where requirements of Contract Documents exceed those of regulations, comply with Contract Documents.
   2. Handrails: Comply with applicable accessibility requirements of ADA Standards.
   3. Structural Design: Provide complete stair and railing assemblies complying with the following:
      a. Stair Capacity: Uniform live load of 100 lb/sq ft and a concentrated load of 300 lb with deflection of stringer or landing framing not to exceed 1/360 of span.
   4. At exit stairwells, provide unit stair towers designed for stacking to height of building as a self-supporting structure.
   5. Dimensions: As indicated on drawings.
   6. Shop assemble components; disassemble into largest practical sections suitable for transport and access to site.
   7. No sharp or rough areas on exposed travel surfaces and surfaces accessible to touch.
   8. Separate dissimilar metals using paint or permanent tape.

## 2.2 METAL STAIRS - GENERAL

A. Metal Jointing and Finish Quality Levels:
   1. Commercial: Exposed joints as inconspicuous as possible, whether welded or mechanical; underside of stair not covered by soffit is considered exposed to view.
      a. Welded Joints: Intermittently welded on back side, filled with body putty, and sanded smooth and flush.
      b. Welds Exposed to View: Ground smooth and flush.
      c. Mechanical Joints: Butted tight, flush, and hairline.
      d. Bolts Exposed to View: Countersunk flat or oval head bolts; no exposed nuts.
      e. Exposed Edges and Corners: Eased to small uniform radius.
      f. Metal Surfaces to be Painted: Sanded or ground smooth, suitable for satin or matte finish.
   2. Service: Exposed joints tight with face surfaces aligned; underside of stair not covered by soffit is not considered exposed to view.
      a. Welded Joints: Welded on back side wherever possible.
      b. Welds Exposed to View: Ground smooth; not required to be flush.
      c. Bolts Exposed to View: Countersunk flat or oval head bolts; no exposed nuts or screw threads.
      d. Metal Surfaces to be Painted: Sanded smooth, suitable for satin or matte finish.

B. Fasteners: Same material or compatible with materials being fastened; type consistent with design and specified quality level.

C. Anchors and Related Components: Same material and finish as item to be anchored, except where specifically indicated otherwise; provide all anchors and fasteners required.

## 2.3 METAL STAIRS WITH CONCRETE TREADS

A. Jointing and Finish Quality Level: Commercial, as defined above.

B. Risers: Closed.

C. Treads: Metal pan with field-installed concrete fill.
   1. Concrete Depth: 1-1/2 inches, minimum.
   2. Tread Pan Material: Steel sheet.
   3. Tread Pan Thickness: As required by design; 14 gauge, 0.075 inch minimum.
   4. Photoluminescent Nosing: Factory fabricated aluminum nosing with embedded photoluminescent strip; cast into front edge of tread.
   5. Pan Anchorage to Stringers: Continuously welded, from top or bottom.
   6. Concrete Reinforcement: Welded wire mesh.
   7. Concrete Finish: Steel troweled.

D. Risers: Same material and thickness as tread pans.
   1. Riser/Nosing Profile: Vertical riser with underside of nosing sloped up from bottom of tread pan at not less than 60 degrees from horizontal, with rounded top of nosing of minimum radius.
   2. Nosing Depth: Not more than 1-1/2 inch overhang.
   3. Nosing Return: Flush with top of concrete fill, not more than 1/2 inch wide.

E. Stringers: Rolled steel channels.
   1. Stringer Depth: 12 inches.
   2. End Closure: Sheet steel of same thickness as risers welded across ends.

F. Landings: Same construction as treads, supported and reinforced as required to achieve design load capacity.

G. Railings: Steel pipe railings.

H. Finish: Shop- or factory-prime painted.

I. Under Side of Stair: Exposed to view, to be finished same as specified for other exposed to view surfaces.

## 2.4 METAL STAIRS WITH METAL TREADS

A. Jointing and Finish Quality Level: Service, as defined above.

B. Risers: Closed.

C. Treads: Checkered steel plate.
   1. Tread Thickness: 1/4 inch, minimum.
   2. Anchorage to Stringers: Welded or bolted to carrier angles welded or bolted to stringers.

D. Risers: Steel sheet.
   1. Riser/Nosing Profile: Sloped riser with rounded nosing of minimum radius.

E. Stringers: Rolled steel channels.
   1. Stringer Depth: 10 inches.
   2. End Closure: Sheet steel of same thickness as risers welded across ends.

F. Landings: Same construction as treads, supported and reinforced as required to achieve design load capacity.

G. Railings: Steel pipe railings.

H. Finish: Shop- or factory-prime painted.

## 2.5 METAL STAIRS WITH GRATING TREADS

A. Jointing and Finish Quality Level: Service, as defined above.

B. Risers: Open.

C. Treads: Steel bar grating.
   1. Grating Type: Welded.
   2. Bearing Bar Depth: 3/4 inch, minimum.
   3. Top Surface: Standard.
   4. Nosing: Checkered plate.
   5. Nosing Width: 1-1/4 inch, minimum.
   6. Anchorage to Stringers: End plates welded to grating, bolted to stringers.
   7. Comply with ADA.

D. Stringers: Rolled steel channels.
   1. Stringer Depth: 12 inches.

E. Landings: Same construction as treads, supported and reinforced as required to achieve design load capacity.
   1. Comply with ADA.

F. Railings: Steel pipe railings.

G. Finish: Galvanized after fabrication.

## 2.6 RAILINGS - GENERAL

A. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of ASTM E985 and applicable building and local codes.

B. Distributed Loads: Design handrails, guards and attachments to resist a linear load of 50 pounds per linear foot applied to the top of the assembly and in any direction, without damage or permanent set; design in accordance with the minimum requirements of Section 4.5.1 of ASCE 7.

C. Concentrated Loads: Design handrails, guards and attachments to resist a concentrated force of 200 pounds applied at any point on the top of the assembly and in any direction, without damage or permanent set; design in accordance with the minimum requirements of Section 4.5.1 of ASCE 7.

D. Concentrated Loads at Intermediate Rails: Design intermediate rails (all those except the handrail), balusters and panel fillers to resist a concentrated force of 50 pounds, without damage or permanent set; design in accordance with the minimum requirements of Section 4.5.1 of ASCE 7.

E. Allow for expansion and contraction of members and building movement without damage to connections or members.

F. Dimensions: See drawings for configurations and heights.
   1. Top Rails and Wall Rails: 1-1/2 inches diameter, round.
   2. Intermediate Rails: 1-1/4 by 1 inch rectangular.
   3. Posts: 1 1/4 by 1 inch rectangular inches square.
   4. Balusters: 1/2 inch square solid bar.

G. Provide anchors and other components as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.
   1. For anchorage to concrete, provide inserts to be cast into concrete, for bolting anchors.
   2. For anchorage to masonry, provide brackets to be embedded in masonry, for bolting anchors.

H. Provide welding fittings to join lengths, seal open ends, and conceal exposed mounting bolts and nuts, including but not limited to elbows, T-shapes, splice connectors, flanges, escutcheons, and wall brackets.

## 2.7 HANDRAILS AND GUARDS

A. Wall-Mounted Rails: Round pipe or tube rails unless otherwise indicated.
   1. Outside Diameter: 1-1/4 inch, minimum, to 1-1/2 inches, maximum.

B. Guards:
   1. Top Rails: Round pipe or tube rails unless otherwise indicated.
      a. Outside Diameter: 1-1/4 inch, minimum, to 1-1/2 inches, maximum.
   2. Infill at Picket Railings: Vertical pickets.
      a. Horizontal Spacing: Maximum 4 inches on center.
      b. Material: Solid steel bar.
      c. Shape: Square.
      d. Size: 1/2 inch diameter.
      e. Top Mounting: Welded to underside of intermediate rail.
      f. Bottom Mounting: welded to top of bottom rail..
   3. Infill at Pipe Railings: Pipe or tube rails sloped parallel to stair.
      a. Outside Diameter: 1 inch.
      b. Material: Steel pipe or tube, round.
      c. Vertical Spacing: Maximum 4 inches on center.
      d. Jointing: Welded and ground smooth and flush.
   4. End and Intermediate Posts: Same material and size as top rails.
      a. Horizontal Spacing: As indicated on drawings.
      b. Mounting: Welded to top surface of stringer.

## 2.8 MATERIALS

A. Steel Sections: ASTM A36/A36M.

B. Steel Tubing: ASTM A500/A500M or ASTM A501/A501M structural tubing, round and

shapes as indicated.

C. Steel Plates: ASTM A6/A6M or ASTM A283/A283M.

D. Pipe: ASTM A53/A53M Grade B Schedule 40, black finish.

E. Ungalvanized Steel Sheet: Hot- or cold-rolled, except use cold-rolled where finished work will be exposed to view.
   1. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Designation CS (commercial steel).
   2. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Designation CS (commercial steel).

F. Galvanized Steel Sheet: ASTM A653/A653M, Structural Steel (SS) Grade 33/230 with G60/Z180 coating.

G. Checkered Plate: ASTM A786/A786M, rolled steel floor plate; manufacturer's standard pattern.

H. Gratings: Bar gratings that comply with NAAMM MBG 531 or NAAMM MBG 532, whichever applies based on bar sizes.

I. Concrete Fill: Type specified in Section 03 30 00

J. Concrete Reinforcement: Mesh type, galvanized.

## 2.9 ACCESSORIES

A. Steel Bolts, Nuts, and Washers: ASTM A325 AA DAF-45 Type 1, and galvanized to ASTM A153/A153M where connecting galvanized components.

B. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

C. Shop and Touch-Up Primer: SSPC-Paint 15, and comply with VOC limitations of authorities having jurisdiction.

D. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20 Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

## 2.10 FABRICATION

A. Accurately form components to suit specific project conditions and for proper connection to building structure.

B. Fit and shop assemble components in largest practical sizes for delivery to site.

C. Fabricate components with joints tightly fitted and secured. Provide spigots and sleeves to accommodate site assembly and installation.

D. Welded Joints:
   1. Exterior Components: Continuously seal joined pieces by intermittent welds and plastic filler. Drill condensate drainage holes at bottom of members at locations that will not encourage water intrusion.
   2. Interior Components: Continuously seal joined pieces by intermittent welds and plastic filler.
   3. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

## 2.11 SHOP FINISHING

A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

B. Do not prime surfaces in direct contact with concrete or where field welding is required.

C. Prime Painting: Use specified shop- and touch-up primer.
   1. Preparation of Steel: In accordance with SSPC-SP 2 Hand Tool Cleaning.
   2. Number of Coats: One.

D. Galvanizing: Hot-dip galvanize to minimum requirements of ASTM A123/A123M.
   1. Touch up abraded areas after fabrication using specified touch-up primer for galvanized surfaces.

# PART 3 EXECUTION

## 3.1 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

## 3.2 PREPARATION

A. When field welding is required, clean and strip primed steel items to bare metal.

B. Supply items required to be cast into concrete and embedded in masonry with setting templates.

## 3.3 INSTALLATION

A. Install components plumb and level, accurately fitted, free from distortion or defects.

B. Provide anchors, plates and angles required for connecting stairs to structure.

C. Allow for erection loads, and for sufficient temporary bracing to maintain true

alignment until completion of erection and installation of permanent attachments.

D. Provide welded field joints where specifically indicated on drawings. Perform field welding in accordance with AWS D1.1/D1.1M.

E. Other field joints may be either welded or bolted provided the result complies with the limitations specified for jointing quality levels.

F. Obtain approval prior to site cutting or creating adjustments not scheduled.

G. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

## 3.4 TOLERANCES

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

B. Maximum Offset From True Alignment: 1/4 inch.

**END OF SECTION**

# SECTION 05 52 13

# PIPE AND TUBE RAILINGS

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Aluminum railings.

### 1.2 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 anchorages for railings. 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.

### 1.3 ACTION SUBMITTALS

A. Product Data:
   1. Manufacturer's product lines of mechanically connected railings.
   2. Fasteners.
   3. Post-installed anchors.
   4. Handrail brackets.
   5. Nonshrink, nonmetallic grout.
   6. Metal finishes.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

C. Samples for Initial Selection: For products involving selection of color, texture, or design, including mechanical finishes.

D. Delegated Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

### 1.4 QUALITY ASSURANCE

## 1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect mechanical finishes on exposed surfaces of railings from damage by applying a strippable, temporary protective covering before shipping.

## 1.6 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication.

# PART 2 PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design railings, including attachment to building construction.

## 2.2 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.
   1. Provide type of bracket with flange tapped for concealed anchorage to threaded hanger bolt and that provides 1-1/2-inch clearance from inside face of handrail to finished wall surface.

## 2.3 ALUMINUM RAILINGS

A. HYPERLINK "http://www.specagent.com/LookUp/?ulid=1546&mf=&src=wd" <Click here to find, evaluate, and insert list of manufacturers and products.>

B. Source Limitations: Obtain each type of railing from single source from single manufacturer.

C. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.

D. Extruded Bars and Tubing: ASTM B221, Alloy 6063-T5/T52.

E. Extruded Structural Pipe and Round Tubing: ASTM B429/B429M, Alloy 6063-T6.
   1. Provide Standard Weight (Schedule 40) pipe unless otherwise indicated.

F. Drawn Seamless Tubing: ASTM B210/B210M, Alloy 6063-T832.

G. Plate and Sheet: ASTM B209, Alloy 6061-T6.

H. Die and Hand Forgings: ASTM B247, Alloy 6061-T6.

I. Castings: ASTM B26/B26M, Alloy A356.0-T6.

## 2.4 FASTENERS

A. Fastener Materials:
   1. Ungalvanized-Steel Railing Components: Plated steel fasteners complying with ASTM F1941/F1941M, Class Fe/Zn 5 for zinc coating.
   2. Aluminum Railing Components: Type 304 stainless steel fasteners.
   3. Finish exposed fasteners to match appearance, including color and texture, of railings.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction and capable of withstanding design loads.

C. Fasteners for Interconnecting Railing Components:
   1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.
   2. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.
   3. Provide tamper-resistant flat-head machine screws for exposed fasteners unless otherwise indicated.

D. Post-Installed Anchors: Fastener systems 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 AC193 or ICC-ES AC308.
   1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
   2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless steel bolts, ASTM F593, and nuts, ASTM F594.

## 2.5 MISCELLANEOUS MATERIALS

A. Handrail Brackets: Cast aluminum, center of handrail 2-1/2 inches from wall.

B. Welding Rods and Bare Electrodes: Select in accordance with AWS specifications for metal alloy welded.
   1. For aluminum railings, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.

C. Etching Cleaner for Galvanized Metal: Complying with MPI#25.

D. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout, complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

## 2.6 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations.
   1. Clearly mark units for reassembly and coordinated installation.
   2. Use connections that maintain structural value of joined pieces.

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

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that are exposed to weather in a manner that excludes water.
   1. Provide weep holes where water may accumulate.
   2. Locate weep holes in inconspicuous locations.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with welded or nonwelded connections unless otherwise indicated.

H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
   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 flux immediately.
   4. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #1 welds; ornamental quality with no evidence of a welded joint.

I. Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.

J. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
   1. Fabricate splice joints for field connection, using an epoxy structural adhesive, if this is manufacturer's standard splicing method.

K. Form changes in direction as follows:
   1. As detailed.
   2. By bending to smallest radius that will not result in distortion of railing member.

L. Bend members in jigs to produce uniform curvature for each configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

M. Close exposed ends of hollow railing members with prefabricated cap and end fittings of same metal and finish as railings.

N. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.

O. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
   1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

P. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work.
   1. Fabricate anchorage devices capable of withstanding loads imposed by railings.
   2. Coordinate anchorage devices with supporting structure.

Q. For railing posts set in concrete, provide stainless steel sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with metal plate forming bottom closure.

## 2.7 ALUMINUM FINISHES

A. 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 the same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples

and are assembled or installed to minimize contrast.

B. Clear Anodic Finish: AAMA 611, AA-M12C22A31.

C. High-Performance Organic Finish, Two-Coat Polyvinylidene Fluoride (PVDF): Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
   1. Color and Gloss: As selected by Architect from manufacturer's full range.

## PART 3 EXECUTION

### 3.1 EXAMINATION

A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements are clearly marked for Installer. Locate reinforcements and mark locations if not already done.

### 3.2 INSTALLATION, GENERAL

A. Perform cutting, drilling, and fitting required for installing railings.
   1. Fit exposed connections together to form tight, hairline joints.
   2. Install railings level, plumb, square, true to line; without distortion, warp, or rack.
   3. Set railings accurately in location, alignment, and elevation; measured from established lines and levels.
   4. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
   5. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
   6. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.

B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
   1. Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

C. Adjust railings before anchoring to ensure matching alignment at abutting joints.

D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

## 3.3 RAILING CONNECTIONS

A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings. Seal recessed holes of exposed locking screws, using plastic cement filler colored to match finish of railings.

B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article, whether welding is performed in the shop or in the field.

C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve, extending 2 inches beyond joint on either side; fasten internal sleeve securely to one side; and locate joint within 6 inches of post.

## 3.4 ANCHORING POSTS

A. Use stainless steel pipe sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Form or core-drill holes not less than 5 inches deep and 3/4 inch larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.

C. Cover anchorage joint with flange of same metal as post, [welded to post after placing anchoring material] and [attached to post with setscrews].

## 3.5 ATTACHING RAILINGS

A. Anchor railing ends to concrete and masonry with sleeves concealed within railing ends and anchored to wall construction with anchors and bolts.

B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and.

C. Attach handrails to walls with wall brackets. Provide brackets with 1-1/2-inch clearance from inside face of handrail and finished wall surface.
   1. Use type of bracket with predrilled hole for exposed bolt anchorage.
   2. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

D. Secure wall brackets to building construction as follows:
   1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
   2. For hollow masonry anchorage, use toggle bolts.

3. For steel-framed partitions, fasten brackets directly to steel framing or concealed steel reinforcements, using self-tapping screws of size and type required to support structural loads.
4. For steel-framed partitions, use toggle bolts installed through flanges of steel framing or through concealed steel reinforcements.

## 3.6 CLEANING

A. Clean aluminum by washing thoroughly with clean water and soap and rinsing with clean water.

## 3.7 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

**END OF SECTION**

# SECTION 05 73 00

# DECORATIVE METAL RAILINGS

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Stainless steel decorative railings.

### 1.2 COORDINATION AND SCHEDULING

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

B. Coordinate installation of anchorages for railings. 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 items to Project site in time for installation.

### 1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

### 1.4 ACTION SUBMITTALS

A. Product Data:
   1. Manufacturer's product lines of decorative metal railings assembled from standard components.
   2. Fasteners.
   3. Post-installed anchors.
   4. Handrail brackets.
   5. Metal finishes.

B. Shop Drawings: Include plans, elevations, sections, and attachment details.

C. Samples for Initial Selection: For products involving selection of color, texture, or design, including mechanical finishes.

D. Delegated Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

## 1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect mechanical finishes on exposed surfaces of railings from damage by applying a strippable, temporary protective covering before shipping.

## 1.6 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication.

# PART 2 PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design railings, including attachment to building construction.

## 2.2 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Same metal and finish as supported rails unless otherwise indicated.

## 2.3 STAINLESS STEEL DECORATIVE RAILINGS

A. Source Limitations: Obtain stainless steel decorative railing components from single source from single manufacturer.

B. Tubing: ASTM A554, Grade MT 304.

C. Pipe: ASTM A312/A312M, Grade TP 304.

D. Castings: ASTM A743/A743M, Grade CF 8 or CF 20.

E. Plate, Sheet, and Strip: ASTM A240/A240M or ASTM A666, Type 304.

F. Flat Bar: ASTM A666, Type 304.

G. Bars and Shapes: ASTM A276/A276M, Type 304.

## 2.4 FASTENERS

A. Fastener Materials:
   1. Stainless Steel Railing Components: Type 304 stainless steel fasteners.
   2. Dissimilar Metal Railing Components: Type 304 stainless steel fasteners.
   3. Finish exposed fasteners to match appearance, including color and texture, of railings.

B. Fasteners for Anchoring to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction and capable of withstanding design loads.

C. Provide concealed fasteners for interconnecting railing components and for attaching railings to other work unless otherwise indicated.
   1. Provide tamper-resistant flat-head machine screws for exposed fasteners unless otherwise indicated.

D. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to the design load, in accordance with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193.
   1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.

## 2.5 MISCELLANEOUS MATERIALS

A. Handrail Brackets: Cast-nickel-silver, or Cast stainless steel, center of handrail 2-1/2 inches from wall.
   1. Provide cast-metal brackets with flange tapped for concealed anchorage to threaded hanger bolt.
   2. Provide either formed- or cast-metal brackets with predrilled hole for exposed bolt anchorage.
   3. Provide extruded-aluminum brackets with interlocking pieces that conceal anchorage. Locate set screws on bottom of bracket.
   4. Provide formed-steel brackets with predrilled hole for bolted anchorage and with snap-on cover that matches rail finish and conceals bracket base and bolt head.

B. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
   1. For stainless steel railings, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.

## 2.6 FABRICATION

A. Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that

required to support structural loads.

B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations.
   1. Clearly mark units for reassembly and coordinated installation.
   2. Use connections that maintain structural value of joined pieces.

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

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that will be exposed to weather in a manner to exclude water.
   1. Provide weep holes where water may accumulate.
   2. Locate weep holes in inconspicuous locations.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with welded or mechanical connections unless otherwise indicated.

H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
   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 flux immediately.
   4. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #1 welds; ornamental quality with no evidence of a welded joint.

I. Mechanical Connections: Connect members with concealed mechanical fasteners and fittings.
   1. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
   2. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.

J. Form changes in direction as follows:
   1. As detailed.
   2. By bending to smallest radius that will not result in distortion of railing member.

K. Bend members in jigs to produce uniform curvature for each configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

L. Close exposed ends of hollow railing members with prefabricated cap and end fittings

of same metal and finish as railings.

M. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns, unless clearance between end of rail and wall is 1/4 inch or less.

N. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, handrail brackets, miscellaneous fittings, and anchors to interconnect railing members to other Work unless otherwise indicated.
   1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and to prevent bracket or fitting rotation and crushing of substrate.

O. Provide inserts and other anchorage devices for connecting railings to concrete or masonry Work.
   1. Fabricate anchorage devices capable of withstanding loads imposed by railings.
   2. Coordinate anchorage devices with supporting structure.

P. For railing posts set in concrete, provide stainless steel sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with metal plate forming bottom closure.

## 2.7 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.

C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. 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.

D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

## 2.8 STAINLESS STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
   1. Run grain of directional finishes with long dimension of each piece.

2. When polishing is completed, passivate and rinse surfaces.
3. Remove embedded foreign matter and leave surfaces chemically clean.

C. Stainless Steel Tubing Finishes:
1. 180-Grit Polished Finish: Uniform, directionally textured finish.
2. 320-Grit Polished Finish: Oil-ground, uniform, fine, directionally textured finish.

D. Stainless Steel Sheet and Plate Finishes:
1. Directional Satin Finish: ASTM A480/A480M, No. 4.

## PART 3 EXECUTION

### 3.1 EXAMINATION

A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

### 3.2 INSTALLATION, GENERAL

A. Perform cutting, drilling, and fitting required for installing railings.
1. Fit exposed connections together to form tight, hairline joints.
2. Install railings level, plumb, square, true to line; without distortion, warp, or rack.
3. Set railings accurately in location, alignment, and elevation; measured from established lines and levels.
4. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
5. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
6. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.

B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

C. Adjust railings before anchoring to ensure matching alignment at abutting joints.

D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

### 3.3 RAILING CONNECTIONS

A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to

railing members and fittings. Seal recessed holes of exposed locking screws, using plastic cement filler colored to match finish of railings.

B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article, whether welding is performed in the shop or in the field.

C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve, extending 2 inches beyond joint on either side; fasten internal sleeve securely to one side; and locate joint within 6 inches of post.

## 3.4 ANCHORING POSTS

A. Use stainless steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Form or core-drill holes not less than 5 inches deep and 3/4 inch larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.

## 3.5 ATTACHING RAILINGS

A. Anchor railing ends to concrete and masonry with sleeves concealed within railing ends and anchored to wall construction with anchors and bolts.

B. Attach handrails to walls with wall brackets , except where end flanges are used. Provide brackets with 1-1/2-inch clearance from inside face of handrail and finished wall surface.
   1. Use type of bracket with [flange tapped for concealed anchorage to threaded hanger bolt] and [predrilled hole for exposed bolt anchorage].
   2. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

C. Secure wall brackets and railing end flanges to building construction as follows:
   1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
   2. For steel-framed partitions, use hanger or lag bolts set into wood backing between studs. Coordinate with stud installation to locate backing members.
   3. For steel-framed partitions, fasten brackets directly to steel framing or concealed steel reinforcements using self-tapping screws of size and type required to support structural loads.
   4. For steel-framed partitions, fasten brackets with toggle bolts installed through flanges of steel framing or through concealed steel reinforcements.

## 3.6 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

**END OF SECTION**

# SECTION 05 73 13

# ARCHITECTURAL GLASS RAILINGS

## PART 1 GENERAL

### 1.1 SCOPE OF WORK

A. Fabricate and install architectural glass railings in accordance with the requirements set forth in this section.

### 1.2 ADDITIONAL WORK INCLUDED IN THIS SECTION

A. Field measuring for weld plates, sleeves and insert locations.

B. Field measuring.

C. Anchors or inserts for terrazzo or precast concrete.

D. The following items are not to be included in the metal rail contractor's work:
1. Temporary shoring or bracing
2. Demolition and removal of existing work
3. Clean up of existing construction prior to installation of stairs
4. Cleaning out of stair wells
5. Cutting; preparation of pockets; setting of plates, inserts, carpenter hardware or any other built ins
6. Temporary lights and electricity
7. Temporary safety rails after erection
8. Field painting
9. Final cleaning and protection of aluminum, stainless steel, bronze and glass

### 1.3 STRUCTURAL REQUIREMENTS

A. The structural adequacy of the metal stair design is the responsibility of the delegated design professional of record.

B. Railing assembly shall withstand a minimum concentrated load of 200 pounds applied vertically downward or horizontally in any direction, but not simultaneously, at any point on the top rail.

### 1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: Furnish references listing projects of similar size and scope

B. If special or unusual capabilities are required they should be set forth here.

C. Installer Qualifications

D. Quality Control:

E. Regulatory Requirements
   1. Components and installation are to be in accordance with state and local code authorities
   2. Components and installation are to follow current ADA and ICC/ANSI A117.1 guidelines.
   3. Determine code regulations that govern this work. Specify requirements and drawings that are necessary to meet governing codes.

F. Certifications
   1. Furnish certification that all components and fittings are furnished by the same manufacturer or approved by the primary component manufacturer.
   2. Furnish certification that components were installed in accordance to the manufacturer's engineering data to meet the specified design loads.

G. Pre-Installation Meeting
   1. Prior to the beginning of work, conduct a pre-job conference at the job site.
   2. Provide seven calendar days advance written notice ensuring the attendance by competent authorized representatives of the fabricator, building owner's representative, architect and subcontractors whose work interfaces with the work of this section.
   3. Review the specifications to determine any potential problems, changes, scheduling, unique job site conditions, installation requirements and procedures and any other information pertinent to the installation.
   4. Record the results of the conference and furnish copies to all participants.

## 1.5 REFERENCES

A. Include only reference standards that are to be indicated within the text of this section. Edit the following, adding and deleting as required for project and product selection.

B. American Concrete Institute (ACI)
   1. ACI 347 Recommended Practice for Concrete Formwork

C. American Institute of Steel Construction (AISC)
   1. Manual of Steel Construction

D. American Iron and Steel Institute (AISI)
   1. Steel Products Manual; Stainless and Heat Resisting Steel.
   2. Code of Standard Practice

E. American National Standards Institute (ANSI)
   1. ANSI A58.1 Minimum Design Loads in Buildings and Other Structures.

2. ICC/ANSI A117.1 Accessible and Usable Buildings and Facilities.
3. ANSI A97.1 Safety Performance Specifications and Methods of Test for Safety Glazing Material used in Buildings.

F. Society for Testing and Materials (ASTM)
1. A 167 Specification for Stainless and Heat Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
2. A 269 Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
3. A 312 Specification for Seamless and Welded Austenitic Stainless Steel Pipe.
4. A1264-1 Safety Requirements for Workplace Floor and Wall Openings, Stairs and Railing Systems
5. B 209 Specification for Aluminum and Aluminum Alloy Sheet and Plate.
6. B 210 Specification for Aluminum and Aluminum Alloy Drawn Seamless Tubes.
7. B 211 Aluminum and Aluminum Alloy Bar, Rod and Wire
8. B 221 Specification for Aluminum-Alloy Bars, Rods, Wires, Shapes and Tubes
9. B 241 Specification for Aluminum and Aluminum Alloy Seamless Pipe and Seamless Extruded Tube.
10. B 429 Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
11. C 595 Specification for Blended Hydraulic Cements.
12. C1036 Standard Specification for Flat Glass
13. C 1048 Standard Specification for Heat-Treated Flat Glass - Kind HS, Kind FT Coated and Uncoated Glass.
14. C 1172 Standard Specification for Laminated Architectural Flat Glass.
15. D 1730 Recommended Practices for Preparation of Aluminum and Aluminum Alloy Surfaces for Painting.
16. E 84 Test Method for Surface Burning Characteristics of Building Materials.
17. E 894 Standard Test Methods for Anchorage of Permanent Metal Railing Systems and Rails for Buildings.
18. E 935 Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings.
19. E 985 Specification for Permanent Metal Railing Systems and Rails for Buildings.
20. E 1300 Standard Practice for Determining Load Resistance of Glass in Buildings
21. E 2353 Standard Test Methods for Performance of Glass in Permanent Glass Railing Systems, Guards, & Balustrades.
22. E 2358 Standard Specification for Performance of Glass in Permanent Glass Railing Systems, Guards, & Balustrades.

G. American Welding Society (AWS)
1. Specifications for Welding Rods and Bare Electrodes.

H. Americans with Disabilities Act Standard for Accessible Design (ADASAD)

I. International Code Council (ICC)

J. International Building Code (IBC)

K. Iron and Steel Society (ISS)

L. Steel Products Manual
   1. Stainless and Heat Resisting Steels

M. National Association of Architectural Metal Manufacturers (NAAMM) and National Ornamental and Miscellaneous Metals Association (NOMMA)

N. Metal Finishes Manual

O. National Association of Architectural Metal Manufacturers (NAAMM)
   1. Metal Stair Manual

P. National Fire Protection Association (NFPA)

Q. 101 Life Safety Code

## 1.6 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01 30 00

B. Show sections and plans of stairs, dimensions and assembly of components.
   1. Railings
   2. Handrail
   3. Brackets
   4. Reinforcements
   5. Anchors
   6. Welded and bolted connections
   7. Show all field connections
   8. Provide setting diagrams for installation of anchors, location of pockets, weld plates for attachment of rails to structure, and blocking for attachment of wall rail.
   9. Specify adequate back up support for anchoring handrail bracket.
   10. Indicate all required field measurements.

C. Indicate component details, materials, finishes, connection and joining methods, and the relationship to adjoining work.

D. Submit manufacturer’s installation instructions under provisions of Section 01 30 00

E. Samples:

F. Submit duplicate samples of railing showing style and finish. One approved sample will be returned to contractor.

G. Submit sample(s) of all components.

H. Certificates:
   1. Furnish manufacturer's certification that materials meet specification requirements.

I. Delegated Design:

J. Furnish calculations and sealed drawings by an engineer registered in the state where the project is located showing that safety requirements are met.

K. Substitutions:

L. See Section 01 25 00 Substitution Procedures.

## 1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the job site in good condition and properly protected against damage to finished surfaces.

B. Storage on site:

C. Store material in a location and in a manner to avoid damage. Stacking shall be done in a way, which will prevent bending.

D. Store material in a clean, dry location away from uncured concrete and masonry. Cover with waterproof paper, tarpaulin, or polyethylene sheeting in a manner that will permit circulation of air inside the covering.

E. Keep handling on site to a minimum. Exercise particular care to avoid damage to finishes of material.

# PART 2 PRODUCTS

## 2.1 ACCEPTABLE MANUFACTURER

A. Railing Pipe and components shall be as manufactured or supplied by The Wagner Companies; P.O. Box 423; Butler, WI 53007. Phone: 888-243-6914. Fax: 414-214-0450. Web site: www.wagnercompanies.com www.panelgrip.com www.wagnerarchitectural.com www.shopwagner.com E-mail: rfq@mailwagner.com

## 2.2 MATERIALS AND FINISHES

A. Stainless Steel: Type 304

B. Pipe and Tubing: ASTM A 269

C. Finish: Ornamental Grade, AISI No. 4.

D. Glass:
1. Fully tempered ASTM C 1048 Kind FT quality q3 conforming to the safety requirements of ANSI Z97.1.
2. Laminated, fully tempered, ASTM C 1172, with PVB interlayer.
3. Tint: None.

## 2.3 RAILING SYSTEM

A. Material shall conform to 2.02. and be finished in accordance with 2.02.

B. Railing system shall be [surface] and [fascia] (embed) mounted.

C. Glass Structural Balustrade shall be 3/4 inch tempered PVB laminated glass and conform to the safety requirements of ANSI Z97.1.

D. Shoe Moulding: Panel Grip 2 - Extruded aluminum alloy Wagner No. (GR2457HCB) (GR2457HCB-10)

E. Cladding stainless steel, Wagner No. (GR2802.4AN alu.) (GR3802.4 stainless)

F. End caps, GR3876EC.4 - Stainless Steel

G. Fittings: Shall be of wrought material of stainless steel.

H. Glazing Accessories:
   1. Dry Glaze:
      a. Wagner Panel Grip™ No. [PG2472], [PG2475], and [PG2421]
      b. Shoe Moulding Sealing Gasket [GR9302] and [GR9355]
      c. Shims Plastic, (GRGL16), Aluminum 1/16” (GR2HS06), 1/8” (GR2HS12), ¼” (GR2HS25)
      d. Weld Block, Wagner No. GR175WB-10
      e. Drain Block, Wagner No. GR225DB-10
   2. Top Rail:
      a. 90” OD - Grade 316 Stainless Steel (3/4” glass) (GR3192.4), (GR3192.4L - Longitudinal polish)
      b. “U” Channel Top Rail
      c. Grade 304 Stainless Steel 1” x 1-1/2” - ¾” glass (GR31115.4)
      d. Top Rail Protective Gasket: Wagner No. GR9397

## 2.4 FASTENERS

A. All mechanical fasteners used in the assembly of stainless steel or aluminum railings shall be manufactured from stainless steel.

B. Base Shoe Moulding Attachment

C. Steel: Low Profile cap screw 18-8 (½”-13 x ¾”), Wagner No. [SHC12123-0750] and [SHC3N2123-0750]

## 2.5 HANDRAIL BRACKETS

A. Stainless steel; selected by Architect from Manufacturer's full range.

B. Check governing codes for dimensional and structural requirements.

## 2.6 FABRICATION

A. Cut material square and remove burrs from all exposed edges, with no chamfer.

B. Make exposed joints butt tight and flush.

C. Verify dimensions on site prior to shop fabrication.

# PART 3 EXECUTION

## 3.1 PREPARATION

A. Supply items to be cast in concrete.

## 3.2 METAL INTERACTION

A. When aluminum components come into contact with dissimilar metals, surfaces shall be kept from direct contact by painting the dissimilar metal with a heavy coat of a proper primer.

B. When aluminum components come into contact with cement or lime mortar, exposed aluminum surfaces shall be painted with zinc chromate.

## 3.3 INSTALLATION

A. Install in accordance with shop drawings and manufacturer’s instructions at locations indicated on the drawings.

B. Erect work square and level, rigid, free from distortion or defects detrimental to appearance or performance.

C. Expansion joints shall be provided as needed to allow for thermal expansion or contraction.

## 3.4 CLEANING

A. As installation is completed, wash thoroughly using clean water and soap; rinse with clean water.

B. Do not use acid solution, steel wool or other harsh abrasives.

C. If stain remains after washing, remove finish and restore in accordance with NAAMM/NOMMA Metal Finishes Manual.

D. Finish must not be removed from anodized aluminum. Reanodizing can only be done

by removing railing and returning it to the anodizer.

## 3.5 REPAIR OF DEFECTIVE WORK

A. Remove stained or otherwise defective work and replace with material that meets specification requirements.

B. Repair damaged finish as directed by Architect

C. Replace defective or damaged components as directed by Architect.

**END OF SECTION**

# SECTION 06 10 00

# ROUGH CARPENTRY

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
1. Wood blocking, cants, and nailers.
2. Wood furring.
3. Wood sleepers.
4. Plywood backing panels.

### 1.2 DEFINITIONS

A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.

B. Dimension Lumber: Lumber of 2 inches nominal size or greater but less than 5 inches nominal size in least dimension.

C. Exposed Framing: Framing not concealed by other construction.

D. OSB: Oriented strand board.

E. Timber: Lumber of 5 inches nominal size or greater in least dimension.

F. Lumber grading agencies, and abbreviations used to reference them, include the following:
1. NeLMA: Northeastern Lumber Manufacturers' Association.
2. NLGA: National Lumber Grades Authority.
3. SPIB: The Southern Pine Inspection Bureau.
4. WCLIB: West Coast Lumber Inspection Bureau.
5. WWPA: Western Wood Products Association.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative

retained.

2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D5664.
4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

## 1.4 INFORMATIONAL SUBMITTALS

A. Reports: For the following, from ICC-ES:
   1. Wood-preservative-treated wood.
   2. Fire-retardant-treated wood.
   3. Engineered wood products.
   4. Shear panels.
   5. Power-driven fasteners.
   6. Post-installed anchors.
   7. Metal framing anchors.
   8. Sill sealer gasket/termite barrier.

## 1.5 QUALITY ASSURANCE

## 1.6 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 WOOD PRODUCTS, GENERAL

A. Lumber: Comply with DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
   1. Factory mark each piece of lumber with grade stamp of grading agency.
   2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by grading agency.

3. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry wood products.
4. Dress lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber:
1. Boards: 19 percent.

## 2.2 PRESERVATIVE TREATMENT

A. 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. Do not use inorganic boron (SBX) for sill plates.
2. For exposed items indicated to receive a stained or natural finish, chemical formulations are not to require incising, contain colorants, bleed through, or otherwise adversely affect finishes.
3. After treatment, redry dimension lumber to 19 percent maximum moisture content.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
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.

D. Application: Treat items indicated on Drawings, and the following:
1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.

## 2.3 FIRE-RETARDANT TREATMENT

A. General: Where fire-retardant-treated materials are indicated, materials are to 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.

B. 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 is not to promote corrosion of metal fasteners.
   2. Exterior Type: Treated materials are to 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 are to have a moisture content of 28 percent or less when tested according to ASTM D3201/D3201M at 92 percent relative humidity. Use where exterior type is not indicated.
   4. Design Value Adjustment Factors: Treated lumber is to be tested according to ASTM D5664 and design value adjustment factors are to be calculated according to ASTM D6841.

C. Kiln-dry lumber after treatment to maximum moisture content of 19 percent. Kiln-dry plywood after treatment to maximum moisture content of 15 percent.

D. Identify fire-retardant-treated wood 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.

E. For exposed items indicated to receive a stained or natural finish, chemical formulations are not to bleed through, contain colorants, or otherwise adversely affect finishes.

F. Application: Treat items indicated on Drawings, and the following:
   1. Concealed blocking.
   2. Plywood backing panels.

## 2.4 MISCELLANEOUS LUMBER

A. Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
   1. Blocking.
   2. Nailers.
   3. Cants.
   4. Furring.

B. Dimension Lumber Items: Construction or No. 2 grade lumber of any of the following species:
   1. Hem-fir (north); NLGA.
   2. Mixed southern pine or southern pine; SPIB.
   3. Spruce-pine-fir; NLGA.

4. Hem-fir; WCLIB or WWPA.
5. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
6. Northern species; NLGA.
7. Eastern softwoods; NeLMA.

C. Concealed Boards: 19 percent maximum moisture content and any of the following species and grades:
1. Mixed southern pine or southern pine; No. 2 grade; SPIB.
2. Hem-fir or hem-fir (north); Construction or No. 2 Common grade; NLGA, WCLIB, or WWPA.
3. Spruce-pine-fir (south) or spruce-pine-fir; Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
4. Eastern softwoods; No. 2 Common grade; NeLMA.

D. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

E. 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.

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

## 2.5 PLYWOOD BACKING PANELS

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

## 2.6 FASTENERS

A. General: Fasteners are to be of size and type indicated and comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches into wood substrate.
1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners of Type 304 stainless steel.
2. For pressure-preservative-treated wood, use stainless steel fasteners.

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

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

## PART 3 EXECUTION

### 3.1 INSTALLATION, GENERAL

A. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.

B. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.

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

D. 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.

E. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
   1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
   2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal thickness.
   3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. and to solidly fill space below partitions.
   4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet o.c.

F. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

G. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
   1. Use inorganic boron for items that are continuously protected from liquid water.
   2. Use copper naphthenate for items not continuously protected from liquid water.

H. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

I. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated.

J. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

## 3.2 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.

C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

## 3.3 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

**END OF SECTION**

# SECTION 06 16 00

# SHEATHING

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Wall sheathing.

### 1.2 ACTION SUBMITTALS

A. Product Data:
   1. Wall sheathing.

B. Product Data Submittals: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
   1. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.
   2. For fire-retardant treatments, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency in accordance with ASTM D5516.
   3. For products receiving waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
   4. For air-barrier and water-resistant glass-mat gypsum sheathing, include manufacturer's technical data and tested physical and performance properties of products.

### 1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: From air-barrier and water-resistant glass-mat gypsum sheathing manufacturer, certifying compatibility of sheathing accessory materials with Project materials that connect to or that come in contact with the sheathing.

B. Product Test Reports: For each air-barrier and water-resistant glass-mat gypsum sheathing assembly, indicating compliance with specified requirements, for tests performed by a qualified testing agency.

C. Evaluation Reports: For the following, from ICC-ES:
   1. Fire-retardant-treated plywood.
   2. Air-barrier and water-resistant glass-mat gypsum sheathing.

## 1.4 DELIVERY, STORAGE, AND HANDLING

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

# PART 2 PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance Ratings: As tested in accordance with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

## 2.2 FIRE-RETARDANT-TREATED PLYWOOD

A. General: Where fire-retardant-treated materials are indicated, use materials complying 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.

B. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested in accordance with 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. Use treatment that does not promote corrosion of metal fasteners.
   2. Exterior Type: Treated materials are to comply with requirements specified above for fire-retardant-treated plywood by pressure process after being subjected to accelerated weathering in accordance with ASTM D2898. Use for exterior locations and where indicated.
   3. Interior Type A: Treated materials are to have a moisture content of 28 percent or less when tested in accordance with ASTM D3201/D3201M at 92 percent relative humidity. Use where exterior type is not indicated.
   4. Design Value Adjustment Factors: Treated lumber plywood is to be tested in accordance with ASTM D5516 and design value adjustment factors are to be calculated in accordance with ASTM D6305. Span ratings after treatment are to be not less than span ratings specified.

C. Kiln-dry material after treatment to a maximum moisture content of 15 percent. Do not

use material that is warped or does not comply with requirements for untreated material.

D. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.

## 2.3 WALL SHEATHING

A. Glass-Mat Gypsum Sheathing, Walls: ASTM C1177/C1177M.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. CertainTeed; SAINT-GOBAIN.
      b. Georgia-Pacific Gypsum LLC.
      c. Gold Bond Building Products, LLC provided by National Gypsum Company.
      d. USG Corporation.
   2. Type and Thickness: Type X, 5/8 inch thick.

## 2.4 FASTENERS

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

B. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

C. 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.

D. Screws for Fastening 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 less than 0.0329 inch thick, use screws that comply with ASTM C1002.
   2. For steel framing from 0.033 to 0.112 inch thick, use screws that comply with ASTM C954.

# PART 3 EXECUTION

## 3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support

members.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:
   1. Table 2304.10.1, "Fastening Schedule," in the ICC's International Building Code.
   2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in the ICC's International Residential Code for One- and Two-Family Dwellings.
   3. ICC-ES evaluation report for fastener.

D. Use common wire 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. Install fasteners without splitting wood.

E. Coordinate wall 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.

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

G. 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.

## 3.2 INSTALLATION OF WOOD STRUCTURAL PANEL

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

## 3.3 INSTALLATION OF GYPSUM SHEATHING

A. Comply with GA-253 and with manufacturer's written instructions.
   1. Fasten gypsum sheathing to cold-formed metal framing with screws.
   2. Install panels with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
   3. 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 V-grooved edge down and tongue edge up. Interlock tongue with groove to bring 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.
   2. For sheathing under stucco cladding, panels may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.

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.
   2. For sheathing under stucco cladding, panels may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.

E. Seal sheathing joints in accordance with sheathing manufacturer's written instructions.
   1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient amount of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.
   2. 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**

# SECTION 06 41 16

# PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Plastic-laminate-clad architectural cabinets.
   2. Cabinet hardware and accessories.

### 1.2 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to support loads imposed by installed and fully loaded cabinets.

### 1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

### 1.4 ACTION SUBMITTALS

A. Product Data:
   1. Plastic-laminate-clad architectural cabinets.
   2. Cabinet hardware and accessories.

B. Shop Drawings:
   1. Include plans, elevations, sections, and attachment details.
   2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
   3. Show locations and sizes of cutouts and holes for items installed in plastic-laminate architectural cabinets.
   4. Apply AWI Quality Certification Program label to Shop Drawings.

C. Samples: For each exposed product and for each color and texture specified, in manufacturer's or manufacturer's standard size.

## 1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver cabinets until painting and similar finish operations that might damage architectural cabinets have been completed in installation areas. Store cabinets in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

## 1.6 FIELD CONDITIONS

A. Environmental Limitations without Humidity Control: Do not deliver or install cabinets 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 the remainder of the construction period.

B. Environmental Limitations with Humidity Control: Do not deliver or install cabinets until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 43 and 70 percent during the remainder of the construction period.

C. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
   1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed/concealed by construction, and indicate measurements on Shop Drawings.

D. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

# PART 2 PRODUCTS

## 2.1 PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of cabinets indicated for construction, finishes, installation, and other requirements.
   1. Provide labels and certificates from AWI certification program indicating that woodwork and installation complies with requirements of grades specified.
   2. The Contract Documents contain requirements that are more stringent than the referenced quality standard. Comply with requirements of Contract Documents in addition to those of the referenced quality standard.

B. Architectural Woodwork Standards Grade: Custom.

C. Type of Construction: Frameless.

D. Door and Drawer-Front Style: Flush overlay.

E. High-Pressure Decorative Laminate: ISO 4586-3, grades as indicated or if not indicated, as required by quality standard.
   1. Refer to Finish Schedule for manufacturer, pattern, and surface finish.

F. Exposed Surfaces:
   1. Plastic-Laminate Grade: HGS.
   2. Edges: PVC edge banding, 3.0 mm thick, matching laminate in color, pattern, and finish.
   3. Pattern Direction: As indicated.

G. Semiexposed Surfaces:
   1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, ISO 4586-3.
      a. Edges of Plastic-Laminate Shelves: PVC edge banding, 3.0 mm thick, matching laminate in color, pattern, and finish.
      b. Edges of Thermally Fused Laminate Panel Shelves: PVC or polyester edge banding.
      c. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, ISO 4586-3, grade to match exposed surface.
   2. Drawer Sides and Backs: Solid-hardwood lumber.
   3. Drawer Bottoms: Hardwood plywood.

H. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, ISO 4583-3, grade to match exposed surface.

I. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
   1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners.

## 2.2 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.

B. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
   1. Softwood Plywood: DOC PS 1, medium-density overlay.

## 2.3 CABINET HARDWARE AND ACCESSORIES

A. Cabinet Hardware: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 08 71 00 "Door Hardware."
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Accuride International Inc.
      b. Grass America.
      c. Hettich America L.P.
      d. Julius Blum & Co., Inc.
      e. Knape & Vogt Manufacturing Company.

B. Frameless Concealed Hinges (European Type): ANSI/BHMA A156.9, B01602, 135 degrees of opening.

C. Bar Pulls: Back mounted, solid metal, 4 inches long, 5/16 inch in diameter.

D. Adjustable Shelf Standards and Supports: ANSI/BHMA A156.9, B04071; with shelf rests, B04081.

E. Shelf Rests: ANSI/BHMA A156.9, B04013; metal.

F. Drawer Slides: ANSI/BHMA A156.9.
   1. Heavy-Duty (Grade 1HD-100 and Grade 1HD-200): Side mount.
      a. Type: Full extension.
      b. Material: Aluminum slides.
      c. Motion Feature: Soft close dampener.
   2. Pencil drawers not more than 3 inches high and not more than 24 inches wide, provide 50 lb load capacity.
   3. General-purpose drawers more than 3 inches high, but not more than 6 inches high and not more than 24 inches wide, provide 75 lb load capacity.
   4. File drawers more than 6 inches high or more than 24 inches wide, provide 100 lb load capacity.
   5. Lateral file drawers more than 6 inches high and more than 24 inches but not more than 30 inches wide, provide 150 lb load capacity.
   6. Lateral file drawers more than 6 inches high and more than 30 inches wide, provide 200 lb load capacity.
   7. Computer keyboard tray, provide 75 lb load capacity.

G. Door Locks: ANSI/BHMA A156.11, E07121.

H. Drawer Locks: ANSI/BHMA A156.11, E07041.

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

J. Grommets for Cable Passage: 1-1/4-inch OD, molded-plastic grommets and matching plastic caps with slot for wire passage.
   1. Color: Selected by Architect.

K. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with ANSI/BHMA A156.18 for ANSI/BHMA finish number indicated.
   1. Satin Stainless Steel: ANSI/BHMA 630.

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

## 2.4 FABRICATION

A. Fabricate architectural cabinets to dimensions, profiles, and details indicated.

B. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
   1. Notify Architect seven days in advance of the dates and times architectural cabinet fabrication will be complete.
   2. Trial fit assemblies at manufacturer's shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.

C. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

# PART 3 EXECUTION

## 3.1 PREPARATION

A. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.

## 3.2 INSTALLATION

A. Architectural Woodwork Standards Grade: Install cabinets to comply with quality standard grade of item to be installed.

B. Assemble cabinets and complete fabrication at Project site to extent that it was not completed in the shop.

C. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with wafer-head cabinet installation screws.

D. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch in 96 inches using concealed shims.
   1. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
   2. 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.

## 3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects. Where not possible to repair, replace architectural cabinets. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean cabinets on exposed and semiexposed surfaces.

**END OF SECTION**

# SECTION 06 42 16

# FLUSH WOOD PANELING

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Flush wood paneling (wood-veneer wall surfacing).
   2. Installation materials.

### 1.2 COORDINATION

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

### 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 data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

B. Shop Drawings: For flush wood paneling.
   1. Include plans, elevations, sections, and attachment details.
   2. Show details full size.
   3. Show locations and sizes of furring and blocking, including concealed blocking specified in other Sections.
   4. For paneling produced from premanufactured sets, show finished panel sizes, set numbers, sequence numbers within sets, and method of cutting panels to produce indicated sizes.
   5. For paneling veneered in fabrication shop, show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.

C. Samples: For each exposed product and for each color and finish specified, in manufacturer's or fabricator's standard size.

## 1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

## 1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

## 1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver paneling until painting and similar operations that might damage paneling have been completed in installation areas. Store paneling in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

## 1.8 FIELD CONDITIONS

A. Environmental Limitations without Humidity Control: Do not deliver or install paneling until building is enclosed, wet-work is complete, and HVAC system is operating and will maintain temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.

B. Environmental Limitations with Humidity Control: Do not deliver or install paneling until building is enclosed, wet-work is complete, and HVAC system is operating and will maintain temperature between 60 and 90 deg F and relative humidity between 43 and 70 percent during the remainder of the construction period.

C. Field Measurements: Where paneling is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
   1. Locate concealed framing, blocking, and reinforcements that support paneling by field measurements before being enclosed/concealed by construction and indicate measurements on Shop Drawings.

D. Established Dimensions: Where paneling is indicated to fit to other construction, establish dimensions for areas where woodwork is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

## PART 2 PRODUCTS

### 2.1 SOURCE LIMITATIONS

A. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production of paneling.

### 2.2 PANELING, GENERAL

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of flush wood paneling (wood-veneer wall surfacing) indicated for construction, finishes, installation, and other requirements.
   1. Provide inspections of fabrication and installation together with labels and certificates from certification program indicating that woodwork complies with requirements of grades specified.
   2. The Contract Documents contain requirements that are more stringent than the referenced woodwork quality standard. Comply with requirements of Contract Documents in addition to those of the referenced quality standard.

### 2.3 FLUSH WOOD PANELING (WOOD-VENEER WALL SURFACING)

A. Grade: Custom.

B. Wood Species and Cut: [White oak, rift sliced], [Select white ash, plain sliced], [Sycamore, plain sliced], [Cherry, plain sliced], [Butternut, plain sliced], and [Avodire, quarter sliced].

C. Veneer Matching Method:
   1. Adjacent Veneer Leaves: [Book], [Slip], and [Pleasing (Random)] match.
   2. Within Panel Face: [Running], [Balance], and [Center-balance] match.
   3. Adjacent Veneer Leaves and within Panel Face: Slip, center-balance, or book match.

D. Panel-Matching Method:
   1. No matching is required between adjacent panels. Select and arrange panels for similarity of grain pattern and color between adjacent panels.
   2. Premanufactured panel sets used full width within each separate area.
      a. See Section 01 10 00 "Summary" for requirements concerning flitches reserved by Architect.

E. Panel Core Construction: Hardwood veneer-core plywood.
   1. Thickness: 3/4 inch.

F. Assemble panels by gluing and concealed fastening.

## 2.4 MATERIALS

A. Materials, General: Provide materials that comply with requirements of referenced quality standard for each quality grade specified unless otherwise indicated.

B. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each quality grade specified unless otherwise indicated.
   1. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1.

## 2.5 INSTALLATION MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls.

C. Installation Adhesive: Product recommended by panel fabricator for each substrate for secure anchorage.

## 2.6 FABRICATION

A. Arrange paneling in shop or other suitable space in proposed sequence for examination by Architect. Mark units with temporary sequence numbers to indicate position in proposed layout.
   1. Lay out one elevation at a time if approved by Architect.
   2. Notify Architect seven days in advance of the date and time when layout will be available for viewing.
   3. Provide lighting of similar type and level as that of final installation for viewing layout unless otherwise approved by Architect.
   4. Rearrange paneling as directed by Architect until layout is approved.
   5. Obtain Architect's approval of layout before start of assembly. Mark units and Shop Drawings with assembly sequence numbers based on approved layout.

B. Complete fabrication, including assembly, to maximum extent possible, before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
   1. Notify Architect seven days in advance of the dates and times paneling fabrication will be complete.

C. Shop cut openings, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

## 2.7 SHOP FINISHING

A. General: Finish paneling at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

B. Transparent Finish:
   1. Grade: Custom.
   2. Finish: System - 5, conversion varnish.
   3. Wash Coat for Closed-Grain Woods: Apply wash-coat sealer to woodwork made from closed-grain wood before staining and finishing.
   4. Staining: Match approved sample for color.
   5. Open Finish for Open-Grain Woods: Do not apply filler to open-grain woods.
   6. Sheen: [Flat, 15-30], [Satin, 31-45], [Semigloss, 46-60], and [Gloss, 61-100] gloss units measured on 60-degree gloss meter per ASTM D523.

# PART 3 EXECUTION

## 3.1 PREPARATION

A. Before installation, condition paneling to humidity conditions in installation areas.

B. Before installing paneling, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

## 3.2 INSTALLATION

A. Grade: Install paneling to comply with quality standard grade of paneling to be installed.

B. Install paneling level, plumb, true in line, and without distortion. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches. Install with no more than 1/16 inch in 96-inch vertical cup or bow and 1/8 inch in 96-inch horizontal variation from a true plane.
   1. For flush paneling with revealed joints, install with variations in reveal width, alignment of top and bottom edges, and flushness between adjacent panels not exceeding 1/16 inch.

C. Anchor paneling to supporting substrate with [concealed panel-hanger clips], [splined connection strips], and [blind nailing].
   1. Do not use face fastening unless otherwise indicated.

D. 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.

## 3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective paneling, where possible, to eliminate defects. Where not possible to repair, replace paneling. Adjust for uniform appearance.

B. Clean paneling on exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

**END OF SECTION**

# SECTION 07 05 43.11

# COMPOSITE METAL HYBRID (CMH) CONTINUOUS INSULATION CLADDING SUPPORT SYSTEM

## PART 1 GENERAL

### 1.1 SECTION INCLUDES

A. Composite metal hybrid (CMH) sub-framing support system with in-fill continuous insulation integrated within metal wall panels or fiber cement panels exterior wall cladding.
   1. Substrate: Exterior sheathing over metal stud framing and Concrete masonry units (CMU).

### 1.2 REFERENCE STANDARDS

A. ASCE American Society of Civil Engineers (www.asce.org).
   1. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; 2022.
   2. ASCE - Structural Plastics Design Manual.

B. ASHRAE American Society of Heating, Refrigerating, and Air-Conditioning Engineers (www.ashrae.org).
   1. ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings; 2019.
   2. ASHRAE 189.1 - Standard for the Design of High-Performance Green Buildings Except Low-Rise Residential Buildings; 2020.

C. ASTM International - American Society for Testing and Materials (www.astm.org).
   1. ASTM A653/A653M - Standard Specification for Steel Sheet, Zing-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2022.
   2. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
   3. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013 (2019).
   4. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (2019).
   5. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2020.
   6. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate

for Use as Sheathing; 2017.
7. ASTM C1363 - Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus; 2019.
8. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017 (2022).
9. ASTM D1622 - Standard Test Method for Apparent Density of Rigid Cellular Plastics; 2020.
10. ASTM D1623 - Standard Test Method for Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics; 2017.
11. ASTM D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics; 2010(2018).
12. ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics; 2019.
13. ASTM D570 - Standard Test Method for Water Absorption of Plastics; 2022.
14. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2022.
15. ASTM D638 - Standard Test Method for Tensile Properties of Plastics; 2022.
16. ASTM D696 - Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between minus 30 degrees C and 30 degrees C with a Vitreous Silica Dilatometer; 2016.
17. ASTM D7332-B - Standard Test Method for Measuring the Fastener Pull-Through Resistance of a Fiber-Reinforced Polymer Matrix Composite; 2022.
18. ASTM D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials; 2017.
19. ASTM D792 - Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement; 2020.
20. ASTM D4385 - Standard Practice for Classifying Visual Defects in Thermosetting Reinforced Plastic Pultruded Products; 2019.
21. ASTM D6641/D6641M - Standard Test Method for Compressive Properties of Polymer Matrix Composite Materials Using a Combined Loading Compression (CLC) Test Fixture; 2016e2.
22. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2022.
23. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2022a.
24. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.
25. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights, and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (2021).
26. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials; 2021a.

D. IBC - International Building Code (ICC - International Code Council); 2021.

E. IECC - International Energy Conservation Code; 2021.

F. IgCC - International Green Construction Code; 2021.

G. NFPA - National Fire Protection Association (www.nfpa.org).
   1. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components; 2023.

H. Voluntary Product Standard; Department of Commerce (DOC) and National Institute of Standards and Technology (NIST) (www.apawood.org).
   1. PS 1 - Structural Plywood; 2019 (Revised 2020).

## 1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordinate installation of continuous insulation sub-framing support system as indicated on drawings for proper drainage, flashing, trim, backup support, soffits, and other related Work.
   1. Review and finalize construction schedule.
   2. Verify availability of materials, installer's personnel, equipment, and facilities needed to meet established schedule.
   3. Review means and methods related to installation in accordance with manufacturer's installation instructions.
   4. Examine support conditions for compliance with installation requirements, including alignment and attachment to structural support system.
   5. Review flashings, wall cladding details, wall penetrations, drainage plane, openings, and condition of other construction that is related to this Work.
   6. Review temporary protection requirements for during and after installation of this Work.

## 1.4 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Submit for each product being used as indicated, including installation details, material descriptions, dimensions of individual components and profiles, and necessary accessories for a complete assembled system.

C. Test and Engineering Reports: Submit Test and Engineering reports on each type of composite sub-framing system based on the evaluation of comprehensive tests performed by a certified testing agency and/or Professional Engineers (PE) approved by authorities having jurisdiction.
   1. Structural Composite Sub-Framing Submittal:
      a. Provide PE stamped calculations for the composite sub-framing system carrying the associated cladding system that takes into account:
         1) Anisotropic properties of the sub-framing.
         2) Point loading of the fasteners and representative dynamics of the cladding system.
         3) Uniform loading calculations not being allowed as it is not representative to actual wall systems.
         4) Calculations for eccentric cantilever conditions.

5) Calculations providing a safety factor minimum of 4 at the high service temperature of 180 degrees Fahrenheit.
6) Fastener Creep and Durability Test for FRP sub-girts, certified by third party/PE. Test to be completed per reference section 2.03E.
7) Fire: ASTM E84 Class A and NFPA 285 tested for the specific wall assembly in this project.

D. Drainage: Provide system that drains when installed horizontally. Provide details and requirements for drainage shims and weeps.

E. Warranty: Submit manufacturer's sample warranty and ensure forms have been completed in Owner's name, registered with manufacturer for the Manufacturer's Warranty for the Sub-Framing System, and FRP Manufacturer's Warranty for Screw Creep and Durability per section 1.09.

## 1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with at least ten years of documented experience.
   1. Engineering Review: Manufacturer to provide Technical Engineering Report (TER) based on CMH support system and cladding system design.
   2. Code Conformance: CMH system to have been evaluated by IAPMO Uniform Evaluation Service and found satisfactory for compliance with 2018 International Building Code.

B. Installer Qualifications: Company specializing in performing work as indicated in this section with at least three years of documented experience and approved by manufacturer.
   1. Install system in strict compliance with manufacturer's installation instructions.

C. Design Engineer's Qualification: Design structural supports and anchorages under direct supervision of a licensed Structural Engineer experienced in design for this type of Work and licensed in State that Project is located. Engineering information provided shall be signed and verified by licensed Structural Engineer.

D. Environmental: CMH system to follow the below guidelines:
   1. CMH system to be registered as red list chemical free with the Declare label.
   2. The components shall be certified to be halogen/bromine free.
   3. CMH composite member shall utilize a minimum of 25% post-consumer recycled material content.
   4. Environmental Product Declaration: CMH Manufacturer shall provide a product-specific EPD Type III report in accordance with EN 15804 and ISO 14025.

## 1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to site without damage or deformation in manufacturer's original unopened containers and with labels that clearly identify product name and

manufacturer.

B. Storage: Store materials in clean, dry, and level interior or exterior areas for limited duration in accordance with manufacturer's written instructions.

C. Protect components during transportation, handling, and installation from moisture, excessive temperatures, and other construction operations in accordance with manufacturer's written instructions.

D. Handle components in accordance with manufacturer's written instructions and in a manner to prevent bending, warping, twisting, and surface, edge, or corner damage.

## 1.7 SITE CONDITIONS

A. Weather Limitations: Only proceed with installation when existing and forecasted weather conditions allow for assembly of this Work in accordance with manufacturer's written installation instructions.

## 1.8 WARRANTY

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

B. Manufacturer's Warranty for the Sub-Framing System: Provide five (5)-year manufacturer's warranty for composite metal hybrid (CMH) sub-framing support system commencing on the date of manufacture or date of substantial completion.

C. FRP Manufacturer's Warranty for Screw Creep and Durability: Provide 20-year manufacturer's non-prorated, product replacement warranty against fastener creep and/or decreased fastener retention capacity for cladding fasteners that are anchored solely into an FRP substrate in lieu of a metal substrate. FRP material to be warrantied to perform long term to retain fasteners in a load capacity equivalent to 16 Ga. steel under the same loading, temperature, duration, and durability.

# PART 2 PRODUCTS

## 2.1 MANUFACTURER

A. Advanced Architectural Products (A2P):
   1. Address: 959 Industrial Drive, Allegan, Michigan 49010.
   2. Phone: (269) 355-1818; Fax: (866) 858-5568; Website: GreenGirt.com.

B. Products:
   1. GreenGirt CMH Sub-Framing System.
   2. SMARTci 1 in 1 System.
   3. Other products shall be pre-submitted and approved products that meet

materials and performance requirements with specified and validated third-party testing.

## 2.2 DESCRIPTION

A. Attach CMH sub-framing support system components through exterior sheathing into metal stud framing andto concrete masonry units (CMU) as indicated on drawings.
   1. See Section 04 20 00 for CMU substrate.
   2. See Section 05 40 00 for metal stud framing.
   3. See Section 07 42 00 for wall panels system.

B. Install CMH sub-framing support system components horizontally or vertically through exterior sheathing into stud support system as indicated on drawings in compliance with project requirements.

C. Install CMH sub-framing support system components horizontally or vertically onto masonry substrate system as indicated on drawings in compliance with project requirements.

D. If necessary, install metal hat channel as indicated on drawings, mounted horizontally to vertical or vertically to horizontal CMH sub-framing support system, connecting adjacent supports in series to each other.

## 2.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide system tested in accordance with ASTM E330/E330M and certified to be without permanent deformation or failure of structural members in accordance with design wind velocities for project location and potential for occurrence based on data from wind velocity maps and other provisions of ASCE 7 and as approved by authorities having jurisdiction (AHJ).
   1. Provide finite element analysis (FEA) to model and evaluate areas of the longest composite girt cantilever span possible between intermediate framing members/attachment.
      a. FEA shall include maximum dead load and wind load conditions.
      b. FEA shall include point loads representative of fastener locations.
      c. Maximum directional stresses in model shall have a safety factor of 4 or greater.
      d. Stresses shall be indicated and analyzed in 3 directions.
      e. FEA shall accurately replicate the wall system and physical loading dynamics.
      f. Report shall be furnished with the submittal.
   2. Butt joints (non-interlocking joints) of adjacent girts shall be installed on a minimum surface width of 3" or double stud condition to accommodate proper fastener margins to composite.

B. System Thermal Design: Ensure that installed continuous insulation and CMH sub-framing support system, and cladding attachment does not have thermal bridging of fasteners or framing that creates a continuous metal path from exterior surface of insulation to interior face of insulation.
   1. Verify that system thermal design meets or exceeds thermal design requirements in accordance with ASHRAE 90.1 or energy code.
   2. Thermal Resistance, Overall: Provide wall assembly R-Value indicated on Drawings, minimum.
   3. Thermal Performance Test: Provide thermal resistance (R-value) indicated, in accordance with ASTM C1363, corrected to 15 mph wind outside and still air inside, with installed condition including fasteners and joints.

C. Temperature Range: Comply with structural loading requirements within a temperature range of minus 55 degrees F to 180 degrees F.

D. Fire-Resistance Ratings: Provide CMH sub-framing support system with fire testing in accordance with ASTM E119 test methods and applied by approved testing agency acceptable to authorities having jurisdiction (AHJ).
   1. Surface Burning Characteristics: Test in accordance with ASTM E84 test method for continuous insulation, composite metal hybrid (CMH), and interior surfaces as follows:
      a. Flame Spread Index (FSI): 25 or less.
      b. Smoke Developed Index (SDI): 450 or less.
   2. Immediate Scale Multistory Fire Test: Comply with NFPA 285 and/or IBC acceptance criteria for wall height above grade and fire separation distances when wall type and other noted conditions require such testing or compliance with requirements as indicated.

E. Fastener Creep and Durability Test: For fasteners anchored into an FRP substrate without metal backer/retention system, perform per ASTM D7332-B, seven (7) day continuous fastener loading at the project's specified high service temperature of 180 degrees F.
   1. The fastener thread pull-out test is to be performed for self-drilling screws anchored solely into an FRP substrate. Test with ASTM D7332-B fixture using a fixture with a clearance opening of 34mm (1.313") in diameter. The pulling yoke is to be attached to the fastener head, with the load transferring into the anchoring threads. Ramp loading for no less than 30 seconds and no more than 120 seconds.
   2. Testing to be performed inside a climate chamber at a temperature of 180 degrees F for a period of 7 days at ultimate fastener load. Passing load values to be considered ultimate pull-out values for project engineering purposes.
   3. Test for 5 samples at same loading and temperature without pull-out. Testing to be certified by independent 3rd party.
   4. Test results of fastener head/thread pull-through performed at room temperature with static ASTM D7332-B are not considered valid for creep and durability testing and are not to be used for determining ultimate screw loading values.

## 2.4 COMPOSITE METAL HYBRID (CMH) SUB-FRAMING SUPPORT SYSTEM

A. CMH Sub-Framing Support System: Provide CMH sub-framing support system with recycled materials, fire retardant additives, and integral continuous metal inserts the length of the profile. Reinforce CMH sub-framing support system with glass strand rovings used internally for longitudinal (lengthwise) strength and continuous strand glass mats or stitched reinforcements used internally for transverse (crosswise) strength.
   1. Length of CMH Support System: 96 inches standard length.
   2. Depth of CMH Support System: 2-1/2 inches or deep.
   3. Grid Spacing of CMH Sub-Framing Supports for Substrate Attachments; Horizontally or Vertically:
      a. Horizontal Spacing: 16 inches on center.
      b. Vertical Spacing: 16 inches in center.
   4. Fastener Retention System: Provide continuous galvanized steel insert for engagement of fasteners, at least 16-gauge thick, with G90 galvanized coating in accordance with ASTM A653/A653M.
      a. Fasten CMH sub-framing support and other wall cladding support accessories through steel insert located within top and bottom of CMH sub-framing.
      b. Provide at least 3-inch overlap of metal inserts between CMH supports with 3/16 inch wide gap; sealant is not required.
   5. Provide integral 3-point compression seal within CMH sub-framing to ensure insulation will not dislodge.
   6. Provide integral anti-siphon grooves on exterior and interior flanges of CMH sub-framing.
   7. Provide force distribution zones integrally designed into profile of CMH sub-framing.
   8. CMH sub-framing is self-extinguishing in accordance with ASTM D635.
   9. Visual defects in CMH sub-framing are classified in accordance with ASTM D4385.
   10. Tensile Properties: Engineered lengthwise and crosswise tensile properties of CMH sub-framing comply with performance loading criteria and specified safety factors in accordance with ASTM D638.
      a. Lengthwise 50,000 psi and crosswise 40,000 psi, minimum.
   11. Compressive Properties: Engineered lengthwise and crosswise compressive properties of CMH sub-framing comply with performance loading criteria and specified safety factors in accordance with ASTM D6641/D6641/D6641M.
      a. Lengthwise 50,000 psi and crosswise 40,000 psi, minimum.
   12. Flexural Properties: Engineered lengthwise and crosswise flexural properties of CMH sub-framing comply with performance loading criteria and specified safety factors in accordance with ASTM D790.
      a. Lengthwise 50,000 psi and crosswise 40,000 psi, minimum.
   13. Modulus of Elasticity: CMH sub-framing is engineered to meet performance loading criteria and specified safety factors in accordance with ASTM D638.
      a. Lengthwise 29,000,000 psi and crosswise 3,300,000 psi, minimum.
   14. Water Absorption: CMH sub-framing absorbs less than 0.46 percent by weight within 24 hours when tested in accordance with ASTM D570.

15. Relative Density: CMH sub-framing is within range of 0.062 to 0.070 lbs/cubic inch when tested in accordance with ASTM D792.
16. Coefficient of Linear Thermal Expansion: CMH sub-framing is at 7.0 x 10¯6 inch/inch/degrees F when tested in accordance with ASTM D696.
17. Notched Izod Pendulum Impact Resistance, Lengthwise: CMH sub-framing is at 160 ft lbs/inch when tested in accordance with ASTM D256 within standard temperature range.
18. Notched Izod Pendulum Impact Resistance, Crosswise: CMH sub-framing is at 100 ft lbs/inch when tested in accordance with ASTM D256 within standard temperature range.
19. Barcol Hardness: 45, in accordance with ASTM D2583.
20. Surface Burning Characteristics:
    a. Flame Spread Index (FSI): 25 or less, when tested in accordance with ASTM E84.
    b. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
21. Flammability: Comply with ASTM E84.
22. Thermal Transmission: CMH sub-framing support system design should limit rate of heat flow crosswise through the profile section to less than 1.428 watts per 8' length in profile and temperature delta of 100 degrees Fahrenheit. Rate of heat flow to be determined in accordance with ASTM C1045-01, validated by a third party.

## 2.5 INSULATION

A. Mineral Fiber Board Insulation: Rigid or semi-rigid mineral fiber, in accordance with ASTM C612 or ASTM C553.
    1. Surface Burning Characteristics:
        a. Flame Spread Index (FSI), Unfaced: Zero (0) when tested in accordance with ASTM E84.
        b. Smoke Developed Index (SDI), Unfaced: Zero (0) when tested in accordance with ASTM E84.
    2. Board Size: Refer to Drawings.
    3. Board Thickness: Refer to Drawings.
    4. Comply with fire-resistance requirements, as indicated on drawings, and as part of an exterior non-load-bearing exterior wall assembly, tested in accordance with NFPA 285.
    5. Board Edges: Square.
    6. Acceptable Mineral Wool Manufacturers:
        a. Johns Manville (www.jm.com).
        b. Owens Corning (www.thermafiber.com).
        c. ROCKWOOL (www.rockwool.com).

## 2.6 COMPOSITE METAL HYBRID (CMH) TRIM

A. CMH Trim: Provide nonstructural trim at rough openings to properly transition continuous insulation (CI) system.
   1. Use angled and flat trim to enclose CI system and to provide thermally broken transitions within wall assemblies.
      a. Angled Trim: As indicated on drawings.
      b. Flat Trim: As indicated on drawings.
   2. Use sealant and tapes as required to transition weather-resistive barriers (WRB) from substrate onto trim.
   3. Trim to provide 90-degree transition of CI substrate for weather-resistive barriers (WRB) and exterior flashing.
   4. Cover trim with exterior panel assembly and flashings.
   5. Surface Burning Characteristics:
      a. Flame Spread Index (FSI): 25 or less when tested in accordance with ASTM E84.
      b. Smoke Developed Index (SDI): 450 or less when tested in accordance with ASTM E84.
   6. Comply with fire-resistance requirements, as indicated on drawings, and as part of an exterior non-load-bearing exterior wall assembly, tested in accordance with NFPA 285.
   7. Water Absorption: Less than 0.46 percent by weight, within 24 hours, tested in accordance with ASTM D570.
   8. Acceptable Products:
      a. SMARTci Trim
      b. Alternative: Performance CI system utilizing metal trim to provide spray foam insulation at a depth of 6" extending 32" around openings to reduce thermal transfer at wall transitions.

## 2.7 ASSEMBLY

A. Assembly CMH sub-framing support system in accordance with manufacturer's installation instructions and as necessary to comply with performance requirements indicated.
   1. Comply with CMH sub-framing support system dimensional and structural requirements as indicated on drawings.
   2. Install CMH sub-framing support system in acceptable sequence in accordance with manufacturer's written installation instructions.
   3. Install spray foam sealant on backside of cantilevered fasteners that completely puncture insulation layer.
   4. Provide uninterrupted, monolithic drainage plane as required per project details.

## 2.8 ACCESSORIES

A. Provide necessary accessories for complete installation of CMH sub-framing support system including metal closure trim transition angle, and other similar items.

B. Fasteners: Corrosion-resistant, self-tapping, and self-drilling screws, bolts, nuts, and other fasteners as recommended by CMH sub-framing support system manufacturer for CMH materials and other project applications.
   1. Cladding to CMH: Use standard self-tapping metal screws.
   2. CMH to Metal Stud Wall Framing: Use standard self-tapping metal screws.
   3. CMH to Concrete or Concrete Masonry Units (CMU): Use standard masonry or concrete screw anchors in pre-drilled hole.
   4. Use of powder, air, or gas-actuated fasteners or actuated fastener tools is not permitted.
   5. Use of impact wrenches when fastening to or from CMH is not permitted.
   6. CMH attachments to follow guidelines of ASCE Structural Plastics Design Manual:
      a. Edge Distance End: Ratio of distance to fastener diameter, minimum distance allow allowable: 3.0
      b. Edge Distance Side: Ratio of distance to fastener diameter minimum distance allowable: 2.0

C. Wall Sheathing: Plywood; Grade C-D and Exposure I in accordance with Voluntary Product Standard PS 1.
   1. Refer to drawings for thickness and see Section 06 10 00 for additional requirements.

D. Wall Sheathing: Gypsum board; V-shaped long edges and Type X fire-resistant in accordance with ASTM C1396/C1396M.
   1. Refer to drawings for thickness.

E. Tape (if necessary): Pressure-sensitive adhesive-coated polypropylene woven fabric. Must be mold, water, tear and UV resistant. Must be applicable in a wide temperature range (-20 degree F).

F. Weather-Resistive Barriers (WRB): See Section 07 25 00 for additional information.

G. Sealants (if necessary): See Section 07 92 00 for additional information.

H. Closure and Transition Accessories (if necessary): Use metal or FRP angles and flat stock per standard system details.

## PART 3 EXECUTION

### 3.1 EXAMINATION

A. Examine substrates, areas of this work, and project conditions with installer present for compliance with requirements for installation tolerances, substrates, CMH sub-framing support system conditions, and other conditions affecting performance of this Work.

B. Examine structural wall framing to ensure that angles, channels, studs, and other

structural support members have been installed within alignment tolerances in accordance with installation instructions of CMH sub-framing support system manufacturer.

C. Examine components and systems penetrating CMH sub-framing support system prior to installation during rough-in stage of construction to coordinate actual locations of penetrations relative to CMH sub-framing support system's joint locations.

D. Verify that mechanical and electrical-related installations for exterior walls have been completed and verify that adjacent materials and finishes are dry and ready for insulation installation.

E. Proceed with installation of CMH sub-framing support system only after wall substrate surfaces have been properly prepared and unsatisfactory conditions have been corrected.

## 3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare substrate surfaces using methods recommended in writing by CMH sub-framing support system manufacturer to achieve excellent results under project conditions.

C. Prepare sub-framing, base angles, sills, furring, and other CMH sub-framing support system components and provide anchorage in accordance with ASTM C754 for substrate and wall cladding types in accordance with manufacturer's installation instructions.

## 3.3 INSTALLATION

A. Install CMH sub-framing support system in accordance with manufacturer's installation instructions.

B. Install CMH sub-framing support system to meet requirements of ASCE Structural Plastics Design Manual.

C. Install system to fill-in exterior spaces without gaps or voids, and do not compress insulation panels.

D. Trim insulation neatly to fit spaces and insulate miscellaneous gaps and voids.

E. Fit insulation tight in spaces and tight to exterior side of Mechanical/Electrical services within plane of insulation.

F. Seal gaps, voids or penetrations completely with approved expandable foam sealant on exterior and interior (if visible) before enclosing wall.

G. Provide spray foam to seal metal penetrations, including cantilevered fasteners, to prevent interstitial space condensation.

H. Exposed insulation must be protected from open flame and kept dry at all times.

I. Exterior wall insulation panels are not intended to be left exposed for periods of time to excess of 60 days without adequate protection.
   1. When extended exposure is anticipated, protect exposed insulation surfaces including corners, windows and door openings with a compatible waterproof tape.

J. Install CMH sub-framing support system in compliance with system orientation, sizes, and locations as indicated on drawings.

## 3.4 TOLERANCES

A. Shim and align CMH sub-framing support system with installation tolerances of ¼ inch in 20 feet, non-cumulative, level, plumb, and aligned with locations as indicated on drawings.

## 3.5 PROTECTION

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

B. Ensure that insulation panels are not exposed to moisture.

C. Remove wet insulation panels or allow them to completely dry prior to installation within CMH sub-framing support system.

D. Replace damaged insulation prior to Date of Substantial Completion.

**END OF SECTION**

# SECTION 07 21 00

# THERMAL INSULATION

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Glass-fiber blanket insulation.
   2. Mineral-wool blanket insulation.
   3. Mineral-wool board insulation.

### 1.2 ACTION SUBMITTALS

A. Product Data:
   1. Glass-fiber blanket insulation.
   2. Mineral-wool blanket insulation.
   3. Mineral-wool board insulation.

### 1.3 DELIVERY, STORAGE, AND HANDLING

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

## PART 2 PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Maximum flame-spread and smoke-developed indexes less than 25 and 450 when tested in accordance with ASTM E84.

B. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.

C. Thermal-Resistance Value (R-Value): R-value as indicated on Drawings in accordance with ASTM C518.

## 2.2 GLASS-FIBER BLANKET INSULATION

A. Glass-Fiber Blanket Insulation, Unfaced : ASTM C665, Type I; passing ASTM E136 for combustion characteristics.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. CertainTeed; SAINT-GOBAIN.
      b. Johns Manville; a Berkshire Hathaway company.
      c. Knauf Insulation.
      d. Owens Corning.

## 2.3 MINERAL-WOOL BLANKET INSULATION

A. Mineral-Wool Blanket Insulation, Unfaced : ASTM C665, Type I (blankets without membrane facing); consisting of fibers; passing ASTM E136 for combustion characteristics.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Johns Manville; a Berkshire Hathaway company.
      b. Owens Corning.
      c. ROCKWOOL.

## 2.4 MINERAL-WOOL BOARD INSULATION

A. Mineral-Wool Board Insulation, Type II, Unfaced : ASTM C612, Type II; passing ASTM E136 for combustion characteristics.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Johns Manville; a Berkshire Hathaway company; JM CladStone Water & Fire Block 45 or JM CladStone Water & Fire Block 60.
      b. Owens Corning; FireSpan 40.
      c. ROCKWOOL; CAVITYROCK.

## 2.5 ACCESSORIES

A. Insulation for Miscellaneous Voids:
   1. Glass-Fiber Insulation: ASTM C764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E84.
   2. Spray Polyurethane Foam Insulation: ASTM C1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84.

## PART 3 EXECUTION

### 3.1 PREPARATION

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

### 3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Install insulation with manufacturer's R-value label exposed after insulation is installed.

D. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

E. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

### 3.3 INSTALLATION OF CAVITY-WALL INSULATION

A. Mineral-Wool Board Insulation: Install insulation fasteners 4 inches from each corner of board insulation, at center of board, and as recommended by manufacturer.
   1. Fit courses of insulation between masonry wall ties and other obstructions, with edges butted tightly in both directions, and with faces flush.
   2. Press units firmly against inside substrates.

### 3.4 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
   1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
   2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
   3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated

for or protected from contact with insulation.

4. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
   1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft.
   2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

## 3.5 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.

B. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

**END OF SECTION**

# SECTION 07 27 26

# FLUID-APPLIED MEMBRANE AIR BARRIERS

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Low-build air barriers, vapor permeable.

### 1.2 DEFINITIONS

A. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.

B. Air-Barrier Assembly: The collection of air-barrier materials and accessories applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

C. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.

### 1.3 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.

### 1.4 ACTION SUBMITTALS

A. Product Data: 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.
   1. Low-build air barriers, vapor permeable.

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.

## 1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: From air-barrier manufacturer, certifying compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with the barrier.

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

D. Field quality-control reports.

## 1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
   1. Installer to be licensed by ABAA in accordance with ABAA's Quality Assurance Program and to employ ABAA-certified installers and supervisors on Project.

## 1.7 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.

## 1.8 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 SOURCE LIMITATIONS

A. Obtain primary air-barrier materials and air-barrier accessories from single

manufacturer.

## 2.2 PERFORMANCE REQUIREMENTS

A. Air-Barrier Performance: Air-barrier assembly and seals with adjacent construction to 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 to 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.

B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft., when tested in accordance with ASTM E2357.

C. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft. pressure difference; ASTM E2178.

D. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

E. UV Resistance: Can be exposed to sunlight for 360 days in accordance with manufacturer's written instructions.

## 2.3 LOW-BUILD AIR BARRIERS, VAPOR PERMEABLE

A. Low-Build, Vapor-Permeable Air Barrier: Synthetic polymer material with an installed dry film thickness, according to manufacturer's written instructions, of 6 to 15 mils over smooth, void-free substrates.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide PROSOCO, Inc; R-Guard Cat 5 or comparable product by one of the following
      a. Polyguard Products, Inc.; Polyguard Airlok Flex VP.
      b. W. R. Meadows, Inc; Air-Shield TMP.
      c. Tremco ExoAir 230.
   2. Tensile Bond: ASTM C297; Pass (minimum 105 kPa).
   3. Water Resistance: ASTM D2247; no cracking, checking, crazing, erosion, delamination, or other deleterious effects: Pass.
   4. Water Vapor Transmission: ASTM E96 Wet Cup; 14 perms.
   5. Water Penetration: ASTM E331; no visible water penetration at the sheathing joints as viewed from the back of the panel; Pass.

## 2.4 ACCESSORY MATERIALS

A. 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 waterborne primer recommended for substrate by air-barrier material manufacturer.

C. Stainless Steel Sheet: ASTM A240/A240M, Type 304, 0.0187 inch thick, and Series 300 stainless steel fasteners.

D. Waterproof Flashing: Waterproofing adhesive/flashing and detailing compound for air barrier applications that combines best characteristics of silicone and polyurethane. Single component STP is easy to gun, spread-and tool, or roller apply to produce a highly durable, seamless, elastomeric flashing membrane.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide PROSOCO, Inc; R-Guard FastFlash, R-Guard Joint & Seam Filler, or comparable product by one of the following:
      a. Pecora Corporation.
      b. The Dow Chemical Company.

E. Preformed Silicone Extrusion: Manufacturer's standard system consisting of cured low-modulus silicone extrusion, sized to fit opening widths, with a single-component, neutral-curing, Class 100/50 (low-modulus) silicone sealant for bonding extrusions to substrates.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide PROSOCO, Inc; or comparable product by one of the following
      a. Pecora Corporation.
      b. The Dow Chemical Company.

## 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.
   4. Verify that masonry joints are flush and completely filled with mortar.

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 in

accordance with 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. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

G. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

H. Bridge expansion joints and discontinuous wall-to-wall, deck-to-wall, and deck-to-deck joints with air-barrier accessory material that accommodates joint movement in accordance with manufacturer's written instructions and details.

## 3.3 INSTALLATION OF ACCESSORIES

A. Install accessory materials in accordance with air-barrier manufacturer's written instructions and details to form a seal with adjacent construction and ensure continuity of air and water barrier.
   1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
   2. Install transition strip on roofing membrane or base flashing so that a minimum of 3 inches of coverage is achieved over each substrate.
   3. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
   4. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.

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. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.

D. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

E. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply liquid flashing membrane capable of spanning joint widths; maximum width not to exceed 3/4-inch. of full contact over firm bearing to perimeter frames, with not less than

F. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air-barrier material with liquid flashing membrane.

G. Seal top of through-wall flashings to air barrier with an additional 6-inch- wide, liquid flashing membrane.

H. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with liquid flashing membrane.

I. Repair punctures, voids, and deficient lapped seams in strips and liquid flashing membrane. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches beyond repaired areas in strip direction.

## 3.4 INSTALLATION OF PRIMARY AIR-BARRIER MATERIAL

A. Apply air-barrier material to form a seal with strips and transition strips and to achieve a continuous air barrier in accordance with 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. Low-Build Air Barriers: Apply continuous unbroken air-barrier material to substrates according to the following thickness. Apply an increased thickness of air-barrier material in full contact around protrusions such as masonry ties.
   1. Vapor-Permeable, Low-Build Air Barrier: Total dry film thickness as recommended in writing by manufacturer to comply with performance requirements, applied in one or more equal coats. Apply additional material as needed to achieve void- and pinhole-free surface, but do not exceed thickness on which required vapor permeability is based.

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. ABAA Quality Assurance Program: Perform examinations, preparation, installation, testing, and inspections under ABAA's Quality Assurance Program.

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

C. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements. Inspections may include the following:
   1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
   2. Air-barrier dry film thickness.
   3. Continuous structural support of air-barrier system has been provided.
   4. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
   5. Site conditions for application temperature and dryness of substrates have been maintained.
   6. Maximum exposure time of materials to UV deterioration has not been exceeded.
   7. Surfaces have been primed, if applicable.
   8. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
   9. Termination mastic has been applied on cut edges.
   10. Strips and transition strips have been firmly adhered to substrate.
   11. Compatible materials have been used.
   12. Transitions at changes in direction and structural support at gaps have been provided.
   13. Connections between assemblies (air-barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
   14. All penetrations have been sealed.

D. Tests: As determined by testing agency from among the following tests:
   1. Air-Leakage-Volume Testing: Air-barrier assemblies will be tested for air-leakage rate in accordance with ASTM E3158.
   2. Adhesion Testing: Air-barrier assemblies will be tested for required adhesion to substrate in accordance with ASTM D4541 for each 600 sq. ft. of installed air barrier or part thereof.

E. Air barriers will be considered defective if they do not pass tests and inspections.
   1. Apply additional air-barrier material, in accordance with manufacturer's written instructions, where inspection results indicate insufficient thickness.
   2. Remove and replace deficient air-barrier components for retesting as specified above.

F. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

G. Prepare test and inspection reports.

## 3.6 CLEANING AND PROTECTION

A. Protect air-barrier system from damage during application and remainder of construction period, in accordance with manufacturer's written instructions.
   1. 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 in accordance with 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**

# SECTION 07 42 13.23

# METAL COMPOSITE MATERIAL (MCM) RAINSCREEN SYSTEM

## PART 1 GENERAL

### 1.1 SUMMARY

A. Definition:
   1. Metal Composite Material (MCM) System includes MCM, joints, attachment system components and miscellaneous materials as appropriate for the design of the project to provide a weather-resistant exterior cladding system.

B. Section Includes: MCM system installations
   1. Applications of MCM system installations include:
      a. Exterior installation and performance of MCM and MCM system components.
      b. Interior installation and performance of MCM and MCM system components (if applicable).

### 1.2 REFERENCES

A. General: Standards listed by reference, including revisions by issuing authority, form a part of this specification section to the extent indicated. Standards listed have either been identified by the International Building Code (IBC), local building code, or specific requirement for this building construction type.

B. Aluminum Association (AA)
   1. Aluminum Design Manual
      a. AA-M12C22A41: Anodized - Clear Coating
      b. AA-M12C22A44: Anodized - Color Coating

C. American Society of Civil Engineers (ASCE)
   1. ASCE/SEI 7 Minimum Design Loads for Buildings and Other Structures

D. American Society for Testing and Materials (ASTM) International:
   1. ASTM D635 Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position
   2. ASTM D1781 Standard Test Method for Climbing Drum Peel for Adhesives
   3. ASTM D1929 Standard Test Method for Determining Ignition Temperature of Plastics
   4. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials
   5. ASTM E283 Standard Test Method for Determining the Rate of Air Leakage

Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
6. ASTM E330 Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors By Uniform Static Air Pressure Difference
7. ASTM E331 Standard Test Method for Water Penetration of Exterior Windows, Curtain Wall, and Doors By Uniform Static Air Pressure Difference
8. ASTM E1233 Standard test Method for Structural Performance of Exterior Windows, Doors, Skylights, and Curtain Walls by Cyclic Air Pressure Differential

E. American Architectural Manufacturers Association (AAMA):
1. AAMA 2605 Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels
2. AAMA 501 Methods of Test for Exterior Walls
3. AAMA 508 Voluntary Test Method and Specification for Pressure Equalized Rain Screen Wall Cladding Systems
4. AMMA 509 Voluntary Test and Classification Method for Drained and Back Ventilated Rain Screen Wall Cladding Systems

F. National Fire Protection Association (NFPA):
1. NFPA 285 Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components

## 1.3 SYSTEM DESCRIPTION

A. Performance Requirements:
1. General Performance: Provide installed MCM system designed to withstand specified loadings while maintaining allowable deflection, thermal movement performance as defined by the Manufacturer, Fabricator, or Installer required by this section without defects, damage or failure.

B. Deflection and Thermal Movement: Provide installed MCM systems that have been designed to resist to the wind loading, acting inward and outward, defined for this project:
1. Perimeter Framing Deflection: Deflection of panel perimeter framing member shall not exceed L/175 normal to plane of the wall where L is the unsupported span of the perimeter framing member.
2. Panel Deflection: Deflection of the panel face shall not exceed L/60 at design load where L is the unsupported span of the panel.
3. Anchor Deflection: At connection points of framing members to anchors, anchor deflection in any direction shall not exceed 0.0625 inch (1.6 mm).
4. At 150% pressure, no permanent deformation exceeding L/1000 or failure to structural members is permitted.
5. Thermal Movements: Allow for free and noiseless horizontal and vertical thermal movement due to expansion and contraction of component parts over a temperature range of -20°F (-29°C) to +180°F (82.2°C) at the material surface.
a. Buckling, opening of joints, undue stress on fasteners, failure of sealants, or

any other detrimental effects of thermal movement will not be permitted.

b. Fabrication, assembly and erection procedures shall take into account the ambient temperature range at the time of the respective operation.

C. System Requirements: (System Type Dependent)

1. Drained and Back Ventilated Rainscreen System (DBVR) - (Tested to AAMA 509 Standard)
   a. ASTM E283 - Air Leakage - When tested to AAMA 509 standards, the air flow measurement across the MCM system (excluding jamb conditions) shall be measured to determine the V-axis classification on chart 1b from AAMA 509.
   b. ASTM E331 and AAMA 501.1 - Water Infiltration Measurement - When tested to AAMA 509 standards, at pressures of 6.24 psf (300 Pa) and 12.0 psf (575 Pa) for ASTM 331 and AAMA 501.1, the average water from the four (4) tests shall be collected, measured, and averaged to determine the W-axis classification.
      1) The system shall have a classification where the V-axis classification number is greater than or equal to the W-axis classification number as presented on the AAMA 509 Chart 1a or 1b. (i.e. V2/W2 is acceptable, V1/W2 is not acceptable)
   c. ASTM E330 (Modified AAMA 509) - Structural Performance - MCM system must be engineered to meet the project design loads, however the MCM system must meet or exceed the following criteria when tested to a minimum pressure of 30.0 psf (1436 Pa). Note: ASTM E330 test shall be conducted with MCM system joinery closed (taped or sealed) producing the required static loads on the MCM system. The AWB is not to be loaded for the measurement:
      1) Deflections do not exceed limitations defined within the section on Deflection and Thermal Movement.

D. Fire Performance: Where required by governing code, provide fire retardant MCM that has been evaluated and is in compliance with code requirements specified herein.

1. Fire Performance: Wall assemblies containing MCM System shall meet the requirements of the Intermediate Scale Multi-story test, NFPA 285, where required by code based for the design of this project.

## 1.4 SUBMITTALS

A. General: Provide submittals in accordance with Conditions of the Contract and Division 01 Submittal Procedures Section.

B. Product Data: For each type of product indicated, include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of MCM System and accessory.

C. Shop Drawings: Submit shop drawings showing elevations and layouts, profiles, and product components, including anchorage, accessories, finish colors, and textures.
   1. Include details showing thickness and dimensions of the system parts, details of edge conditions, attachment system, corners, fastening and anchoring methods, locations of joints and gaskets, location and configuration of joints necessary to accommodate thermal movement, and all trim and flashings.
   2. Provide signed and sealed drawings by a qualified Design Professional in the project jurisdiction, of the MCM System showing conformance with the performance requirements and design criteria identified for this project.

D. System Calculations: Submit MCM System Fabricator's complete system design and engineering analysis/calculations including, but not limited to the following:
   1. Show governing MCM types, mounting system including anchorages, connections, and fasteners. Indicate location, type magnitude, and direction of loads imposed on the building structural frame.
   2. Analysis/Calculations shall be signed and sealed by a qualified Design Professional in the project jurisdiction that the MCM system shows conformance with the performance requirements and design criteria identified for this project.

E. Samples: Submit selection and verification samples for finishes, colors and textures
   1. Selected Samples: Manufacturer's color charts or chips illustrating full range of colors, finishes and patterns available for MCM with factory applied finishes. Custom color selection requires color sample to be submitted for approval. Approval signatures are required by Owner and/or Architect.
   2. Verification Samples:
      a. MCM System assembly: 12 inch × 12 inch (305 mm × 305 mm) MCM system samples in thickness specified, including clips, anchors, supports, fasteners, closures and other panel accessories. Panel sample need not be provided in the specified color.
      b. Two samples of each color or finish selected, approximately 3 inch x 4 inch (76.2mm x 101.6mm) minimum.
      c. Custom color samples may contain drawn down lines. Sizes for custom color samples are limited.

F. Quality Assurance Submittals: Submit the following:
   1. MCM Manufacturer's material test reports: Certified test reports showing compliance with specified performance requirements, and a third-party listing documenting compliance to a comparable code section.
   2. Certificates: Product certificates signed by MCM Manufacturer when requested certifying MCM complies with specified performance requirements indicated in this specification.
   3. MCM System Fabricator's certified system test reports: Certified system test reports showing system compliance with specific performance characteristics or a third-party listing documenting compliance to a comparable code section. Performance requirements shall be based on the type of MCM systems provided:
      a. Drained and Back Ventilated Rainscreen System (DBVR)
         1) Tested to AAMA 509 Standard

G. Closeout Submittals: Submit the following:
   1. Warranty: MCM Manufacturer, Fabricator, and Installer warranty documents as specified within the warrantee section of this specification.

## 1.5 QUALITY ASSURANCE

A. Qualifications:
   1. MCM Manufacturer Qualifications: Company with a minimum of 10 years of continuous experience manufacturing MCM of the type specified in North America:
      a. Able to provide specified warranty on finish.
      b. Able to provide a list of other projects of similar size, including approximate date of installation and name of Architect for each.
   2. MCM System Fabricator Qualifications: The MCM System Fabricator of this project's MCM System must be:
      a. A Certified MCM Fabricator by the Metal Construction Association (MCA) or
      b. Meet the Fabricator Requirements shown in this section and provide supporting documentation ten (10) days prior to Bid.
         1) Fabricator Requirements:
            a) The MCM System Fabricator shall demonstrate and offer written attested certification by at least one (1) specified MCM Manufacturer that he has fabricated; a minimum of 150,000 square feet (13935 square meters) of architectural walls per year, that are used as the building weathering envelope, utilizing MCM of at least 4mm (0.157 inch) thickness.
            b) System components shall be shop fabricated.
            c) Fabrication of other types of panels or fabricator's goods is not considered as meeting the above requirement.
            d) MCM System Fabricator shall have been in business under its present name for at least five (5) years prior to the start of this project.
            e) MCM System Fabricator shall not have filed for protection from creditors under state or federal insolvency or debtor relief statues or codes.
            f) MCM System Fabricator shall substantiate a track record of one of the Manufacturers listed in this specification working with the Fabricator/Installer for three (3) consecutive years and at a scale of operations cited above.
   3. MCM System Installer Qualifications:
      a. The MCM System Installer shall have been in business under the present name for at least five (5) years prior to the start of this project and have experience with similar sized MCM system projects. The MCM System Installer must be capable of providing field service representation during construction.
      b. The MCM System Installer must be an approved installer by a MCA Certified Fabricator for the installation of their MCM System and have undergone proper training for the specified system thereof.

B. Regulatory Code Agencies Requirements: Provide MCM system which have been evaluated and are in compliance with the following, where required:
   1. International Code Council (ICC)

C. Pre-installation Meetings: Conduct pre-installation meeting to verify project requirements, substrate conditions, and system Fabricator's installation details.

## 1.6 PROJECT CONDITIONS

A. Substrate Tolerances: The General Contractor is responsible for providing a substrate with a tolerance of 1/4 inch in 20.0 feet (6mm in 6m), on level, plumb, and location control lines as indicated and within 1/8 inch (3mm) offset of adjoining faces of alignment of matching profiles tolerances are noncumulative.

B. Field Measurements: Verify locations of wall framing members and wall opening dimensions by field measurements prior the fabrication of the MCM System. Indicate measurements on the "As Built Shop Drawings". Field measurements to be taken once all substrate materials and adjacent materials are installed.

C. Project Schedule: Provisions in the project schedule must accommodate the time interval between field measurements and fabrication/installation.

## 1.7 WARRANTY

A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.

B. MCM Manufacturer's Material Warranty: Submit, to the Owner, the manufacturer's standard warranty.
   1. Warranty Period:
      a. MCM Material Integrity: Five (5) plus 1 years from date of shipment
      b. MCM Painted Finish: Twenty (20) plus 1 years from date of shipment

C. MCM System and System Installation Warranty: Submit to the Owner, the MCM Fabricator system's standard warranty document executed by authorized company official. The MCM system's assembly warranty is in addition to and not a limitation of, other rights Owner may have under the Contract Documents.
   1. Warranty Period
      a. MCM System Workmanship: One (1) year warranty period commencing on Date of Substantial Completion.
      b. Special Warranty: The MCM System Fabricator will repair or replace components of the MCM System that fails in materials or workmanship within the specified one (1) year warranty period above.
         1) Failures include: deterioration of metals and other materials beyond normal weathering; structural failures including rupturing, cracking, puncturing, or loss of bond/adhesion characteristics.

## PART 2 PRODUCTS

### 2.1 METAL COMPOSITE MATERIAL (MCM) MANUFACTURERS AND PREMIUM MCM SYSTEM FABRICATORS

A. MCM Manufacturers:
   1. Alpolic material manufactured by Mitsubishi Chemicals - www.alpolic-americas.com
   2. Alucobond material manufactured by 3A Composites USA, Inc. - www.alucobondusa.com
   3. larson material manufactured by Alucoil North America - www.alucoilnorthamerica.com
   4. Reynobond material manufactured by Alcoa Architectural Products - www.reynobond.com

B. MCM System Fabricators:
   1. Basis of Design: The Miller-Clapperton Partnership, Inc. - www.millerclapperton.com
      a. System 1500.
   2. Premium Certified MCM Fabricators recognized by the Metal Construction Association

### 2.2 METAL COMPOSITE MATERIAL (MCM)

A. Material Description
   1. MCM Composition:
      a. Two sheets of aluminum sandwiching a solid core of extruded thermoplastic material formed in a continuous process with no glues or liquid adhesives between dissimilar materials. The core material shall be free of voids and/or air spaces and not contain foamed insulation material. Products that are laminated sheet by sheet in a batch process using glues or adhesives between materials shall not be acceptable.
   2. MCM Thickness: 4mm (0.157 inch)
   3. MCM Face Sheets:
      a. Thickness: 0.5mm (0.02 inch) (nominal)
   4. MCM Product:
      a. Fire Retardant core material product acceptable for use:
         1) On any construction where standard core material is allowed for use or
         2) On Types I, II, III, and IV Construction to any height above grade in general accordance with the specific provisions of IBC Section 1407.10.
   5. Fire Performance: (Class A Material)
      a. ASTM E84: MCM shall have a flame spread index of not more than 25 when tested in the maximum thickness intended for use.
      b. ASTM E84: MCM shall have a smoke developed index of not more than 450 when tested in the maximum thickness intended for use.
   6. Bond Integrity: Tested for resistance to delamination as follows:
      a. Peel Strength (ASTM D1781): 22.5 in-lb/in (100 N-m/m) minimum as

manufactured.
b. No degradation in bond performance after 8 hours of submersion in water at 212°F (100°C) or 21 days of immersion in water at 70°F (21°C).
c. Thermally bonded to the core material in a continuous process under heat, pressure, and tension.

## 2.3 FINISH

A. Exterior Finish: Finish shall meet the performance criteria of AAMA 2605.
1. Standard 2-coat Mica finish:
a. Selected from a Manufacturer's standard color chart

## 2.4 ACCESSORIES

A. General: Provide Fabricator's standard MCM system accessories, including fasteners, clips, anchorage devices, and attachments for specific applications indicated on contract documents.

## 2.5 RELATED MATERIALS

A. General: Refer to other related sections in Related Sections paragraph specified herein for related materials, including cold-form metal framing, flashing and trim, joint sealants, aluminum windows, glass and glazing and curtain walls.

## 2.6 FABRICATION

A. General: Shop-fabricate panels to sizes and joint configurations indicated on drawings.
1. Fabricate panels to dimensions indicated on drawings based on an assumed design temperature of 70°F (21°C). Allow for ambient temperature range at time of fabrication.
2. Formed MCM panel lines, breaks and angles to be sharp and true, with surfaces that are free from warp or buckle.
3. Fabricate panels with sharply cut edges and no displacement of face sheet or protrusion of core.

B. Fabrication Tolerances: Shop-fabricate panels to sizes and joint configurations indicated on drawings.
1. Width: +/- 0.079 inch (+/- 2mm) @ 70°F (21°C)
2. Length: +/- 0.079 inch (+/- 2mm) @ 70°F (21°C)
3. Squareness: +/- 0.079 inch (+/- 2mm) @ 70°F (21°C)

C. System Type
1. Drained and Back Ventilated Rainscreen System
a. System must provide an open joint design with allowance for adequate

ventilation while preventing excessive water infiltration to contact the air/water barrier. The moisture barrier and sheeting must be installed and compliant to related sections. All Drained and Back Ventilated Rainscreen systems must have undergone the voluntary test and classification of AAMA 509.

D. Attachment System Components
   1. Formed from extruded aluminum as indicated on Contract Drawings to meet the specified design loads and system test performance according to each MCM System Fabricator's design. Galvanized cold formed steel clips or staggered aluminum angles are not acceptable for panel to panel attachment.
   2. Panel stiffeners, as required, shall be positively engaged in the perimeter extrusion or mechanically fastened to the perimeter extrusion and shall be secured to the rear face of the composite panel with silicone or high-strength double-sided bonding tape of sufficient size and strength to maintain panel's specified deflection under load. Structural calculations shall be provided to show the adequacy of this connection to resist the applied loads. Galvanized steel and MCM are not to be used as stiffener elements. Only panel stiffeners composed of extruded aluminum or 300 Series stainless steel shapes shall be adequate.

## PART 3 EXECUTION

### 3.1 MCM FABRICATOR/INSTALLER INSTRUCTIONS

A. Compliance: Comply with Manufacturer's product data, including product technical bulletins and product packaging instructions.

### 3.2 EXAMINATION

A. Site Verification of Conditions: Verify that conditions of substrates previously installed under other sections are acceptable for the MCM system installation. Documentation should be provided indicating any conditions detrimental to the performance of the MCM System.

### 3.3 PREPARATION

A. Miscellaneous Framing: Install miscellaneous MCM system support members and anchorage according to MCM System written instructions and drawings supplied by the MCM System Fabricator.

B. If required per project conditions, field measurements of the site condition are to be taken prior to beginning fabrication work and notification of any material modifications and resulting schedule adjustment shall be formally documented.

## 3.4 INSTALLATION

A. General:
   1. Install the MCM system plumb, level and true in compliance with MCM System fabricator's recommendations.
   2. Anchor the MCM system securely in place in accordance with Fabricator's approved shop drawings.
   3. Comply with the MCM System Fabricator's instructions for installation of concealed fasteners and with provisions of Section 07 90 00 for installation of joint sealants.
   4. Installation Tolerances: Maximum deviation from horizontal and vertical alignment of installed panels: 0.25 inch in 20 feet (6.4mm in 6.1m), noncumulative.
   5. Do not cut, trim, weld, or braze component parts during erection in a manner which would damage the finish, decrease strength, or result in visual imperfection or a failure in performance. Return component parts which require alteration to shop for modification, if possible, or for replacement with new parts.
   6. Separate contact of dissimilar metals with bituminous paint, approved plastic shims, or other approved methods as defined within the Aluminum Design Manual (ASD). Use gasketed or approved coated fasteners where needed to eliminate the possibility of corrosive or electrolytic action between metals.

B. Related Products Installation Requirements: Refer to other sections in Related Sections paragraph herein for installation of related products.

## 3.5 FIELD QUALITY REQUIREMENTS

A. Field Quality Control: When required by contract, mock up shall be constructed and tested at the expense of the Architect/Owner/General Contractor, conduct water-spray test on the mock-up of the MCM System, testing for water penetration according to AAMA 501.2.

B. Testing Agency: If required, the Owner shall engage a qualified testing agency top perform tests and inspections.

## 3.6 ADJUSTING AND CLEANING

A. Adjusting:
   1. Remove and replace panels damaged beyond repair as a direct result of the panel installation. After installation, panel repair and replacement shall become the responsibility of the General Contractor.
   2. Removal of panels damaged by other trades shall be the responsibility of the General Contractor.
   3. Repair components of the MCM system with minor damage such that repairs are not discernible at a distance of 10 feet (3m) from the surface at a 90° angle per AAMA 2605.
   4. Remove and replace components of the MCM system damaged beyond repair.
   5. Remove protective film immediately after installation of MCM and immediately

prior to completion of the MCM system work. Masking intentionally left in place after panel installation on an elevation at the direction of the General Contractor, shall become the responsibility of the General Contractor.

6. Any additional protection, after installation, shall be the responsibility of the General Contractor.
7. Make sure weep holes and drainage channels are unobstructed and free of dirt and sealants.
8. Remove from project site damaged MCM panels, protective film and other debris attributable to work of this section.

B. Cleaning:
   1. Final cleaning shall not be part of the work of this section.

**END OF SECTION**

# SECTION 07 42 93

# SOFFIT PANELS

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Metal soffit panels.

### 1.2 ACTION SUBMITTALS

A. Product Data:
   1. Metal soffit panels.

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 flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.

C. Samples for Initial Selection: For each type of metal panel indicated with factory-applied color finishes.
   1. Include similar Samples of trim and accessories involving color selection.

### 1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each product, tests performed by a qualified testing agency.

### 1.4 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.

## 1.5 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.

## 1.6 COORDINATION

A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of walls, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

## 1.7 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.

B. 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 METAL SOFFIT PANELS

A. Provide metal soffit panels designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.

B. Metal Soffit Panels: Match profile and material of metal wall panels.
   1. Finish: Match finish and color of metal wall panels.
   2. Sealant: Factory applied within interlocking joint.

C. Flush-Profile Metal Soffit Panels : Solid panels formed with vertical panel edges and a flat pan between panel edges; with flush joint between panels. Match profile of MBCI 1-inch thick Artisan L12 with 4 beads. Provide perforated panels where indicated.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ATAS International, Inc.
      b. CENTRIA, a Nucor Brand.
      c. Elevate; Amrize Building Envelope LLC.
      d. MBCI; Cornerstone Building Brands.
      e. McElroy Metal, Inc.
      f. PAC-CLAD; Petersen; a Carlisle company.
   2. Material: Same material, finish, and color as metal wall panels.
   3. Aluminum Sheet: Coil-coated sheet, ASTM B209, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
      a. Thickness: 0.032 inch.
      b. Surface: Smooth, flat finish.
      c. Exterior Finish: Mica fluoropolymer.
      d. Color: As selected by Architect from manufacturer's full range.

## 2.3 MISCELLANEOUS MATERIALS

A. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
   1. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

B. 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.

## 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. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.

C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

## 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. Aluminum Panels and Accessories:
   1. Mica Fluoropolymer: AAMA 2605. Two-coat fluoropolymer finish with suspended mica flakes containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

## 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 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 panel manufacturer.
   2. Examine sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal panel manufacturer.
      a. Verify that air- or water-resistive barriers 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.
   1. Soffit Framing: Wire tie or clip furring channels to supports, as required to comply with requirements for assemblies indicated.

### 3.3 INSTALLATION OF METAL SOFFIT PANELS

A. Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
   1. Shim or otherwise plumb substrates receiving metal panels.
   2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
   3. Install screw fasteners in predrilled holes.
   4. Locate and space fastenings in uniform vertical and horizontal alignment.
   5. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
   6. 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.
   2. Aluminum Panels: Use aluminum or stainless steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
   3. Copper Panels: Use copper, stainless steel, or hardware-bronze fasteners.
   4. Stainless Steel Panels: Use stainless steel fasteners.

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. Lap-Seam Metal Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.
   1. Apply panels and associated items true to line for neat and weathertight enclosure.
   2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
   3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
   4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.

E. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
   1. Install components required for a complete metal panel system including trim, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.

## 3.4 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**

# SECTION 07 44 53

# GLASS-FIBER-REINFORCED CEMENTITIOUS PANELS

## PART 1 GENERAL

### 1.1 SECTION INCLUDES

A. Fiber reinforced cement panel siding system.

B. Accessories required for complete installation.

### 1.2 REFERENCES

A. ASCE 7 - Minimum Design Loads for Buildings and Other Structures.

B. ASTM C 1185 - Standard Test Methods for Sampling and Testing Non-Asbestos Fiber Cement Flat Sheet, Roofing and Siding Shingles, and Clapboards.

C. ASTM C 1186 - Standard Specification for Flat Non-Asbestos Fiber-Cement Sheets.

D. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Materials.

E. ASTM E 330 - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure.

F. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components.

### 1.3 SYSTEM DESCRIPTION

A. Performance Requirements:
   1. Design and size components to withstand live loads caused by pressure of wind acting normal to plane of wall as calculated in accordance with ANSI/ASCE 7, and as measured in accordance with ANSI/ASTM E 330.
   2. Deflection: Provide system capable of withstanding wind loading within the following limitations:
   3. No permanent deformation is acceptable.
   4. Design system to accommodate, without damage to system, components or deterioration of seals; movement within system; movement between system and perimeter framing components; dynamic loading and release of loads; and deflection of structural support framing.

5. Design to accommodate vertical inter-story movement and provide an allowance for the following tolerances:
6. Building floor slab live load differential deflection.
    a. Structural creep.
    b. Thermally induced expansion and contraction of framing members.
    c. Fabrication and erection tolerances.
    d. Design ultimate load capacity of anchor components to withstand 2.0 times "Design Wind Load" without failure.
7. Maintain continuous air and vapor barrier throughout assembly.
8. Conform to the requirements of NFPA 285 as applicable.

## 1.4 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, including:
    1. Preparation instructions and recommendations.
    2. Storage and handling requirements and recommendations.
    3. Installation methods, including concealed fastening patterns.

B. Shop Drawings: Provide shop drawings and erection plans for review including the following:
    1. Layout of furring, weather barrier, finished sheets and concealed fastener pattern.
    2. Details at base and top of walls, corners, at window and door trim and at other openings and connections.
    3. Site specific shop drawings prepared and stamped by a structural engineer licensed in the state where the project is located.
    4. Project specific building elevations with all panel joints and bond patterns shown.

C. Calculations: Provide wind load calculations, engineering calculations and substantiating data to validate wind resistance of roof system.

D. Product certificates including Research//Evaluation report or Code Authority approval of the system use for intended application.

E. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

F. Verification Samples: For each finish product specified, two samples, minimum size 3 inches by 6 inches (76 mm by 150 mm) square, representing actual product, color, and patterns.

G. Manufacturer's Certificates: Certify materials and accessory components meet or exceed specified requirements.

H. Manufacturer's warranties. Executed by manufacturer and installer.

## 1.5 QUALITY ASSURANCE

A. Installer Qualifications: Provide installer with not less than three years of experience with products similar to those specified.

B. Mock-Up: Provide a mock-up of complete panel system including furring, insulation, weather barrier and panels for approval by Architect.
   1. Finish areas designated by Architect.
   2. Mock-up shall be a minimum of 4 panels showing one vertical and one horizontal joint and complete installation system and fastener layout.
   3. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
   4. Refinish mock-up area as required to produce acceptable work.

C. Pre-Installation Conference:
   1. Prior to any panel application, the Contractor shall convene a pre-installation conference.
   2. Coordinate conference scheduling with the Architect. Conference shall be attended by the Contractor, Architect, personnel directly responsible for the installation of panels, flashing and sheet metal work and other trades interfacing with the panel work.
   3. Provide a copy of meeting notes and action items to all attending parties. Note action items requiring resolution prior to start of roof work.
   4. Discuss specific expectations and responsibilities, construction procedures, specification requirements, application, environmental conditions, job and surface readiness, material storage, and protection.

## 1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver cement panels to site until job is ready for their installation.

B. Store products in manufacturer's unopened packaging until ready for installation.

C. Store materials off the ground, flat and under cover in a dry place until erection.

D. Keep materials dry and protect from freezing.

E. Store materials in such a way to accommodate easy inspection of the materials prior to installation.

## 1.7 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

### 1.8 WARRANTY

A. Installed material shall have a manufacturer's 10 year warranty.

B. Warranty includes the repair or replacement of siding that does not comply with requirements or that fails within specified warranty period. Failures include, but are not limited to, cracking, deforming or otherwise deteriorating beyond normal weathering.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

A. Basis-of-Design: Rieder Facades; Oko Skin.

B. Other Acceptable Manufacturers:
   1. Cement Board Fabricators, Louisville, KY.
   2. Cladding Corp: Swisspearl Fiber Cement Panel

### 2.2 MATERIALS

A. Prefinished Cement Board Siding Panels: Siding sheets, fiber reinforced, cement based product conforming to ASTM C 1186 and manufactured of cement sand, cellulose fibers and fillers.
   1. Panel Size: Refer to Drawings
   2. Colors:
      a. Selected by Architect.
   3. Mechanical fasteners: External tamper proof anchors, stainless steel fasteners.
      a. Screws shall be length as required by the panel manufacturer for the furring material used
      b. Steel Screws: Size: #10 by 10 inch (25.4 mm).
      c. Use painted screws to match panel finish.
   4. Undercut Anchor: Consists of a concealed anchor sleeve with matching hex bolt with locking ratchets (screw).
      a. Model for Basis-of-Design: Keil, Article Number 555 020 823.
   5. Continuous cushions of black EPDM rubber, 1-1/4 inch (32 mm) and 3-1/2 inch (95 mm) as required.

### 2.3 ACCESSORIES

A. Trim: Composite and stainless steel trim shapes suitable for trim conditions.

B. Sheet Metal Flashing: Minimum 26 gauge hot-dipped galvanized steel sheet, or stainless steel.

C. Metal furring shall conform to the requirements of Section 09 22 36 - Lath [09 22 36-Furring and Lathing.

## PART 3 EXECUTION

### 3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. Ensure that framing is completed and that electrical rough-in, windows, doors, and flashing are in place before proceeding with work of this section.

C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

### 3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation. Repair as necessary any substrate conditions that would be detrimental to proper installation

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Ensure that all dust, dirt, fingerprints and all other foreign marks on the material are removed prior to installation of the panels.

### 3.3 INSTALLATION - GENERAL

A. Install in accordance with manufacturer's instructions and the approved shop drawings.

B. Panel Cutting:
1. Cut panels using a high speed circular saw with a segmented diamond blade.
2. Cut panels from the front side and protect the face from being damaged during cutting.
3. For incidental cuts, cut panels from the front side using a jigsaw with a carbide tip blade.
4. Provide adequate ventilation during cutting. Use of a dust extractor is required.

C. Drilling:
1. Drilling of holes must be done from the front of the panel using a carbide tip drill bit.
2. Larger holes, or cut-outs on the panel, can be made by a jig saw with a carbide blade or a hole saw with a diamond blade.

D. Prepare structural backing with studs, backer board, weather barrier and furring as required to meet the performance requirements specified. Install fiber reinforced panels over a properly prepared support system in accordance with the manufacturer's installation instructions and approved shop drawings.

E. Install weather barrier over prepared substrate.

F. Fiber reinforced cement panel siding shall be installed over an impervious weather barrier, on furring strips with black EPDM rubber strips, and with an air cavity behind the face panel to allow ventilation of the substrate.

G. Panels shall be attached to furring using the attachment pattern and fasteners indicated in the manufacturer's installation instructions and approved shop drawings.

H. Install black EPDM rubber strips to each furring member.

I. Pre-drill holes in cement boards in pattern indicated in the manufacturers installation instructions and approved shop drawings. Holes shall be of size as specified by the panel manufacturer for the fasteners being used.

J. Fasten fiber cement board to furring as per vendor's details with approved stainless steel fasteners.

## 3.4 PROTECTION

A. Protect installed products until completion of project.

B. Inspect walls for any damage. Replace panels that are damaged. Do not attempt to repair.

C. Ensure all dirt, dust, fingerprints and all foreign marks are immediately removed from the face of the material to avoid from permanent damage.

D. Replace damaged products before Substantial Completion.

**END OF SECTION**

# SECTION 07 54 19

# POLYVINYL-CHLORIDE (PVC) ROOFING

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Adhered polyvinyl chloride (PVC) roofing system.
   2. Substrate board.
   3. Roof insulation.
   4. Cover board.
   5. Walkways.

B. Section includes installation of sound-absorbing insulation strips in ribs of roof deck. Sound-absorbing insulation strips are furnished under Section 05 31 00 "Steel Decking."

### 1.2 DEFINITIONS

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

### 1.3 PREINSTALLATION MEETINGS

A. Preliminary Roofing Conference: Before starting roof deck construction, conduct conference at Project site.
   1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system 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. Review deck substrate requirements for 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 system.

7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

B. Preinstallation Roofing Conference: Conduct conference at Project site.
1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system 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 for compliance with requirements, 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 system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

## 1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. For insulation and roof system component fasteners, include copy of SPRI's Directory of Roof Assemblies 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. Roof plan showing orientation of steel roof deck and orientation of roof membrane, fastening spacings, and patterns for mechanically fastened roofing system.
6. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
7. Tie-in with air barrier.

C. Samples for Verification: For the following products:
   1. Roof membrane and flashing, of color required.
   2. Walkway pads or rolls, of color required.

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

## 1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.

B. Manufacturer Certificates:
   1. Performance Requirement Certificate: Signed by roof membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
      a. Submit evidence of compliance with performance requirements.
   2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.

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

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

E. Field Test Reports:
   1. Concrete internal relative humidity test reports.
   2. Fastener-pullout test results and manufacturer's revised requirements for fastener patterns.

F. Field quality-control reports.

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

## 1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing system 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.

## 1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is listed in SPRI's Directory of Roof Assemblies for roofing system identical to that used for this Project.

B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by

roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

C. Manufacturer's Technical Representative: Representative shall attend the pre-installation conference. Representative shall visit the project site at least twice to review work in place and will provide a deficiency report noting corrective items required from each inspection.

## 1.8 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 system manufacturer. Protect stored liquid material from direct sunlight.
   1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

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.

## 1.9 FIELD CONDITIONS

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

## 1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.
   1. Special warranty includes roof membrane, base flashings, roof insulation, cover boards, substrate board, and other components of roofing system.
   2. Warranty Period: 20 years from date of Substantial Completion.

B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section, including all components of roofing system such as roof membrane, base flashing, roof insulation, cover boards, and walkway products, for the following warranty period:
   1. Warranty Period: Two years from date of Substantial Completion.

## PART 2 PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Installed roofing 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. Roof system and flashings shall remain watertight.
   1. Accelerated Weathering: Roof membrane shall withstand 2000 hours of exposure when tested in accordance with ASTM G152, ASTM G154, or ASTM G155.
   2. Impact Resistance: Roof membrane shall resist impact damage when tested in accordance with ASTM D3746, ASTM D4272/D4272M, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.
   3. Puncture Resistance: Roofing system shall resist puncture damage when tested in accordance with ASTM D5602 or ASTM D5635.

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. Wind Uplift Resistance: Design roofing system to resist the following wind uplift pressures when tested in accordance with FM Approvals 4474, UL 580, or UL 1897.

D. SPRI's Directory of Roof Assemblies Listing: Roof membrane, base flashings, and component materials shall comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system, and shall be listed in SPRI's Directory of Roof Assemblies for roof assembly identical for that specified for this Project.
   1. Wind Uplift Load Capacity: As indicated on structural drawings.

E. Exterior Fire-Test Exposure: ASTM E108 or UL 790, Class A; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

F. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated. Identify products with appropriate markings of applicable testing agency.

### 2.2 POLYVINYL CHLORIDE (PVC) ROOFING

A. PVC Sheet: ASTM D4434/D4434M, Type III, fabric reinforced and fabric backed.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide

Carlisle SynTec Incorporated; FleeceBACK Polyester Reinforced PVC or comparable product by one of the following:
   a. Duro-Last Roofing, Inc.
   b. GAF.
   c. Johns Manville; a Berkshire Hathaway company.
   d. Versico Roofing Systems.
2. Membrane Thickness: 60 mils.
3. Exposed Face Color: White.

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

## 2.3 AUXILIARY ROOFING MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.
   1. Adhesives and Sealants: Comply with VOC limits of authorities having jurisdiction.
   2. Adhesives and sealants shall comply with the following limits for VOC content:
      a. Plastic Foam Adhesives: 50 g/L.
      b. Gypsum Board and Panel Adhesives: 50 g/L.
      c. Multipurpose Construction Adhesives: 70 g/L.
      d. Fiberglass Adhesives: 80 g/L.
      e. Contact Adhesives: 80 g/L.
      f. PVC Welding Compounds: 510 g/L.
      g. Other Adhesives: 250 g/L.
      h. Single-Ply Roof Membrane Sealants: 450 g/L.
      i. Nonmembrane Roof Sealants: 300 g/L.
      j. Sealant Primers for Nonporous Substrates: 250 g/L.
      k. Sealant Primers for Porous Substrates: 775 g/L.
   3. Adhesives and sealants shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
   4. Adhesives and sealants shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
   5. Adhesives and sealants shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions shall not exceed 9 mcg/cu. m or 7 ppb, whichever is less.
   6. Adhesives and sealants shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33

mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.

B. Sheet Flashing: Manufacturer's standard sheet flashing of same material, type, reinforcement, thickness, and color as PVC sheet.

C. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.

D. Roof Vents: As recommended by roof membrane manufacturer.
   1. Size: Not less than 4-inch diameter.

E. Bonding Adhesive: Manufacturer's standard, water based.

F. Water-Based, Fabric-Backed Membrane Adhesive: Roofing system manufacturer's standard water-based, cold-applied adhesive formulated for compatibility and use with fabric-backed membrane roofing.

G. Low-Rise, Urethane, Fabric-Backed Membrane Adhesive: Roof system manufacturer's standard spray-applied, low-rise, two-component urethane adhesive formulated for compatibility and use with fabric-backed membrane roofing.

H. Slip Sheet: ASTM D2178/D2178M, Type IV, glass fiber, asphalt-impregnated felt.

I. Slip Sheet: Manufacturer's standard, of thickness required for application.

J. Vented Base Sheet: ASTM D4897/D4897M, Type II; nonperforated, asphalt-impregnated fiberglass reinforced, with mineral granular patterned surfacing on bottom surface.

K. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.

L. Metal Battens: Manufacturer's standard, aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 1 inch wide by 0.05 inch thick, prepunched.

M. Ballast Retaining Bar: Perimeter securement system consisting of a slotted extruded-aluminum retention bar with an integrated compression fastening strip.
   1. Fasteners: 1-1/2-inch stainless steel fasteners with neoprene washers.

N. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roofing components to substrate, and acceptable to roofing system manufacturer.

O. 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.

## 2.4 SUBSTRATE BOARDS

A. Substrate Board: ASTM C1177/C1177M, glass-mat, water-resistant gypsum substrate or ASTM C1278/C1278M, fiber-reinforced gypsum board.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. CertainTeed Corporation.
      b. Georgia-Pacific Gypsum LLC.
      c. National Gypsum Company.
      d. USG Corporation.
   2. Thickness: Type X, 5/8 inch.
   3. Surface Finish: Unprimed.

## 2.5 ROOF INSULATION

A. General: Preformed roof insulation boards manufactured or approved by PVC roof membrane manufacturer, approved for use in SPRI's Directory of Roof Assemblies listed roof assemblies.

B. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 2, Grade 2, felt or glass-fiber mat facer on both major surfaces.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Carlisle SynTec Incorporated; SecurShield Polyisocyanurate or comparable product by one of the following:
      a. Atlas EPS; a Division of Atlas Roofing Corporation.
      b. Atlas Roofing Corporation.
      c. Dyplast Products.
      d. Firestone Building Products.
      e. Flex Membrane International Corp.
      f. GAF.
      g. Hunter Panels.
      h. Insulfoam; Carlisle Construction Materials Company.
      i. Johns Manville; a Berkshire Hathaway company.
      j. Rmax, Inc.
   2. Compressive Strength: 20 psi.
   3. Thickness:
      a. Base Layer: 1-1/2 inches.
      b. Tapered: Refer to Drawings.

C. Tapered Insulation: Provide factory-tapered insulation boards.
   1. Material: Match roof insulation.
   2. Minimum Thickness: 1/4 inch.
   3. Slope:
      a. Roof Field: 1/4 inch per foot unless otherwise indicated on Drawings.
      b. Saddles and Crickets: 1/2 inch per foot unless otherwise indicated on Drawings.

## 2.6 INSULATION ACCESSORIES

A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with other roofing system components.

B. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:
   1. Modified asphaltic, asbestos-free, cold-applied adhesive.
   2. Bead-applied, low-rise, one-component or multicomponent urethane adhesive.
   3. Full-spread, spray-applied, low-rise, two-component urethane adhesive.

C. Cover Board: ASTM C1177/C1177M, glass-mat, water-resistant gypsum board or ASTM C1278/C1278M fiber-reinforced gypsum board.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Georgia-Pacific Gypsum LLC.
      b. National Gypsum Company.
      c. USG Corporation.
   2. Thickness: 5/8 inch.
   3. Surface Finish: Factory primed.

## 2.7 WALKWAYS

A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads or rolls, approximately 3/16 inch thick and acceptable to roofing system manufacturer.
   1. Size: Approximately 36 by 60 inches.
   2. Color: Contrasting with roof membrane.

# 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.
   3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 05 31 00 "Steel Decking."
   4. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.

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 system installation in accordance with roofing system 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.

C. Install sound-absorbing insulation strips in accordance with acoustical roof deck manufacturer's written instructions.

## 3.3 INSTALLATION OF ROOFING, GENERAL

A. Install roofing system in accordance with roofing system manufacturer's written instructions, SPRI's Directory of Roof Assemblies listed roof assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.

B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

C. Coordinate installation and transition of roofing system component serving as an air barrier with air barrier specified under Section 07 27 26 "Fluid-Applied Membrane Air Barriers."

## 3.4 INSTALLATION OF SUBSTRATE BOARD

A. Install substrate board with long joints in continuous straight lines, with end joints staggered not less than 24 inches in adjacent rows.
   1. At steel roof decks, install substrate board at right angle to flutes of deck.
      a. Locate end joints over crests of steel roof deck.
   2. Tightly butt substrate boards together.
   3. Cut substrate board to fit tight around penetrations and projections, and to fit tight to intersecting sloping roof decks.
   4. Fasten substrate board to top flanges of steel deck in accordance with recommendations in SPRI's Directory of Roof Assemblies listed roof assembly requirements for specified Wind Uplift Load Capacity and FM Global Property Loss Prevention Data Sheet 1-29.
   5. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof in accordance with roofing system manufacturers' written instructions.
   6. Loosely lay substrate board over roof deck.

## 3.5 INSTALLATION OF INSULATION

A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at end of workday.

B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.

C. Installation Over Metal Decking:
   1. Install base layer of insulation with joints staggered not less than 24 inches in adjacent rows and with long joints continuous at right angle to flutes of decking.
      a. Locate end joints over crests of decking.
      b. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
      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.
   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. Staggered end joints within each layer not less than 24 inches in adjacent rows.
      b. Install with long joints continuous and with end joints staggered not less than 12 inches in adjacent rows.
      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.
      f. Trim insulation so that water flow is unrestricted.
      g. Fill gaps exceeding 1/4 inch with insulation.
      h. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
      i. Loosely lay each layer of insulation units over substrate.
      j. Adhere each layer of insulation to substrate using adhesive in accordance with SPRI's Directory of Roof Assemblies listed roof assembly requirements for specified Wind Uplift Load Capacity and FM Global Property Loss Prevention Data Sheet 1-29, as follows:
         1) Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F of equiviscous temperature.
         2) Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.

3) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

## 3.6 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 in accordance with SPRI's Directory of Roof Assemblies listed roof assembly requirements for specified Wind Uplift Load Capacity and FM Global Property Loss Prevention Data Sheet 1-29, as follows:
      a. Set cover board in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F of equiviscous temperature.
      b. Set cover board in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
      c. Set cover board in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

B. Install slip sheet over cover board and immediately beneath roof membrane.

## 3.7 INSTALLATION OF ADHERED ROOF MEMBRANE

A. Adhere roof membrane over area to receive roofing in accordance with roofing system manufacturer's written instructions.

B. Unroll roof membrane and allow to relax before installing.

C. Start installation of roofing in presence of roofing system 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. Fabric-Backed Roof Membrane Adhesive: Apply to substrate at rate required by manufacturer, and install fabric-backed roof membrane.

G. In addition to adhering, mechanically fasten roof membrane securely at terminations, penetrations, and perimeter of roofing.

H. Apply roof membrane with side laps shingled with slope of roof deck where possible.

I. 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.
   3. 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.

## 3.8 INSTALLATION OF BASE FLASHING

A. Install sheet flashings and preformed flashing accessories, and adhere to substrates in accordance with 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.

## 3.9 INSTALLATION OF WALKWAYS

A. Flexible Walkways: Install walkway products in accordance with 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. Locations indicated on Drawings.
      g. 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 in accordance with roofing system manufacturer's written instructions.

## 3.10 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to inspect substrate conditions, surface preparation, roof membrane application, sheet flashings, protection, and drainage components, and to furnish reports to Architect.

B. Final Roof Inspection: Arrange for roofing system 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 system 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.

## 3.11 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing, inspect roofing system 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 system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and in accordance with warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

**END OF SECTION**

# SECTION 07 62 00

# SHEET METAL FLASHING AND TRIM

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Low-slope roof sheet metal fabrications.

### 1.2 COORDINATION

A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.

B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

### 1.3 ACTION SUBMITTALS

A. Shop Drawings: For sheet metal flashing and trim.
   1. Include plans, elevations, sections, and attachment details.
   2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled Work.
   3. Include identification of material, thickness, weight, and finish for each item and location in Project.
   4. Include details for forming, including profiles, shapes, seams, and dimensions.
   5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
   6. Include details of termination points and assemblies.
   7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
   8. Include details of roof-penetration flashing.
   9. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, flashings, and counterflashings.
   10. Include details of special conditions.
   11. Include details of connections to adjoining work.

B. Samples: For each exposed product and for each color and texture specified, 12 inches long by actual width.

## 1.4 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For copings and roof edge flashing, from ICC-ES showing compliance with ANSI/SPRI/FM 4435/ES-1.

## 1.5 CLOSEOUT SUBMITTALS

## 1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.
   1. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
   2. Protect stored sheet metal flashing and trim from contact with water.

B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

## 1.7 WARRANTY

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

# PART 2 PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

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

B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual: Architectural Metal Flashing, Condensation and Air Leakage Control, and Reroofing" and SMACNA's "Architectural Sheet Metal Manual" requirements for

dimensions and profiles shown unless more stringent requirements are indicated.

C. SPRI Wind Design Standard: Manufacture and install copings and roof edge flashings tested in accordance with ANSI/SPRI/FM 4435/ES-1 and capable of resisting the following design pressure:
   1. Design Pressure: As 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. Exposed Coil-Coated Finish:
      a. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
   2. Color: As selected by Architect from manufacturer's full range.
   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 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 for each application and metal.
   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.

B. Fabrication Tolerances:
   1. Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
   2. Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified.

C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
   1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
   2. Use lapped expansion joints only where indicated on Drawings.

D. 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.

E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

F. 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.

G. Seams:
   1. Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
   2. 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.
   3. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints where necessary for strength.

H. Do not use graphite pencils to mark metal surfaces.

## 2.4 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Base Flashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:
   1. Aluminum: 0.040 inch thick.

B. Counterflashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:
   1. Aluminum: 0.032 inch thick.

## PART 3 EXECUTION

### 3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.
   1. Verify compliance with requirements for installation tolerances of substrates.
   2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
   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, 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 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. Install continuous cleats with fasteners spaced not more than 12 inches o.c.
   6. Space individual cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
   7. Install exposed sheet metal flashing and trim with limited oil-canning, and free of buckling and tool marks.
   8. Do not field cut sheet metal flashing and trim by torch.
   9. 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 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.
   2. Prepare joints and apply sealants to comply with requirements in Section 07 92 00 "Joint Sealants."

G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter.
   1. Pretin edges of sheets with solder to width of 1-1/2 inches; however, reduce pretinning where pretinned surface would show in completed Work.
   2. Do not solder aluminum sheet.
   3. Do not use torches for soldering.
   4. Heat surfaces to receive solder, and flow solder into joint.
      a. Fill joint completely.
      b. Completely remove flux and spatter from exposed surfaces.
   5. Copper Soldering: Tin edges of uncoated sheets, using solder for copper.

H. Rivets: Rivet joints in uncoated aluminum where necessary for strength.

## 3.3 INSTALLATION OF ROOF FLASHINGS

A. Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard.
   1. Provide concealed fasteners where possible, and set units true to line, levels, and slopes.
   2. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

B. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches over

base flashing. Install stainless steel draw band and tighten.

C. Counterflashing: Coordinate installation of counterflashing with installation of base flashing.
   1. Insert counterflashing in reglets or receivers and fit tightly to base flashing.
   2. Extend counterflashing 4 inches over base flashing.
   3. Lap counterflashing joints minimum of 4 inches.
   4. Secure in waterproof manner by means of interlocking folded seam or blind rivets and sealant unless otherwise indicated.

## 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 and neutralize flux materials. Clean off excess solder.

C. 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**

# SECTION 07 72 00

# ROOF ACCESSORIES

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Roof hatches.

### 1.2 COORDINATION

A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.

B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of roof accessory.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For roof accessories.
   1. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and special conditions. Distinguish between plant- and field-assembled work.

C. Samples: For each exposed product and for each color and texture specified, prepared on Samples of size to adequately show color.

### 1.4 INFORMATIONAL SUBMITTALS

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

### 1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For roof accessories to include in operation and maintenance manuals.

### 1.6 WARRANTY

A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finishes or replace roof accessories that show evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Finish Warranty Period: 20 years from date of Substantial Completion.

## PART 2 PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Roof accessories to 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.

### 2.2 ROOF HATCHES

A. Roof Hatches: Metal roof-hatch units with lids and insulated single -walled curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, straight sides, and integrally formed deck-mounting flange at perimeter bottom.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ACUDOR Products, Inc.
      b. BILCO Company (The).
      c. JL Industries; Activar Construction Products Group, Inc.
      d. Milcor by Duravent; Duravent Group.
      e. O'Keeffe's Inc.

B. Type and Size:
   1. Single-leaf lid, Refer to Drawings.

C. Loads: Minimum 40-lbf/sq. ft. external live load and 20-lbf/sq. ft. internal uplift load.

D. Hatch Material, Steel: Zinc-coated (galvanized) steel sheet.
   1. Thickness: Manufacturer's standard thickness for hatch size indicated.
   2. Finish: Two-coat fluoropolymer.
   3. Color: As selected by Architect from manufacturer's full range.

E. Construction:
   1. Insulation: 2-inch- thick, polyisocyanurate board.
      a. R-Value: 12.0 according to ASTM C1363.
   2. Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
   3. Fabricate curbs to minimum height of 12 inches above roofing surface unless otherwise indicated.

F. Hardware: Spring operators, hold-open arm, stainless steel spring latch with turn handles, stainless steel butt- or pintle-type hinge system, and padlock hasps inside and outside.

G. Safety Railing System: Roof-hatch manufacturer's standard system including rails, clamps, fasteners, safety barrier at railing opening, and accessories required for a complete installation; attached to roof hatch and complying with 29 CFR 1910.23 requirements and authorities having jurisdiction.
   1. Height: 42 inches above finished roof deck.
   2. Posts and Rails: Galvanized-steel pipe, 1-1/4 inches in diameter or galvanized-steel tube, 1-5/8 inches in diameter.
   3. Flat Bar: Galvanized steel, 2 inches high by 3/8 inch thick.
   4. Maximum Opening Size: System constructed to prevent passage of a sphere 21 inches in diameter.
   5. Chain Passway Barrier: Galvanized proof coil chain with quick link on fixed end.
   6. Self-Latching Gate: Fabricated of same materials and rail spacing as safety railing system. Provide manufacturer's standard hinges and self-latching mechanism.
   7. Post and Rail Tops and Ends: Weather resistant, closed or plugged with prefabricated end fittings.
   8. Provide weep holes or another means to drain entrapped water in hollow sections of handrail and railing members.
   9. Fabricate joints exposed to weather to be watertight.
   10. Fasteners: Manufacturer's standard, finished to match railing system.
   11. Finish: Manufacturer's standard.
      a. Color: As selected by Architect from manufacturer's full range.

H. Ladder-Assist Post: Roof-hatch manufacturer's standard device for attachment to roof-access ladder.
   1. Operation: Post locks in place on full extension; release mechanism returns post to closed position.
   2. Height: 42 inches above finished roof deck.
   3. Material: Steel tube.
   4. Post: 1-5/8-inch- diameter pipe.
   5. Finish: Manufacturer's standard baked enamel or powder coat.
      a. Color: As selected by Architect from manufacturer's full range.

## 2.3 METAL MATERIALS

A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653/A653M, G90 coating designation.
   1. Exposed Coil-Coated Finish: Prepainted by the coil-coating process to comply with ASTM A755/A755M. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
      a. Two-Coat Fluoropolymer Finish: AAMA 621. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight.

B. Stainless Steel Sheet and Shapes: ASTM A240/A240M or ASTM A666, Type 304.

C. Steel Shapes: ASTM A36/A36M, hot-dip galvanized according to ASTM A123/A123M unless otherwise indicated.

D. Steel Tube: ASTM A500/A500M, round tube.

E. Galvanized-Steel Tube: ASTM A500/A500M, round tube, hot-dip galvanized according to ASTM A123/A123M.

F. Steel Pipe: ASTM A53/A53M, galvanized.

## 2.4 MISCELLANEOUS MATERIALS

A. Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.

B. Polyisocyanurate Board Insulation: ASTM C1289, thickness and thermal resistivity as indicated.

C. Underlayment:
1. Felt: ASTM D226/D226M, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
2. Polyethylene Sheet: 6-mil- thick polyethylene sheet complying with ASTM D4397.
3. Slip Sheet: Building paper, 3 lb/100 sq. ft. minimum, rosin sized.
4. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.

D. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:
1. Fasteners for Zinc-Coated or Aluminum-Zinc Alloy-Coated Steel: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A153/A153M or ASTM F2329.
2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
3. Fasteners for Stainless Steel Sheet: Series 300 stainless steel.

E. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.

F. Elastomeric Sealant: ASTM C920, elastomeric silicone polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.

G. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for expansion joints with limited movement.

H. Asphalt Roofing Cement: ASTM D4586/D4586M, asbestos free, of consistency required for application.

## 2.5 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

# 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. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

C. Verify dimensions of roof openings for roof accessories.

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

## 3.2 INSTALLATION

A. Install roof accessories according to manufacturer's written instructions.
   1. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
   2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
   3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
   4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.

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. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of underlayment and cover with manufacturer's recommended slip sheet.
   2. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof accessories for waterproof performance.

C. Roof-Hatch Installation:
   1. Verify that roof hatch operates properly. Clean, lubricate, and adjust operating mechanism and hardware.
   2. Attach safety railing system to roof-hatch curb.
   3. Attach ladder-assist post according to manufacturer's written instructions.

D. Seal joints with elastomeric or butyl sealant as required by roof accessory manufacturer.

## 3.3 REPAIR AND CLEANING

A. Touch up factory-primed surfaces with compatible primer ready for field painting according to Section 09 91 13 "Exterior Painting."

B. Clean exposed surfaces according to manufacturer's written instructions.

C. Clean off excess sealants.

D. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

**END OF SECTION**

# SECTION 07 81 00

# APPLIED FIRE PROTECTION

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Sprayed fire-resistive materials.

### 1.2 DEFINITIONS

A. SFRM: Sprayed fire-resistive materials.

### 1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
   1. Review products, design ratings, restrained and unrestrained conditions, densities, thicknesses, bond strengths, and other performance requirements.

### 1.4 ACTION SUBMITTALS

A. Product Data:
   1. Sprayed fire-resistive materials.
   2. Substrate primers.
   3. Bonding agent.
   4. Sealer.

B. Shop Drawings: Framing plans or schedules, or both, indicating the following:
   1. Extent of fire protection for each construction and fire-resistance rating.
   2. Applicable fire-resistance design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.
   3. Minimum sprayed fire-resistive material thicknesses needed to achieve required fire-resistance rating of each structural component and assembly.
   4. Treatment of sprayed fire-resistive material after application.

### 1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For each type of sprayed fire-resistive material.

C. Evaluation Reports: For sprayed fire-resistive material, from ICC-ES.

D. Field quality-control reports.

## 1.6 QUALITY ASSURANCE

A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by sprayed fire-resistive material manufacturer as experienced and with sufficient trained staff to install manufacturer's products in accordance with specified requirements.

## 1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not apply fire protection when ambient or substrate temperature is 44 deg F or lower unless temporary protection and heat are provided to maintain temperature at or above this level for 24 hours before, during, and for 24 hours after product application.

B. Ventilation: Ventilate building spaces during and after application of fire protection, providing complete air exchanges in accordance with manufacturer's written instructions. Use natural means or, if they are inadequate, forced-air circulation until fire protection dries thoroughly.

# PART 2 PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

A. Assemblies: Provide fire protection, including auxiliary materials, in accordance with requirements of each fire-resistance design and manufacturer's written instructions.

B. Source Limitations: Obtain fire protection for each fire-resistance design from single source.

## 2.2 SPRAYED FIRE-RESISTIVE MATERIALS

A. Sprayed Fire-Resistive Material: Manufacturer's standard, factory-mixed, lightweight, dry formulation, complying with indicated fire-resistance design, and mixed with water at Project site to form a slurry or mortar before conveyance and application.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Carboline Company; a subsidiary of RPM International.
      b. GCP Applied Technologies Inc.
      c. Isolatek International.
   2. Application: Designated for exterior use by a qualified testing agency acceptable to authorities having jurisdiction.
   3. Thickness: As required for fire-resistance design indicated, measured in

accordance with requirements of fire-resistance design or ASTM E605, whichever is thicker, but not less than 0.375 inch.

4. Combustion Characteristics: ASTM E136.
5. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   a. Flame-Spread Index: 10 or less.
   b. Smoke-Developed Index: 10 or less.
6. Corrosion Resistance: No evidence of corrosion in accordance with ASTM E937.
7. Deflection: No cracking, spalling, or delamination in accordance with ASTM E759.
8. Fungal Resistance: Treat products with manufacturer's standard antimicrobial formulation to result in no growth on specimens per ASTM G21 or rating of 10 in accordance with ASTM D3274 when tested in accordance with ASTM D3273.

## PART 3 EXECUTION

### 3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrates and other conditions affecting performance of the Work and in accordance with each fire-resistance design.
   1. Verify that substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible primers, paints, and encapsulants, or other foreign substances capable of impairing bond of fire protection with substrates under conditions of normal use or fire exposure.
   2. Verify that objects penetrating fire protection, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
   3. Verify that substrates receiving fire protection are not obstructed by ducts, piping, equipment, or other suspended construction that will interfere with fire protection application.

B. Verify that concrete work on steel deck is complete before beginning Work.

C. Verify that roof construction, installation of rooftop HVAC equipment, and other related work are complete before beginning Work.

D. Conduct tests in accordance with sprayed fire-resistive material manufacturer's written instructions to verify that substrates are free of substances capable of interfering with bond.

E. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

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

## 3.2 PREPARATION

A. Cover other work subject to damage from fallout or overspray of fire protection materials during application.

B. Clean substrates of substances that could impair bond of fire protection.

C. Prime substrates where included in fire-resistance design and where recommended in writing by sprayed fire-resistive material manufacturer unless compatible shop primer has been applied and is in satisfactory condition to receive fire protection.

D. For applications visible on completion of Project, repair substrates to remove surface imperfections that could affect uniformity of texture and thickness in finished surface of fire protection. Remove minor projections and fill voids that would telegraph through fire-resistive products after application.

## 3.3 APPLICATION

A. Construct fire protection assemblies that are identical to fire-resistance design indicated and products as specified, tested, and substantiated by test reports; for thickness, primers, sealers, topcoats, finishing, and other materials and procedures affecting fire protection Work.

B. Comply with sprayed fire-resistive material manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and apply fire protection; as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.

C. Coordinate application of fire protection with other construction to minimize need to cut or remove fire protection.
   1. Do not begin applying fire protection until clips, hangers, supports, sleeves, and other items penetrating fire protection are in place.
   2. Defer installing ducts, piping, and other items that would interfere with applying fire protection until application of fire protection is completed.

D. Metal Decks:
   1. Do not apply fire protection to underside of metal deck substrates until concrete topping, if any, is completed.
   2. Do not apply fire protection to underside of metal roof deck until roofing is completed; prohibit roof traffic during application and drying of fire protection.

E. Install auxiliary materials as required, as detailed, and in accordance with fire-resistance design and sprayed fire-resistive material manufacturer's written instructions for conditions of exposure and intended use. For auxiliary materials, use attachment and anchorage devices of type recommended in writing by sprayed fire-resistive material manufacturer.

F. Spray apply fire protection to maximum extent possible. After the spraying operation in each area, complete the coverage by trowel application or other placement method

recommended in writing by sprayed fire-resistive material manufacturer.

G. Extend fire protection in full thickness over entire area of each substrate to be protected.

H. Install body of fire protection in a single course unless otherwise recommended in writing by sprayed fire-resistive material manufacturer.

I. For applications over encapsulant materials, including lockdown (post-removal) encapsulants, apply fire protection that differs in color from that of encapsulant over which it is applied.

J. Where sealers are used, apply products that are tinted to differentiate them from fire protection over which they are applied.

K. Provide a uniform finish complying with description indicated for each type of fire protection material and matching finish approved for required mockups.

L. Cure fire protection in accordance with sprayed fire-resistive material manufacturer's written instructions.

M. Do not install enclosing or concealing construction until after fire protection has been applied, inspected, and tested and corrections have been made to deficient applications.

## 3.4 FIELD QUALITY CONTROL

A. Perform the tests and inspections of completed Work in successive stages. Do not proceed with application of fire protection for the next area until test results for previously completed applications of fire protection show compliance with requirements. Tested values must equal or exceed values as specified and as indicated and required for approved fire-resistance design.

B. Fire protection will be considered defective if it does not pass tests and inspections.
   1. Remove and replace fire protection that does not pass tests and inspections, and retest.
   2. Apply additional fire protection, in accordance with manufacturer's written instructions, where test results indicate insufficient thickness, and retest.

C. Prepare test and inspection reports.

## 3.5 CLEANING

A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.

## 3.6 PROTECTION

A. Protect fire protection, according to advice of manufacturer and Installer, from damage resulting from construction operations or other causes, so fire protection is without damage or deterioration at time of Substantial Completion.

## 3.7 REPAIRS

A. As installation of other construction proceeds, inspect fire protection and repair damaged areas and fire protection removed due to work of other trades.

B. Repair fire protection damaged by other work before concealing it with other construction.

C. Repair fire protection by reapplying it using same method as original installation or using manufacturer's recommended trowel-applied product.

**END OF SECTION**

# SECTION 07 84 13

# PENETRATION FIRESTOPPING

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes: Penetration firestopping systems.

### 1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

### 1.3 ACTION SUBMITTALS

A. Product Data: Penetration firestopping systems.

B. Product Schedule: For each penetration 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 penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly developed in accordance with current International Firestop Council (IFC) guidelines. Obtain approval of authorities having jurisdiction prior to submittal.

### 1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Listed System Designs: For each penetration firestopping system, for tests performed by a qualified testing agency.

### 1.5 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

## 1.6 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Approvals according to FM Approvals 4991, "Approval Standard for Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

## 1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.

B. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

## 1.8 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.

# PART 2 PRODUCTS

## 2.1 SOURCE LIMITATIONS

A. Obtain penetration firestop systems for each type of opening indicated from single manufacturer.

## 2.2 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 are to be compatible with one another, with the substrates forming openings, and with penetrating items if any.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Hilti, Inc.
      b. Specified Technologies Inc.

B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined in accordance with ASTM E814 or UL 1479.
   1. F-Rating: Not less than the fire-resistance rating of the wall penetrated.
   2. Membrane Penetrations: Install recessed fixtures such that the required fire resistance will not be reduced.

C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined in accordance with ASTM E814 or UL 1479.
   1. F-Rating: At least one hour, but not less than the fire-resistance rating of the floor penetrated.
   2. T-Rating: At least one hour, but not less than the fire-resistance rating of the floor. The following floor penetrations do not require a T-rating:
      a. Those within the cavity of a wall.
      b. Floor, tub, or shower drains within a concealed space.
      c. 4-inch or smaller metal conduit penetrating directly into metal-enclosed electrical switchgear.
   3. W-Rating: Provide penetration firestopping systems with a Class 1 W-rating in accordance with UL 1479.

D. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined in accordance with UL 1479.
   1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening and no more than 50-cfm cumulative total for any 100 sq. ft. at both ambient and elevated temperatures.

E. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, in accordance with ASTM E84.

F. Accessories: 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.

## 2.3 FILL MATERIALS

A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors 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 strips for use around combustible penetrants.

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: Compressible, removable, and reusable intumescent pillows encased in fire-retardant polyester or glass-fiber cloth. 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.

K. Fire-Rated Cable Sleeve Kits: Complete kits designed for new or existing cable penetrations through walls to accept standard accessories.

L. Thermal Wrap: Flexible protective wrap tested and listed for up to 2-hour fire ratings in accordance with ASTM E814 or UL 1479 for membrane penetrations or ASTM E1725 or UL 1724 for thermal barrier and circuit integrity protection.

M. Fire-Rated Cable Pathways: Single or gangable device modules composed of a steel raceway with integral intumescent material and requiring no additional action in the form of plugs, twisting closure, putty, pillows, sealant, or otherwise to achieve fire and air-leakage ratings.

N. Retrofit Device for Cable Bundles: Factory-made, intumescent, collar-like device for firestopping existing over-filled cable sleeves and capable of being installed around projecting sleeves and cable bundles.

O. Wall-Opening Protective Materials: Intumescent, non-curing putty pads or self-adhesive inserts for protection of electrical switch and receptacle boxes.

P. Fire-Rated HVAC Retaining Angles: Steel angle system with integral intumescent firestop gasket for use around rectangular steel HVAC ducts without fire dampers.

Q. Firestop Plugs: Flexible, re-enterable, intumescent, foam-rubber plug for use in blank round openings and cable sleeves.

R. Fire-Rated Cable Grommet: Molded two-piece grommet made of plenum-grade polymer and foam inner core for sealing small cable penetrations in gypsum walls up to 1/2 inch in diameter.

S. Closet Flange Gasket: Molded, single-component, flexible, intumescent gasket for use beneath a water closet (toilet) flange in floor applications.

T. Endothermic Wrap: Flexible, insulating, fire-resistant, endothermic wrap for protecting membrane penetrations of utility boxes, critical electrical circuits, communications lines, and fuel lines.

## 2.4 MIXING

A. Penetration Firestopping Materials: For those products requiring mixing before application, comply with penetration 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 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 firestopping systems, clean out openings immediately to comply with manufacturer's written instructions and with the following requirements:
   1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping materials.
   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. Remove laitance and form-release agents from concrete.

B. Prime substrates where recommended in writing by 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 OF PENETRATION FIRESTOPPING SYSTEMS

A. General: Install penetration 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. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
   2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
   3. For 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.

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.

## 3.5 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that penetration 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 firestopping material and install new materials to produce systems complying with specified requirements.

**END OF SECTION**

# SECTION 07 84 43

# JOINT FIRESTOPPING

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Joints in or between fire-resistance-rated construction.
   2. Joints at exterior curtain-wall/floor intersections.
   3. Joints in smoke barriers.

### 1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

### 1.3 ACTION SUBMITTALS

A. Product Data:
   1. Joints in or between fire-resistance-rated construction.
   2. Joints at exterior curtain-wall/floor intersections.
   3. Joints in smoke barriers.

B. Product Schedule: For each joint firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing agency.
   1. Engineering Judgments: Where Project conditions require modification to a qualified testing agency's illustration for a particular joint firestopping system condition, submit illustration, with modifications marked, approved by joint firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly developed in accordance with current International Firestop Council (IFC) guidelines.

### 1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Listed System Designs: For each joint firestopping system, for tests performed by a qualified testing agency.

## 1.5 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that joint firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

## 1.6 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Approvals according to FM Approvals 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements."

## 1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install joint firestopping systems when ambient or substrate temperatures are outside limits permitted by joint firestopping system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Install and cure joint firestopping systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

## 1.8 COORDINATION

A. Coordinate construction of joints to ensure that joint firestopping systems can be installed according to specified firestopping system design.

B. Coordinate sizing of joints to accommodate joint firestopping systems.

# PART 2 PRODUCTS

## 2.1 SOURCE LIMITATIONS

A. Obtain joint firestop systems for each type of joint opening indicated from single manufacturer.

## 2.2 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:
   1. Perform joint firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
   2. Test per testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:
      a. Joint firestop systems installed with products bearing the classification

marking of a qualified product certification agency in accordance with Listed System Designs published by a qualified testing agency.
1) UL in its online directory "Product iQ."
2) Intertek Group in its "Directory of Building Products."

B. Rain/Water Resistance: For perimeter fire-barrier system applications, where inclement weather or greater-than-transient water exposure is expected, use products that dry rapidly and cure in the presence of atmospheric moisture sufficient to pass ASTM D6904 early rain-resistance test (24-hour exposure).

## 2.3 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 must accommodate building movements without impairing their ability to resist the passage of fire and hot gases.
1. Joint firestopping systems that are compatible with one another, with the substrates forming openings, and with penetrating items, if any.
2. Provide products that, upon curing, do not re-emulsify, dissolve, leach, breakdown, or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture.
3. Provide firestop products that do not contain ethylene glycol.

B. Intumescent Gypsum Wall Framing Gaskets (Applied to Steel Tracks, Runners, and Studs prior to Framing Installation): Provide products with fire, smoke, and acoustical ratings that allow movement up to 100 percent compression and/or extension in accordance with UL 2079 or ASTM E1966; have an L Rating less than 1 cfm/ft. in accordance with UL 2079; and a minimum Sound Transmission Class (STC) rating of 56 in accordance with ASTM E90 or ASTM C919.

C. For aluminum curtain-wall assemblies with one- or two-piece rectangular mullions at least 2-1/2 by 5 inches, provide perimeter fire-barrier system that does not require direct screw attachment to mullions and transoms to support and fasten curtain-wall insulation. System to be tested in accordance with ASTM E2307 for up to 2-hour fire resistance and with ASTM E1233 for wind cycling equivalent to 108 mph wind for 500 cycles.

D. 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.

E. Joints at Exterior Curtain-Wall/Floor Intersections: Provide joint firestopping systems with rating determined per ASTM E2307.
1. F-Rating: Equal to or exceeding the fire-resistance rating of the floor assembly.

F. 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.

G. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E84.

## 2.4 ACCESSORIES

A. 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.

# PART 3 EXECUTION

## 3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, 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 joint firestopping systems, clean joints immediately to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:
   1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of elastomeric fill materials or compromise fire-resistive rating.
   2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with elastomeric fill materials. Remove loose particles remaining from cleaning operation.
   3. Remove laitance and form-release agents from concrete.

B. Prime substrates where recommended in writing by joint 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.

C. Apply a suitable bond-breaker to prevent three-sided adhesion in applications where this condition occurs, such as the intersection of a gypsum wall to floor or roof assembly where the joint is backed by a steel ceiling runner or track.

## 3.3 INSTALLATION

A. General: Install joint firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming materials and other accessories of types required to support elastomeric fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
   1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.

C. Install elastomeric fill materials for joint firestopping systems by proven techniques to produce the following results:
   1. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
   2. 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 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 ft. from end of wall and at intervals not exceeding 30 ft.

B. 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 in

accordance with ASTM E2393.

B. Where deficiencies are found or joint firestopping systems are damaged or removed due to testing, repair or replace joint firestopping systems so they comply with requirements.

C. Proceed with enclosing 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 elastomeric fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by joint firestopping system manufacturers and that do not damage materials in which joints occur.

B. Provide final protection and maintain conditions during and after installation that ensure joint firestopping systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated joint firestopping systems immediately and install new materials to produce joint firestopping systems complying with specified requirements.

**END OF SECTION**

# SECTION 07 92 00

# JOINT SEALANTS

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Silicone joint sealants.
   2. Mildew-resistant joint sealants.
   3. Latex joint sealants.

### 1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

### 1.3 ACTION SUBMITTALS

A. Product Data:
   1. Silicone joint sealants.
   2. Mildew-resistant joint sealants.
   3. Latex joint sealants.

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

C. 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. Sample warranties.

## 1.5 CLOSEOUT SUBMITTALS

A. Manufacturers' special warranties.

B. Installer's special warranties.

## 1.6 QUALITY ASSURANCE

A. Installer Qualifications: Authorized representative who is trained and approved by manufacturer.

B. Testing Agency Qualifications: Qualified in accordance with ASTM C1021 to conduct the testing indicated.

## 1.7 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.
   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.

## 1.8 WARRANTY

A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. Warranty Period: Five years from date of Substantial Completion.

# PART 2 PRODUCTS

## 2.1 SOURCE LIMITATIONS

A. Obtain joint sealants from single manufacturer for each sealant type.

## 2.2 JOINT SEALANTS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

## 2.3 SILICONE JOINT SEALANTS

A. Silicone, S, NS, 100/50, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Use NT.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. GE Construction Sealants; Momentive Performance Materials Inc.
      b. Sika Corporation - Building Components.

B. Silicone, S, NS, 50, NT: Single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 50, Use NT.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. GE Construction Sealants; Momentive Performance Materials Inc.
      b. Pecora Corporation.
      c. Sika Corporation - Building Components.
      d. The Dow Chemical Company.

## 2.4 MILDEW-RESISTANT JOINT SEALANTS

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

B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. GE Construction Sealants; Momentive Performance Materials Inc.
      b. Pecora Corporation.
      c. Sika Corporation - Building Components.
      d. Tremco Incorporated.

## 2.5 BUTYL JOINT SEALANTS

A. Butyl-Rubber-Based Joint Sealants: ASTM C1311.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Bostik; Arkema.
      b. Pecora Corporation.
      c. Sika Corporation - Building Components.

## 2.6 LATEX JOINT SEALANTS

A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Pecora Corporation.
      b. Sherwin-Williams Company (The).
      c. Tremco Incorporated.

## 2.7 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.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Adfast.
      b. Alcot Plastics Ltd.
      c. Construction Foam Products; a division of Nomaco, Inc.

B. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin) Type O (open-cell material) Type B (bicellular material with a surface skin) or any of the preceding types, 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.

## 2.8 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

## PART 3 EXECUTION

### 3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.

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

### 3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
   1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
   2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
      a. Concrete.
      b. Masonry.
   3. Remove laitance and form-release agents from concrete.
   4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
      a. Metal.
      b. Glass.

### 3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
   1. Do not leave gaps between ends of sealant backings.
   2. Do not stretch, twist, puncture, or tear sealant backings.
   3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
   1. Place sealants so they directly contact and fully wet joint substrates.
   2. Completely fill recesses in each joint configuration.
   3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants in accordance with requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
   1. Remove excess sealant from surfaces adjacent to joints.
   2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
   3. Provide concave joint profile in accordance with Figure 8A in ASTM C1193 unless otherwise indicated.

## 3.4 CLEANING

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

## 3.5 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

**END OF SECTION**

# SECTION 07 92 19

# ACOUSTICAL JOINT SEALANTS

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Acoustical joint sealants.

### 1.2 ACTION SUBMITTALS

A. Product Data:
   1. Acoustical joint sealants.

B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants, showing full range of available colors for each product exposed to view.

C. Acoustical 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.

### 1.3 INFORMATIONAL SUBMITTALS

A. Test and Evaluation Reports:
   1. Product Test Reports: For each type of acoustical joint sealant, for tests performed by manufacturer and witnessed by a qualified testing agency.

B. Sample warranties.

### 1.4 CLOSEOUT SUBMITTALS

A. Warranty Documentation:
   1. Manufacturers' special warranties.
   2. Installer's special warranties.

### 1.5 WARRANTY

A. Installer's Special Warranty: Installer agrees to repair or replace acoustical joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. Warranty Period: Two years from date of Substantial Completion.

B. Manufacturer's Special Warranty: Manufacturer agrees to furnish acoustical joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. Warranty Period: Two years from date of Substantial Completion.

## PART 2 PRODUCTS

### 2.1 ACOUSTICAL JOINT SEALANTS

A. Acoustical joint-sealant products that effectively reduce airborne sound transmission through perimeter joints and openings in building construction, as demonstrated by testing representative assemblies in accordance with ASTM E90.

B. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex acoustical sealant complying with ASTM C834.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Hilti, Inc.
      b. Pecora Corporation.
      c. Specified Technologies Inc.
      d. USG Corporation.
   2. Colors of Exposed Acoustical Joint Sealants: As selected by Architect from manufacturer's full range of colors.

C. Acoustical Sealant for Concealed Joints: Manufacturer's standard nonsag, nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber acoustical sealant.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Pecora Corporation.
      b. Tremco Incorporated.
      c. USG Corporation.

### 2.2 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by acoustical joint-sealant manufacturer where required for adhesion of sealant to joint substrates.

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 acoustical 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 acoustical joint sealants to comply with joint-sealant manufacturer's written instructions.

B. Joint Priming: Prime joint substrates where recommended by acoustical joint-sealant manufacturer. 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 ACOUSTICAL JOINT SEALANTS

A. Comply with acoustical joint-sealant manufacturer's written installation instructions unless more stringent requirements apply.

B. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical joint sealant. Install acoustical joint sealants at both faces of partitions, at perimeters, and through penetrations. Comply with ASTM C919, ASTM C1193, and manufacturer's written instructions for closing off sound-flanking paths around or through assemblies, including sealing partitions to underside of floor slabs above acoustical ceilings.

C. Acoustical Ceiling Areas: Apply acoustical joint sealant at perimeter edge moldings of acoustical ceiling areas in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.

## 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 acoustical joint sealants and of products in which joints occur.

## 3.5 PROTECTION

A. Protect acoustical 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 acoustical joint sealants immediately so installations with repaired areas are indistinguishable from original work.

**END OF SECTION**

# SECTION 08 11 13

# HOLLOW METAL DOORS AND FRAMES

## PART 1 GENERAL

### 1.1 SUMMARY

A. Principal Products:

B. Section Includes:
1. Interior standard steel doors and frames.
2. Exterior standard steel doors and frames.

### 1.2 DEFINITIONS

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

### 1.3 COORDINATION

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

B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

### 1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

### 1.5 ACTION SUBMITTALS

A. Product Data:
1. Interior standard steel doors and frames.
2. Exterior standard steel doors and frames.

B. Product Data Submittals: For each product.
1. Include construction details, material descriptions, core descriptions, and finishes.

C. Shop Drawings: Include the following:
   1. Elevations of each door type.
   2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
   3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
   4. Locations of reinforcement and preparations for hardware.
   5. Details of each different wall opening condition.
   6. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
   7. Details of anchorages, joints, field splices, and connections.
   8. Details of accessories.
   9. Details of moldings, removable stops, and glazing.

## 1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
   1. Provide additional protection to prevent damage to factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch- high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

# PART 2 PRODUCTS

## 2.1 HOLLOW METAL DOORS AND FRAMES

A. HYPERLINK "http://www.specagent.com/LookUp/?ulid=5745&mf=04&src=wd" Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Ceco Door; AADG, Inc.; ASSA ABLOY.
   2. Curries, AADG, Inc.; ASSA ABLOY Group.
   3. Republic Doors and Frames; an Allegion brand.
   4. Steelcraft; Allegion plc.

## 2.2 INTERIOR STANDARD STEEL DOORS AND FRAMES

A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Extra-Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 3; ANSI/SDI A250.4, Level A.
   1. Doors:
      a. Type: As indicated in the Door and Frame Schedule on Drawings.
      b. Thickness: 1-3/4 inches.
      c. Face: Uncoated steel sheet, minimum thickness of 0.053 inch.
      d. Edge Construction: Model 1, Full Flush.
      e. Edge Bevel: Provide manufacturer's standard beveled or square edges.
      f. Core: Manufacturer's standard.
   2. Frames:
      a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch.
      b. Construction: Full profile welded.
   3. Exposed Finish: Prime.

## 2.3 EXTERIOR STANDARD STEEL DOORS AND FRAMES

A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Extra-Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 3; ANSI/SDI A250.4, Level A.
   1. Doors:
      a. Type: As indicated in the Door and Frame Schedule on Drawings.
      b. Thickness: 1-3/4 inches.
      c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum G90 coating.
      d. Edge Construction: Model 1, Full Flush.
      e. Edge Bevel: Provide manufacturer's standard beveled or square edges.
      f. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
      g. Bottom Edges: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
      h. Core: Polyisocyanurate.
   2. Frames:
      a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum G90 coating.
      b. Construction: Face welded.
      c. Electrical Box: At exterior doors, provide electrical boxes at top of each side of frame. Electrical boxes shall be integral with door frame and have a cover.

Install 1/2-inch conduit in frames prior to frames being grouted. Coordinate requirements with Division 26 Electrical Sections. Electrical box and conduit shall be used for future installation of electronic/electric hardware.

d. Electric Power Transfer Back Box: At exterior doors, provide one electrical power transfer box on each side of the frame. Coordinate location of box and location of hinges specified in door hardware specifications for future installation of electronic/electric hardware.

3. Exposed Finish: Prime.

## 2.4 FRAME ANCHORS

A. 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 underlayment.

B. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized in accordance with ASTM A153/A153M, Class B.

## 2.5 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.

C. Inserts, Bolts, and Fasteners: Hot-dip galvanized in accordance with ASTM A153/A153M.

D. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

E. 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.

## 2.6 FABRICATION

A. Door Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.

B. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.
   1. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
   2. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
      a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
      b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

C. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping in accordance with ANSI/SDI A250.6, the Door Hardware Schedule on Drawings, and templates.
   1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
   2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.

## 2.7 STEEL FINISHES

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

# PART 3 EXECUTION

## 3.1 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.

B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

## 3.2 INSTALLATION

A. Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.

B. Hollow-Metal Frames: Comply with ANSI/SDI A250.11.
   1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.
      a. 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.
   2. Floor Anchors: Secure with postinstalled expansion anchors.
      a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
   3. Solidly pack mineral-fiber insulation inside frames.
   4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.
   5. 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.
   6. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:
      a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
      b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
      c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
      d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.

## 3.3 REPAIR

A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

**END OF SECTION**

# SECTION 08 14 16

# FLUSH WOOD DOORS

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Solid-core five-ply flush wood veneer-faced doors and transom panels for transparent finish.

### 1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

### 1.3 ACTION SUBMITTALS

A. Product Data:
   1. Solid-core five-ply flush wood veneer-faced doors and transom panels for transparent finish.

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 and louver cutouts, and glazing thicknesses.
   3. Details of frame for each frame type, including dimensions and profile.
   4. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
   5. Dimensions and locations of blocking for hardware attachment.
   6. Dimensions and locations of mortises and holes for hardware.
   7. Clearances and undercuts.
   8. Requirements for veneer matching.
   9. 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.
   2. Corner sections of doors, approximately 8 by 10 inches, with door faces and

edges representing actual materials to be used.

## 1.4 CLOSEOUT SUBMITTALS

A. Special warranties.

## 1.5 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 top and bottom rail with opening number used on Shop Drawings.

## 1.6 FIELD CONDITIONS

A. Environmental Limitations:
   1. Do not deliver or install doors until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and HVAC system is operating and maintaining temperature and relative humidity at levels designed for building occupants for the remainder of construction period.
   2. 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 43 and 70 percent during remainder of construction period.

## 1.7 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 also includes 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 FLUSH WOOD DOORS AND FRAMES, GENERAL

A. Quality Standard: In addition to requirements specified, comply with ANSI/WDMA I.S. 1A.
   1. 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.

### 2.2 SOLID-CORE FIVE-PLY FLUSH WOOD VENEER-FACED DOORS AND TRANSOM PANELS FOR TRANSPARENT FINISH

A. Interior Doors, Solid-Core Five-Ply Veneer-Faced :
   1. HYPERLINK "http://www.specagent.com/LookUp/?ulid=13433&mf=04&src=wd" Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Lambton Doors.
      b. Forte Opening Solutions (previously Masonite Architectural).
      c. Oshkosh Door Company.
      d. VT Industries, Inc.
   2. Performance Grade: ANSI/WDMA I.S. 1A Extra Heavy Duty.
   3. ANSI/WDMA I.S. 1A Quality Grade: Custom.
   4. Faces: Single-ply wood veneer not less than 1/50 inch thick.
      a. Species: Select white maple.
      b. Cut: Quarter sliced.
      c. Match between Veneer Leaves: Book match.
      d. Assembly of Veneer Leaves on Door Faces: Running match.
      e. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
   5. Core for Non-Fire-Rated Doors:
      a. ANSI A208.1, Grade LD-1 particleboard.
         1) Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware.
         2) Provide doors with WDMA I.S. 10 structural-composite-lumber cores instead of particleboard cores for doors scheduled to receive exit devices in Section 08 71 00 "Door Hardware."
      b. Glued wood stave.
      c. WDMA I.S. 10 structural composite lumber.
         1) Screw Withdrawal, Door Face: 550 lbf.
         2) Screw Withdrawal, Vertical Door Edge: 550 lbf.
      d. Either glued wood stave or WDMA I.S. 10 structural composite lumber.
   6. 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.

7. Construction: Five plies, hot-pressed bonded (vertical and horizontal edging is bonded to core), with entire unit abrasive planed before veneering.

## 2.3 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.
   5. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.

C. Transom and Side Panels:
   1. Fabricate matching panels with same construction, exposed surfaces, and finish as specified for associated doors.
   2. Finish bottom edges of transoms and top edges of rabbeted doors same as door stiles.
   3. Fabricate door and transom panels with full-width, solid-lumber, rabbeted, meeting rails.
   4. Provide factory-installed spring bolts for concealed attachment into jambs of metal door frames.

D. 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 80 00 "Glazing."
   3. Louvers: Factory install louvers in prepared openings.

## 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 71 00 "Door Hardware."

B. Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.

C. Install frames level, plumb, true, and straight.
   1. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.
   2. Anchor frames to anchors or blocking built in or directly attached to substrates.
      a. Secure with countersunk, concealed fasteners and blind nailing.
      b. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.
         1) For factory-finished items, use filler matching finish of items being installed.
   3. Install fire-rated doors and frames in accordance with NFPA 80.
   4. Install smoke- and draft-control doors in accordance with NFPA 105.

D. Job-Fitted Doors:
   1. Align and fit doors in frames with uniform clearances and bevels as indicated below.
      a. Do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors.
   2. Machine doors for hardware.
   3. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
   4. Clearances:
      a. Provide 1/8 inch at heads, jambs, and between pairs of doors.
      b. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering unless otherwise indicated on Drawings.
      c. Where threshold is shown or scheduled, provide 1/4 inch from bottom of door to top of threshold unless otherwise indicated.
      d. Comply with NFPA 80 for fire-rated doors.
   5. Bevel non-fire-rated doors 1/8 inch in 2 inches at lock and hinge edges.

6. Bevel fire-rated doors 1/8 inch in 2 inches at lock edge; trim stiles and rails only to extent permitted by labeling agency.

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**

# SECTION 08 18 16

# SLIDING GLASS DOORS

## PART 1 GENERAL

### 1.1 SUMMARY

A. Sliding glass panel system.

### 1.2 SUBMITTALS

A. Action Submittals:
   1. Shop Drawings: Illustrate products, installation, and relationship to adjacent construction.
   2. Product Data: Manufacturer's descriptive data and product attributes.
   3. Samples: Minimum 6- by 6-inch glass.
   4. Delegated Design Data: Prepared by qualified Professional Engineer, indicating sliding glass door system seismic restraint requirements.

B. Informational Submittals:
   1. Qualification Statement: For Installer.
   2. Certificate of Compliance: Certification that installed products meet specified design and performance requirements.

C. Closeout Submittals:
   1. Operation and Maintenance Data.
   2. Warranty: Executed copy.

### 1.3 QUALITY ASSURANCE

A. Installer Qualifications: Firm specializing in work of this Section with minimum 2 years' experience.

### 1.4 WARRANTY

A. Manufacturer's two year warranty against faulty operation of operable panels and deterioration of metals and metal finishes.

## PART 2 PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

A. Design system in accordance with NGA Heavy Glass Door and Entrance Systems Design Guide.

B. Design system in accordance with ASCE-7 and State Building Code requirements for seismic design criteria indicated on Structural Drawings.

### 2.2 MANUFACTURERS

A. Basis-of-Design: CRL 690/695 Series by C.R. Laurence.

B. Other Manufacturers: As approved by Architect.

### 2.3 SYSTEM DESCRIPTION

A. Interior sliding glass doors and fixed glass panels, with soft-brake sliding component.
   1. Single soft-brake body in lieu of two for dual closing decreasing its length, which improves durability and reduces the minimum glass panel width.

B. Easy-to-install channel track, dry-glazed and uses a smart snap-on system to secure sidelites in place quickly and with minimum labor. Simplified adjustment or replacement of glass panels.

C. Tested to 200,000 cycles.

### 2.4 MATERIALS

A. Aluminum Extrusions: ASTM B221, 6061-T5 or T6 alloy and temper.

B. Glass: ASTM C1048, clear, fully tempered float glass, nominally 1/2 inch thick. Ease and polish exposed edges.

C. Door Hardware:
   1. Push and Pull: To be selected from manufacturer's full range of selections. Refer to Section 08 71 00.

### 2.5 ACCESSORIES

A. Anchors and Fasteners: Series 300 stainless steel as indicated on approved shop drawings.

## 2.6 FABRICATION

A. Overhead Track Header: Continuous, square profile extruded aluminum, 2-1/2 inches high by 2-1/2 inches wide.

B. Bottom Sill: Continuous, square profile extruded aluminum, 15/16 inch high by 1 inch wide.

C. Fixed Panel Sidelite Channel: Continuous, square profile extruded aluminum, 1/2 inches high by 1/2 inch wide, snap-on.

D. Aluminum Grid System: Field adhered.

E. Glazing Method: Dry glazed.

## 2.7 FINISHES

A. Aluminum: AAMA 611, Architectural Class I anodized, clear anodized.

# PART 3 EXECUTION

## 3.1 INSTALLATION

A. Install sliding glass doors in accordance with manufacturer's instructions and approved Shop Drawings.

B. Installation Tolerances:
   1. Maximum variation from plumb or level: 1/8 inch in 3 feet or 1/4 inch in any 10 feet, whichever is less.
   2. Maximum misalignment of members abutting end to end: 1/32 inch.

**END OF SECTION**

# SECTION 08 33 23

# OVERHEAD COILING DOORS

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Insulated service doors.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type and size of overhead coiling door and accessory.
   1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
   2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
   3. Include description of automatic-closing device and testing and resetting instructions.

B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.
   1. Include plans, elevations, sections, and mounting details.
   2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
   4. For exterior components, include details of provisions for assembly expansion and contraction and for excluding and draining moisture to the exterior.
   5. Show locations of controls, locking devices, and other accessories.
   6. Include diagrams for power, signal, and control wiring.

C. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.
   1. Include similar Samples of accessories involving color selection.

### 1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.
   1. Wind Load: Submit documentation of compliance with wind loads and design pressures indicated on Structural Drawings.

B. Sample Warranty: For special warranty.

## 1.4 CLOSEOUT SUBMITTALS

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

## 1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.
   1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

## 1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of doors that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Two years from date of Substantial Completion.

# PART 2 PRODUCTS

## 2.1 MANUFACTURERS

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

## 2.2 PERFORMANCE REQUIREMENTS

A. Sound-Control Doors: Assemblies tested in a laboratory for sound-transmission-loss performance according to ASTM E90, calculated according to ASTM E413, and rated for not less than the STC value indicated.

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

C. Structural Performance, Exterior Doors: Capable of withstanding the following design wind loads:
   1. Design Wind Load: As indicated on Drawings.
   2. Testing: According to ASTM E330/E330M.
   3. Deflection Limits: Design overhead coiling doors to withstand design wind load without evidencing permanent deformation or disengagement of door components.

4. Operability under Wind Load: Design overhead coiling doors to remain operable under design wind load, acting inward and outward.

D. Windborne-Debris Impact Resistance: Provide overhead coiling doors that pass ASTM E1886 missile-impact and cyclic-pressure tests according to indicated on Structural Drawings.

E. Seismic Performance: Overhead coiling doors are to withstand the effects of earthquake motions determined according to ASCE/SEI 7.
   1. Component Importance Factor: As indicated on Structural Drawings.

## 2.3 DOOR ASSEMBLY

A. Insulated Service Door: Overhead coiling door formed with curtain of interlocking metal slats.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Overhead Door Corporation; Rolling Steel Service Door Model 625S, or comparable product by one of the following:
      a. Clopay Building Products.
      b. Cornell; a CornellCookson company.
      c. Wayne Dalton; a division of Overhead Door Corporation.

B. Operation Cycles: Door components and operators capable of operating for not less than 100,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.
   1. Include tamperproof cycle counter.

C. STC Rating: 21.

D. Insulated Door Curtain R-Value: 7.71 R-Value.

E. Door Curtain Material: Galvanized steel.

F. Door Curtain Slats: Flat profile slats.
   1. Vision Panels: Approximately 10- by 1-5/8-inch openings spaced approximately 2 inches apart and beginning 12 inches from end guides; in three rows of slats at height indicated on Drawings; installed with insulated vision-panel glazing.
   2. Insulated-Slat Interior Facing: Metal.
   3. Gasket Seal. Manufacturer's standard continuous gaskets between slats.

G. Bottom Bar: Two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch thick; fabricated from aluminum extrusions and finished to match door.

H. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.

I. Hood: Match curtain material and finish.
   1. Shape: Round.
   2. Mounting: Face of wall.

J. Locking Devices: Equip door with locking device assembly.
   1. Locking Device Assembly: Cremone-type, both jamb sides locking bars, operable from inside with thumbturn.

K. Manual Door Operator: Push-up operation Chain-hoist operator.

L. Electric Door Operator:
   1. Usage Classification: Medium duty, up to 12 cycles per hour and up to 50 cycles per day.
   2. Operator Location: Front of hood.
   3. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use; moving parts of operator enclosed or guarded if exposed and mounted at 8 ft. or lower.
   4. Motor Exposure: Interior.
   5. Motor Electrical Characteristics:
      a. Horsepower: 3 hp.
      b. Voltage: 208 V ac, three phase, 60 Hz.
   6. Emergency Manual Operation: Chain type.
   7. Obstruction-Detection Device: Automatic photoelectric sensor.
      a. Sensor Edge Bulb Color: Black.
   8. Control Station(s): Interior mounted.
   9. Other Equipment: Audible and visual signals.

M. Curtain Accessories: Equip door with weatherseals.

N. Door Finish:
   1. Baked-Enamel or Powder-Coated Finish: Color as selected by Architect from manufacturer's full range.
   2. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face Finish as selected by Architect from manufacturer's full range.

## 2.4 MATERIALS, GENERAL

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

## 2.5 DOOR CURTAIN MATERIALS AND CONSTRUCTION

A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
   1. Aluminum Door Curtain Slats: ASTM B209 sheet or ASTM B221 extrusions, alloy and temper standard with manufacturer for type of use and finish indicated; thickness of 0.050 inch; and as required.

2. Vision-Panel Glazing: Manufacturer's standard clear glazing, fabricated from transparent acrylic sheet or fire-protection-rated glass as required for type of door; set in glazing channel secured to curtain slats.
3. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E84 or UL 723. Enclose insulation completely within slat faces.

B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain, and a continuous bar for holding windlocks.

## 2.6 HOODS

A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.
1. Aluminum: 0.040-inch- thick aluminum sheet complying with ASTM B209, of alloy and temper recommended by manufacturer and finisher for type of use and finish indicated.

B. Removable Metal Soffit: Formed or extruded from same metal and with same finish as curtain if hood is mounted above ceiling unless otherwise indicated.

## 2.7 LOCKING DEVICES

A. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.
1. Lock Cylinders: As specified in Section 08 71 00 "Door Hardware".
2. Keys: Three for each cylinder.

## 2.8 CURTAIN ACCESSORIES

A. Smoke Seals: Equip each fire-rated door with replaceable smoke-seal perimeter gaskets or brushes for smoke and draft control as required for door listing and labeling by a qualified testing agency.

B. Weatherseals for Exterior Doors: Equip each exterior door with weather-stripping gaskets fitted to entire exterior perimeter of door for a weather-resistant installation unless otherwise indicated.
   1. At door head, use 1/8-inch- thick, replaceable, continuous-sheet baffle secured to inside of hood or field-installed on the header.
   2. At door jambs, use replaceable, adjustable, continuous, flexible, 1/8-inch- thick seals of flexible vinyl, rubber, or neoprene.

## 2.9 COUNTERBALANCE MECHANISM

A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, seamless carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. of span under full load.

C. Counterbalance Spring: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.
   1. Fire-Rated Doors: Equip with auxiliary counterbalance spring and prevent tension release from main counterbalance spring when automatic-closing device operates.

D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.

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

## 2.10 MANUAL DOOR OPERATORS

A. General: Equip door with manual door operator by door manufacturer.

B. Chain-Hoist Operator: Consisting of endless steel hand chain, chain-pocket wheel and guard, and gear-reduction unit with a maximum 25-lbf force for door operation. Provide alloy-steel hand chain with chain holder secured to operator guide.

## 2.11 ELECTRIC DOOR OPERATORS

A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation-cycles requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
   1. Comply with NFPA 70.
   2. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V ac or dc.

B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.

C. Door Operator Location(s): Operator location indicated for each door.
   1. Front-of-Hood Mounted: Operator is mounted to the right or left door head plate with the operator on coil side of the door-hood assembly and connected to the door drive shaft with drive chain and sprockets. Front clearance is required for this type of mounting.

D. Motors: Reversible-type motor with controller (disconnect switch) for motor exposure indicated for each door assembly.
   1. Electrical Characteristics: Minimum as indicated for each door assembly. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. and not more than 12 in./sec., without exceeding nameplate ratings or service factor.
   2. Operating Controls, Controllers, Disconnect Switches, Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
   3. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.

E. Limit Switches: Equip each motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.

F. Obstruction-Detection Devices: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of door opening. For non-fire-rated doors, activation of device immediately stops and reverses downward door travel.
   1. Photoelectric Sensor: Manufacturer's standard system designed to detect an obstruction in door opening without contact between door and obstruction.
      a. Self-Monitoring Type: Designed to interface with door operator control circuit to detect damage to or disconnection of sensing device. When self-monitoring feature is activated, door closes only with sustained or constant pressure on close button.
   2. Electric Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-

coiling cable.
a. Self-Monitoring Type: Four-wire-configured device designed to interface with door operator control circuit to detect damage to or disconnection of sensor edge.
3. Pneumatic Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device.

G. Control Station: Three-button control station in fixed location with momentary-contact push-button controls labeled "Open" and "Stop" and sustained- or constant-pressure push-button control labeled "Close."
1. Interior-Mounted Units: Full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.

H. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf.

I. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

J. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

K. Audible and Visual Signals: Audible alarm and visual indicator lights in compliance with the accessibility standard.

## 2.12 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM/NOMMA 500 for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## 2.13 ALUMINUM FINISHES

A. Baked-Enamel or Powder-Coat Finish: AAMA 2603. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

## 2.14 STEEL AND GALVANIZED-STEEL FINISHES

A. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

# PART 3 EXECUTION

## 3.1 EXAMINATION

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

B. Examine locations of electrical connections.

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

## 3.2 INSTALLATION, GENERAL

A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

B. Install overhead coiling doors, hoods, controls, and operators at the mounting locations indicated for each door.

C. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with the accessibility standard.

D. Power-Operated Doors: Install according to UL 325.

## 3.3 FIELD QUALITY CONTROL

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

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
   1. Test door release, closing, and alarm operations when activated by smoke detector or building's fire-alarm system. Test manual operation of closed door. Reset door-closing mechanism after successful test.
   2. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, Section 5.2.

C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

E. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80.

## 3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.
   1. Complete installation and startup checks according to manufacturer's written instructions.
   2. After electrical circuitry has been energized, operate doors to confirm proper motor rotation and door performance.
   3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

## 3.5 ADJUSTING

A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
   1. Adjust exterior doors and components to be weather resistant.

B. Lubricate bearings and sliding parts as recommended by manufacturer.

C. Adjust seals to provide tight fit around entire perimeter.

## 3.6 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service includes 12 months' full maintenance by skilled employees of coiling-door Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door operation. Parts and supplies are to be manufacturer's authorized replacement parts and supplies.
   1. Include 24-hour-per-day, seven-day-per-week, emergency callback service.

## 3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

**END OF SECTION**

# SECTION 08 33 43

# OVERHEAD COILING SMOKE CURTAINS

## PART 1 GENERAL

### 1.1 SUMMARY

A. Overhead Coiling Smoke Curtains for Elevator Doors.

### 1.2 COORDINATION

A. Coordinate smoke curtain assemblies with power, signal, fire-alarm, and smoke-detection systems specified in Division 26 and Division 28.

B. Coordinate elevator smoke-protective curtain assemblies with elevator hoistway door frames specified in Division 14.

C. Coordinate smoke-protective curtain assemblies with ceilings for operational clearances and maintenance access requirements.

D. Coordinate smoke-protective curtain assemblies with walls for support requirements, rating continuity above ceilings, and recessed wall switches.

E. Coordinate requirements for metal supports required for smoke-protective curtain assemblies.

### 1.3 INFORMATIONAL SUBMITTALS

A. Submit under provisions of Section 01 30 00

B. Product Data: Manufacturer's product information and data sheets for each product specified in this section, including:
   1. Substrate preparation instructions and recommendations.
   2. Installation means and methods.
   3. Recommendations and requirements for proper storage and handling.

C. Shop Drawings:
   1. Submit Manufacturer’s approved shop drawings detailing the section and elevation views of each product to be installed.
   2. Coordinate with locations listed on Contract Drawings.

D. Warranty Information:
   1. Submit confirmation and details of manufacturer’s warranty, extended warranty,

and replacement policies.

## 1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For smoke-protective curtain assemblies to include in emergency, operation, and maintenance manuals.

B. Field quality-control reports for required testing.

## 1.5 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer: Minimum of seven (7) years experience in manufacturing draft-control curtain assemblies at a facility in the United States that have been successfully installed in compliance with requirements of authorities having jurisdiction.
   2. Installers: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

## 1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store and handle materials and products in accordance with the manufacturer's instructions and recommendations and industry standards.

B. Store all materials in the manufacturer’s original packaging until ready for installation. Protect all products from damage or exposure to adverse weather conditions.

## 1.7 PROJECT CONDITIONS

A. Prior to fabrication, verify that dimensions are consistent with those found in the construction drawings. Where discrepancies exist, confirm the proper dimensions with the Architect before proceeding with work.

## 1.8 WARRANTY

A. Manufacturer Warranty: Provide manufacturer’s warranty covering parts and labor costs to repair or replace part that fail to perform.
   1. Warranty Period: Parts and labor warranty for 12 months from date of Substantial completion.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

A. Basis of Design Manufacturer: Smoke Guard, A CSW Industrials Company.
   1. Address: 287 North Maple Grove Road, Boise, ID 83704.
   2. Phone: (800) 574-0330.
   3. Website: https://smokeguard.com

B. Other Manufacturers List:
   1. Cornell-Cookson.
   2. McKeon.
   3. Won-Door Corporation.

C. Substitution Limitations:
   1. Submit substitution requests in accordance with provisions of Section 01 60 00
   2. Single manufacturer to provide, from a single source, a fully integrated smoke-and-draft containment system consisting of smoke-and-draft-protective curtains and the following components:
      a. Smoke-and-Draft-Protective Curtain Operators.
      b. Smoke-and-Draft-Protective Curtain Controls.

### 2.2 SMOKE-PROTECTIVE CURTAIN ASSEMBLIES FOR ELEVATOR ENTRANCES

A. Alarm-activated transparent-film smoke curtain assembly complying with ICC-ES AC77 and NFPA 105.
   1. Basis of Design Product: Model 200, by Smoke Guard, a CSW Industrials Company.
   2. Basis of Design Product: Model 400, by Smoke Guard, a CSW Industrials Company.

B. Smoke-Protective Curtain Assemblies: Provide smoke-protective curtains listed and labeled with the letter "S" by a qualified testing agency for smoke- and draft-control based on testing in accordance with UL 1784 without an artificial bottom seal; with maximum air-leakage rate of 3.0 cfm/sq. ft. (0.01524 cu. m/s x sq. m) of opening at 0.10 inch wg (24.9 Pa) for both ambient and elevated temperature tests in accordance with ICC-ES AC77.

C. Curtain Materials: Provide manufacturer’s standard curtain complying with each of the following:
   1. Flame-Spread and Smoke-Developed Indexes: No greater than 25 and 450, respectively, when tested in accordance with ASTM E84.
   2. Transparent-Film Curtain: Provide curtain of transparent film in compliance with vision panel requirements of ASME A17.1.
   3. Screen Reinforcement: Provide film with reinforcement to limit deflection or tearing.

D. Curtain Egress: Provide curtain that is operable from the egress side without use of keys, tools, special knowledge, or effort in excess of the opening force requirements of authorities having jurisdiction.
   1. Egress Switch: Include switch to rewind screen into housing to comply with egress requirements of ASME A17.1.
      a. Switch Size and Color: Provide switch no less than 4 by 4 inches and in contrasting color with curtain.
      b. Switch Operation: Provide switch operable with a closed fist or a loose grip, not requiring finger movements in compliance with the requirements of authorities having jurisdiction.
      c. Switch Location: Centered on screen between 15 and 48 inches above finished floor level in compliance with forward reach requirements of authorities having jurisdiction.
   2. Manual Egress: Provide curtain allowing fail-safe manual egress with less than 15 pounds release pressure in the direction of travel.
      a. Opening Size: Provide curtain with manual egress opening of at least 32 inches in compliance with the requirements of authorities having jurisdiction.

E. Curtain Attachment: Provide curtain that forms a pressure-resisting seal by magnetic adhesion with flexible multi-pole magnetic strips attached to longitudinal edges of film with low modulus silicone adhesive.
   1. Curtain Installation: Provide curtain attachment systems that do not require modification of the elevator jamb including direct or mechanical attachment.
   2. Elevator Door Frame Method: Type 430 ferritic stainless steel elevator door frames to create seal with curtain by magnetic adhesion.
      a. Auxiliary Rails: Provide 16-gauge ASTM A240/240M, Type 430, ferritic stainless steel vertical rails above elevator door head to create seal with curtain by magnetic adhesion no less than 2 inches (51 mm) wide.
   3. Auxiliary Rail Method: Provide vertical rails to create seal with curtain by magnetic adhesion.
      a. Material: 16-gauge ASTM A240/240M, Type 430, ferritic stainless steel.
      b. Size: At least 2 inches (51 mm) wide.

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

G. Curtain Housing: Provide sheet metal housings containing support rollers and associated electronics.
   1. Coordinate operator wiring requirements and electrical characteristics with building electrical system.
   2. Housing includes electrical junction box that does not require the removal of any part of the building in accordance with NFPA 70.
   3. Provide electrical junction box access through housing in the open condition.
   4. Curtain housing to contain all components required for operation.
   5. Housing Finish: Manufacturer’s standard powder coat finish in white.
   6. Housing Finish: Manufacturer’s standard powder coat finish in custom RAL color.
   7. Housing Finish: Manufacturer’s standard stainless steel.

H. Curtain Operation: Controlled descent automatically by fail-safe, gravity-closing deployment and motorized rewind.
   1. Curtain deploys on activation of one of the following:
      a. Local Smoke Detector.
      b. Building Fire Alarm.
      c. Testing Key Switch
   2. Release Mechanism: Labeled as defined by UL864.

## 2.3 ACCESSORIES

A. End of Line Diode: Provide manufacturer's standard diode device installed at smoke detector to monitor the circuit.
   1. Power Requirements: 3.9 Volts, 2 Watts.

# PART 3 EXECUTION

## 3.1 EXAMINATION

A. Examine substrates upon which work will be installed.
   1. Verify related work performed under other sections is complete and in accordance with Shop Drawings.
   2. Verify wall surfaces and elevator door frames are acceptable for installation of smoke containment system components.

B. Coordinate with responsible entity to perform corrective work on unsatisfactory substrates.

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

D. Verify that locations of concealed reinforcements have been clearly marked for the installer.

E. Locate reinforcement points and clearly mark their locations if not already done.

## 3.2 PREPARATION

A. Clean surfaces prior to installation.

B. Prepare surfaces as recommended by the manufacturer for achieving optimal results.

## 3.3 INSTALLATION

A. Install in accordance with manufacturer's current installation instructions and industry recognized best practices.

B. Install in accordance with all code bodies having jurisdiction.

## 3.4 CLEANING AND PROTECTION

A. Clean and remove all stains, grime, or other soils using soap and water. Only use detergents approved by the manufacturer for use on the finishes specified. Do not use acid solutions, steel wool, and other harsh abrasives.

B. Damaged products must be repaired or replaced prior to substantial completion.

C. Protect installed products until completion of work specified in this section.

## 3.5 FIELD QUALITY CONTROL

A. Field Test: Follow manufacturer's cycle test procedures.
   1. Notify Owner's Representative, local Fire Marshal, alarm sub-contractor and elevator sub-contractor or service company minimum one week in advance of scheduled testing.
   2. Complete maintenance service record.

## 3.6 DEMONSTRATION

A. Demonstrate required testing and maintenance procedures to Owner's Representative.

## 3.7 MAINTENANCE AND TESTING

A. Perform minimum semi-annual maintenance and testing on each smoke containment system as required by the manufacturer's warranty, code agency evaluation reports, and as required by local authority having jurisdiction.
   1. Retain permanent record of tests.

B. Future Painting: Paint elevator door frame and/or auxiliary rails in accordance with Operation and Maintenance Manual.

C. Fire Event: Owner shall engage a qualified inspector to assess unit(s) after exposure to a fire event.

**END OF SECTION**

# SECTION 08 41 13

# ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

## PART 1 GENERAL

### 1.1 SUMMARY

A. This Section covers Architectural Aluminum Storefront Systems, including perimeter trims, stools, accessories, shims and anchors, and perimeter sealing of storefront units and swing doors.

B. Related Sections: Section 09 22 16 - Non-Structural Metal Framing for partition gap closure system.

### 1.2 DEFINITIONS

A. For fenestration industry standard terminology and definitions, refer to the Fenestration & Glazing Industry Alliance (FGIA) Glossary (AAMA AG-13).

### 1.3 PERFORMANCE REQUIREMENTS

A. General Performance:
   1. Product to comply with the specified performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction, as determined by testing of aluminum storefront systems representing those indicated for this project.
   2. Aluminum storefront systems shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
   3. Failure includes any of these events:
      a. Thermal stresses transferring to building structure
      b. Glass breakage
      c. Loosening or weakening of fasteners, attachments, and other components
      d. Failure of operating units

B. Delegated Design:
   1. Design aluminum storefront systems, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

C. Wind Loads:
   1. The storefront system shall include anchorage that is capable of withstanding the

following wind load design pressures:
a. Inward: Refer to Structural Drawings.
b. Outward: Refer to Structural Drawings.

D. Air Leakage:
1. The test specimen shall be tested in accordance with ASTM E 283.
2. With interior seal, air leakage rate shall not exceed 0.06 cfm/ft2 (0.3 l/s · m2) at a static air pressure differential of 6.2 psf (300 Pa).
3. Without interior seal, air leakage rate shall not exceed 0.06 cfm/ft2 (0.3 l/s · m2) at a static air pressure differential of 1.6 psf (75 Pa).
4. CSA A440 Fixed Rating

E. Water Resistance:
1. The test specimen shall be tested in accordance with ASTM E 331.
2. There shall be no leakage at a minimum static air pressure differential of 10 psf (479 Pa) as defined in AAMA 501.
3. CSA A440 B5 Rating

F. Uniform Load Structural:
1. A static air design load of 30 psf (1436 Pa) shall be applied in the positive and negative direction in accordance with ASTM E 330.
2. There shall be no deflection in excess of L/175 of the span of any framing member.
3. At a structural test load equal to 1.5 times the specified design load, no glass breakage or permanent set in the framing members in excess of 0.2% of their clear spans shall occur.
4. CSA A440 C2 Rating

G. Thermal Transmittance (U-factor):
1. Thermal transmittance test results are based upon 1" (25.4 mm) clear high-performance insulating glass 1/4" (e=0.035, #2), 1/2" warm edge spacer and argon fill gas, 1/4".
2. When tested to AAMA Specification 1503, the thermal transmittance (U-factor) shall not be more than Third Party test results for exterior storefront system.

## 1.4 SUBMITTALS

A. Product Data:
1. For each type of aluminum-framed storefront system indicated, include:
a. Construction details
b. Material descriptions
c. Dimensions of individual components and profiles
d. Hardware
e. Finishes
f. Installation instructions

B. Shop Drawings:
1. Plans

2. Elevations
3. Sections
4. Details
5. Hardware
6. Attachments to other work
7. Operational clearances
8. Installation details

C. Samples for Initial Selection:
   1. Provide samples for units with factory-applied color finishes.
   2. Provide samples of hardware and accessories involving color selection.

D. Product Test Reports:
   1. Provide test reports for each type of aluminum-framed storefront used in the project.
   2. Test reports must be based on evaluation of comprehensive tests performed by a qualified preconstruction testing agency.
   3. Test reports must indicate compliance with performance requirements.

## 1.5 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Installer must have successfully installed the same or similar units required for the project and other projects of similar size and scope.

B. Manufacturer Qualifications:
   1. Manufacturer must be capable of providing aluminum-framed storefront systems that meet or exceed performance the stated performance requirements.
   2. Manufacturer must document this performance by the inclusion of test reports and calculations.

C. Source Limitations:
   1. Obtain aluminum-framed storefront system through one source from a single manufacturer.

D. Product Options:
   1. Drawings indicate size, profiles, and dimensional requirements of aluminum-framed storefront system and are based on the specific system indicated. Refer to Division 01 Product Requirements Section. Do not modify size and dimensional requirements.
   2. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

E. Pre-installation Conference:
   1. Conduct conference at project site to comply with requirements in Division 01 Project Management and Coordination Section.

F. Structural-Sealant Glazing must comply with ASTM C 1401, “Guide for Structural Sealant Glazing” for design and installation of structural-sealant-glazed systems.

G. Structural-Sealant Joints: Design reviewed and approved by structural-sealant manufacturer.

## 1.6 PROJECT CONDITIONS

A. Field Measurements:
   1. Verify actual dimensions of aluminum-framed storefront openings by field measurements before fabrication.
   2. Indicate measurements on shop drawings.

## 1.7 WARRANTY

A. Submit manufacturer's standard warranty for owner's acceptance.

B. Warranty Period:
   1. Two years from Date of Substantial Completion of the project provided however that in no event shall the Limited Warranty begin later than six months from date of shipment by manufacturer.

# PART 2 PRODUCTS

## 2.1 MATERIALS

A. Aluminum Extrusions:
   1. Alloy and temper recommended by aluminum storefront manufacturer for strength, corrosion resistance, and application of required finish.
   2. Not less than 0.070" (1.8 mm) wall thickness at any location for the main frame
   3. Complying with ASTM B221: 6063-T6 alloy and temper

B. Fasteners:
   1. Nonmagnetic stainless steel or other materials must be non-corrosive and compatible with aluminum members, trim hardware, anchors, and other components.

C. Anchors, Clips, and Accessories:
   1. Anchors, clips, and accessories shall provide sufficient strength to withstand the design pressure indicated.

D. Sealant:
   1. For sealants required within fabricated storefront system, provide permanently elastic, non-shrinking, and non-migrating type recommended by sealant manufacturer for joint size and movement.

E. Tolerances:
   1. References to tolerances for wall thickness and other cross-sectional dimensions of storefront members are nominal and in compliance with AA Aluminum Standards and Data.

## 2.2 STOREFRONT FRAMING SYSTEM

A. Basis-of-Design for interior and exterior storefront systems:
   1. Basis-of-Desing: Kawneer Trifab® Versaglaze® 451 (Interior Locations):
      a. 2 inch by 4-1/2-inch nominal dimension.
      b. Non-thermal.
      c. Center Plane.
      d. Screw Spline Fabrication.
      e. Kawneer IsoLock™ Thermal Break with a nominal 1/4" (6.4 mm) separation consisting of a two-part chemically curing, high-density polyurethane, which is mechanically and adhesively joined to aluminum storefront sections.
   2. Basis-of-Design: Kawneer Trifab® Versaglaze® 601UT: 601UT: 601T (Exterior Locations):
      a. 2 inch by 6 inch nominal dimensions.
      b. Thermal.
      c. Front Plane.
      d. Screw Spline, Shear Block, and Stick Fabrication.
      e. Kawneer IsoLock® Thermal Break with dual nominal 1/4" (6.4 mm) separation consisting of a two-part chemically curing, high-density polyurethane, which is mechanically and adhesively joined to aluminum storefront sections.
      f. Thermal break shall be designed in accordance with AAMA TIR-A8 and tested in accordance with AAMA 505.
   3. Other Manufacturers: In compliance with the requirements of this Section, other manufacturers include the following:
      a. Oldcastle.
      b. YKK.

B. Brackets and Reinforcements:
   1. Manufacturer's standard high-strength aluminum with non-staining, non-ferrous shims for aligning system components.

C. Fasteners and Accessories:
   1. Manufacturer's standard corrosion-resistant, non-staining, non-bleeding fasteners and accessories must be compatible with adjacent materials.
   2. Where exposed, fasteners and accessories shall be stainless steel.

D. Perimeter Anchors:
   1. When steel anchors are used, provide insulation between steel material and aluminum material to prevent galvanic action.

E. Packing, Shipping, Handling, and Unloading:
   1. Deliver materials in manufacturer's original, unopened, undamaged containers

with identification labels intact.

F. Storage and Protection:
1. Store materials so that they are protected from exposure to harmful weather conditions.
2. Handle material and components to avoid damage.
3. Protect material against damage from elements, construction activities, and other hazards before, during, and after installation.

## 2.3 GLAZING SYSTEMS

A. Glazing to meet requirements in Division 08 Glazing Section.

B. Glazing Gaskets:
1. Manufacturer's standard compression types
2. Replaceable, extruded EPDM rubber

C. Spacers and Setting Blocks:
1. Manufacturer's standard elastomeric type

D. Bond-Breaker Tape:
1. Manufacturer's standard TFE-fluorocarbon or polyethylene material to which sealants will not develop adhesion.

E. Glazing Sealants for structural-sealant-glazed systems as recommended by manufacturer for joint type, and as follows:
1. Weatherseal sealant:
a. ASTM C 920 for Type S, Grade NS, Class 25, Uses NT, G, A, and O
b. Single-component neutral-curing formulation that is compatible with the structural sealant and other system components with which it comes in contact
c. Recommended by structural-sealant, weatherseal-sealant, and aluminum-framed-system manufacturers for this use
d. Color: Matching structural sealant

## 2.4 ENTRANCE DOOR SYSTEMS

A. Basis-of-Design: Kawneer 350T Insulpour® Thermal Entrance (Thermal):
1. Medium stile
2. Vertical face dimension: 3-1/2" (88.9 mm)
3. Depth: 2-1/4" (57.2 mm)
4. High traffic applications

B. Basis-of-Design: Kawneer, 350 Swing Door: Non-thermal:
1. Medium stile
2. Vertical face dimension: 3-1/2" (88.9 mm)
3. Depth: 1-3/4" (44.5 mm)

4. High-traffic applications

C. Other Manufacturers: In compliance with this Section, other manufacturers include the following:
   1. Oldcastle.
   2. YKK.

D. Refer to Entrance Door Hardware as specified in Division 08 41 13 Door Hardware Section.

## 2.5 ACCESSORIES

A. Refer to Section 09 22 16 - Non-Structural Metal Framing for partition gap closure system.

## 2.6 FABRICATION

A. Fabricate framing member components that, when assembled, have the following characteristics:
   1. Profiles that are sharp, straight, and free of defects or deformations
   2. Accurately fitted joints that are flush, hairline, and weatherproof
   3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior
   4. Physical and thermal isolation of glazing from framing members
   5. Accommodations for thermal and mechanical movements of glazing and framing that maintain required glazing edge clearances
   6. Provisions for field replacement of glazing
   7. Fasteners, anchors, and connection devices that are concealed from view to the greatest extent possible

B. Mechanically Glazed Framing Members:
   1. Fabricate for flush glazing without projecting stops.

C. Structural-Sealant-Glazed Framing Members:
   1. Include accommodations for using temporary support device to retain glazing in place while structural sealant cures.

D. Storefront Framing:
   1. Fabricate components for assembly using manufacturer’s standard installation instructions.

E. After fabrication, clearly mark components to identify their locations in project according to shop drawings.

## 2.7 ALUMINUM FINISHES

A. Finish designations that are prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Factory Finishing:
   1. Kawneer Permafluor™ (70% PVDF), AAMA 2605, Fluoropolymer Coating; Metallic mica color from manufacturer's full range.

# PART 3 EXECUTION

## 3.1 EXAMINATION

A. With installer present, examine openings, substrates, structural support, anchorage, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of work:
   1. Verify rough opening dimensions.
   2. Verify levelness of sill plate.
   3. Verify operational clearances.
   4. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components for proper water management.
   5. Masonry Surfaces:
      a. Masonry surfaces must be visibly dry and free of excess mortar, sand, and other construction debris.
   6. Metal Surfaces:
      a. Metal surfaces must be dry and clean (free of grease, oil, dirt, rust, corrosion, and welding slag).
      b. Ensure that metal surfaces are without sharp edges or offsets at joints.

B. Proceed with installation only after correcting unsatisfactory conditions.

## 3.2 INSTALLATION

A. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing aluminum-framed storefront system, accessories, and other components.

B. Install aluminum-framed storefront system so that components:
   1. Are level, plumb, square, and true to line
   2. Are without distortion and do not impede thermal movement
   3. Are anchored securely in place to structural support
   4. Are in proper relation to wall flashing and other adjacent construction

C. Set sill members in bed of sealant or with gaskets, as indicated, for weather-tight construction.

D. Install aluminum-framed storefront system and components to drain condensation,

water penetrating joints, and moisture migrating within aluminum-framed storefront system to the exterior.

E. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

## 3.3 FIELD QUALITY CONTROL

A. Field Tests:
   1. Architect shall select storefront units to be tested as soon as a representative portion of the project has been installed, glazed, perimeter caulked and cured.
   2. Conduct tests for air infiltration and water penetration with manufacturer’s representative present.
   3. Tests that do not meet the specified performance requirements and units that have deficiencies shall be corrected as part of the contract amount.
   4. For each failed test, in addition to re-testing the failed window assembly, one additional window assembly will be selected by the Architect for testing at no expense to the Owner.
   5. Testing shall be performed per AAMA 503 by a qualified independent testing agency. Refer to Testing Section for payment of testing and testing requirements.
   6. Air Infiltration Tests:
      a. Conduct tests in accordance with ASTM E 783.
      b. Allowable air infiltration shall not exceed 1.5 times the amount indicated in the performance requirements or 0.09 cfm/ft2, whichever is greater.
   7. Water Infiltration Tests:
      a. Conduct tests in accordance with ASTM E 1105.
      b. No uncontrolled water leakage is permitted when tested at a static test pressure of two-thirds the specified water penetration pressure but not less than 6.2 psf (300 Pa).

B. Manufacturer's Field Services:
   1. Upon owner’s written request, provide periodic site visit by manufacturer’s field service representative.

## 3.4 ADJUSTING, CLEANING, AND PROTECTION

A. Adjusting: Not applicable.

B. Protection:
   1. Protect installed product’s finish surfaces from damage during construction.

C. Cleaning:
   1. Clean glass immediately after installation.
      a. Comply with glass manufacturer's written recommendations for final cleaning and maintenance.
      b. Remove non-permanent labels and clean surfaces.
   2. Clean aluminum surfaces.

3. Avoid damaging protective coatings and finishes.
4. Remove excess sealants, glazing materials, dirt, and other substances.
5. Repair or replace damaged installed products.
6. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during the construction period.
7. Remove construction debris from project site and legally dispose of debris.

**END OF SECTION**

# SECTION 08 44 23

# STRUCTURAL SEALANT GLAZED CURTAIN WALLS

## PART 1 GENERAL

### 1.1 SUMMARY

A. This Section covers Architectural Aluminum Curtain Wall Systems, including perimeter trims, stools, accessories, shims and anchors, and perimeter sealing of curtain wall framing.

B. Related Sections: Section 09 22 16 - Non-Structural Metal Framing for partition gap closure system.

### 1.2 DEFINITIONS

A. For fenestration industry standard terminology and definitions, refer to the Fenestration & Glazing Industry Alliance (FGIA) Glossary (AAMA AG-13).

### 1.3 PERFORMANCE REQUIREMENTS

A. General Performance:
   1. Product to comply with the specified performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction, as determined by testing of glazed aluminum curtain walls representing those indicated for this project.
   2. Glazed aluminum curtain walls shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
   3. Failure includes any of these events:
      a. Thermal stresses transferring to building structure
      b. Glass breakage
      c. Loosening or weakening of fasteners, attachments, and other components
      d. Failure of operating units

B. Delegated Design:
   1. Design glazed aluminum curtain walls, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

C. Wind Loads:
   1. The curtain wall system shall include anchorage that is capable of withstanding

the following wind load design pressures:
a. Inward: Refer to Structural Drawings.
b. Outward: Refer to Structural Drawings.

D. Air Leakage:
1. Maximum air leakage through fixed glazing and framing areas of 0.06 cfm/ft2 (0.31 l/s·m2) of fixed wall area as determined according to ASTM E 283 at a minimum static-air-pressure differential of 6.2 psf (300 Pa).

E. Water Resistance:
1. Static:
a. The test specimen shall be tested in accordance with ASTM E 331.
b. There shall be no leakage at a minimum static air pressure differential of 15 psf (720 Pa) as defined in AAMA 501.
2. Dynamic:
a. The test specimen shall be tested in accordance with AAMA 501.1.
b. There shall be no leakage at an air pressure differential of 15 psf (720 Pa) as defined in AAMA 501.

F. Structural-Test Performance:
1. Test according to ASTM E 330.
2. When tested at positive and negative wind load design pressures, assemblies do not evidence deflection exceeding L/175 of clear span.
3. A static air design load of 40 psf (1915 Pa) shall be applied in the positive and negative direction.
a. When tested at 150% of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2% percent of clear span.
b. Minimum test duration according to ASTM E 330 is 10 seconds.

G. Structural-Test Performance:
1. Based on Aluminum Association “Specification for Aluminum Structures” or CSA CAN3-S157 “Strength Design in Aluminum”.
2. There shall be no deflection exceeding L/175 of the span of any framing member at design load.

H. Deflection of Framing Members at Design Wind Pressure:
1. Deflection Normal to Wall Plane:
a. Limited to edge of glass in a direction perpendicular to glass plane not exceeding L/175 of the glass edge length for each individual glazing lite, or an amount that restricts edge deflection of individual glazing lites to 3/4" (19 mm), whichever is less.
b. Limit deflection of clear span of framing members to L/175 for spans less than or equal to 13'-6" (4.11 meters) and L/240 + 1/4" for spans greater than 13'-6" (4.11 meters).
2. Deflection Parallel to Glazing Plane:
a. Operable Units - Provide a minimum 1/16-inch (1.6 mm) clearance between framing members and operable units.

b. Limited to L/360 of clear span or 1/8 inch (3.2 mm), whichever is smaller
c. 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 (3.2 mm)

3. Cantilever Deflection:
   a. Where framing members overhang an anchor point, limit deflection to two times the length of cantilevered member, divided by 175.

I. Thermal Movements:
   1. Allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures:
      a. Temperature Change (Range): 0 °F (-18 °C); 180 °F (82 °C).
      b. Test Interior Ambient Air Temperature: 75 °F (24 °C).
      c. Test Performance: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performancewhen tested according to AAMA 501.5 for a minimum 3 cycles.

J. Seismic:
   1. When tested to AAMA 501.4, system must meet design displacement (elastic) of 0.010 times the story height and ultimate displacement (inelastic) of 1.5 times the design displacement.
   2. When tested to AAMA 501.6, system must meet dynamic seismic drift causing glass fallout (∆Fallout) of 6” or 0.0300 times the story height.

K. Thermal Transmittance (U-factor), Physical Test:
   1. For 1" (25.4 mm) glass: When tested using AAMA 1503, the U-factor shall not be more than Third Party tested results for the Basis-of-Design system.

L. Solar Heat Gain Coefficient:
   1. Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than 0.25 as determined according to NFRC 200.

## 1.4 SUBMITTALS

A. Product Data:
   1. For each type of product indicated, include:
      a. Construction details
      b. Material descriptions
      c. Dimensions of individual components and profiles
      d. Finishes

B. Shop Drawings:
   1. Plans
   2. Elevations
   3. Sections
   4. Full-size details
   5. Attachments to other work

6. Project specific wiring diagrams.

C. Samples for Initial Selection:
   1. Provide samples for units with factory-applied color finishes.

D. Samples for Verification:
   1. Provide a verification sample for each type of exposed finish required, in manufacturer's standard sizes.

E. Product Test Reports:
   1. Provide test reports for glazed aluminum curtain walls.
   2. Test reports must be based on evaluation of comprehensive tests performed by a qualified preconstruction testing agency.
   3. Test reports must indicate compliance with performance requirements.

## 1.5 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Installer must have successfully installed the same or similar systemsrequired for the project and other projects of similar size and scope.

B. Manufacturer Qualifications:
   1. Manufacturer must be capable of fabricating glazed aluminum curtain walls that meet or exceed the stated performance requirements.

C. Source Limitations:
   1. Obtain aluminum curtain wall system through one source from a single manufacturer.

D. Product Options:
   1. 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.
   2. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

E. Pre-installation Conference:
   1. Conduct conference at project site to comply with requirements in Division 01 Project Management and Coordination Section.

## 1.6 PROJECT CONDITIONS

A. Field Measurements:
   1. Verify actual locations of structural supports for glazed aluminum curtain walls by field measurements before fabrication.
   2. Indicate measurements on shop drawings.

## 1.7 WARRANTY

A. Submit manufacturer's standard warranty for owner's acceptance.

B. Warranty Period:
   1. Two years from Date of Substantial Completion of the project provided however that in no event shall the Limited Warranty begin later than six months from date of shipment by manufacturer.

# PART 2 PRODUCTS

## 2.1 MANUFACTURERS

A. Basis-of-Design Product:
   1. Kawneer Company, Inc.
   2. 1600UT System™2 Curtain Wall types:
      a. 1600UT System™2 Curtain Wall with 1" (25.4 mm) double glazed insulating glass:
         1) Sight line: 2-1/2" (63.5 mm)
         2) Outside glazed structural silicone glazed (SSG) format
         3) System depth: 6" (152.4 mm) or 7-1/2" (190.5 mm)
   3. Test to AAMA 501-05.

B. Subject to compliance with requirements, provide a comparable product by the following:
   1. Oldcastle.
   2. YKK.

C. Substitutions:
   1. Refer to Division 01 Substitutions Section for procedures and submission requirements.
   2. Pre-Contract (Bidding Period) Substitutions:
      a. Submit written requests ten (10) days prior to bid date.
   3. Post-Contract (Construction Period) Substitutions:
      a. Submit written request in order to avoid installation and construction delays.
   4. Product Literature and Drawings:
      a. Submit product literature and drawings modified to suit specific project requirements and job conditions.
   5. Certificates:
      a. Submit certificate(s) certifying that the substitute manufacturer (1) attests to

adherence to specification requirements for curtain wall system performance criteria, and (2) has been engaged in the design, manufacture, and fabrication of aluminum curtain walls for a period of not less than ten (10) years. (Company Name).

6. Test Reports:
   a. Submit test reports verifying compliance with each test requirement required by the project.
7. Samples:
   a. Provide samples of typical product sections and finish samples in manufacturer's standard sizes.

D. Substitution Acceptance:
   1. Acceptance will be in written form, either as an addendum or modification.
   2. Acceptance will be documented by a formal change order signed by the owner and contractor.

## 2.2 MATERIALS

A. Aluminum Extrusions:
   1. Alloy and temper recommended by glazed aluminum curtain wall manufacturer for strength, corrosion resistance, and application of required finish
   2. Not less than 0.070" (1.8 mm) wall thickness at any location for the main frame
   3. Complying with ASTM B221: 6063-T6 alloy and temper

B. Aluminum Sheet Alloy:
   1. Shall meet the requirements of ASTM B209.

C. Fasteners:
   1. Aluminum, nonmagnetic stainless steel or other materials must be non-corrosive and compatible with aluminum members, trim hardware, anchors, and other components.

D. Anchors, Clips, and Accessories:
   1. Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions or other suitable zinc coating.
   2. Anchors, clips, and accessories shall provide sufficient strength to withstand the design pressure indicated.

E. Pressure Plate:
   1. Pressure plate shall be aluminumor fiberglass.
   2. Pressure plate shall be fastened to the mullion with stainless steel screws.
   3. Fiberglass pressure plate shall be tested to ASTM D638, D790, D695, D953, D3846.

F. Reinforcing Members:
   1. Aluminum, nonmagnetic stainless steel, or nickel/chrome-plated steel complying with ASTM B 456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions or other suitable zinc coating.
   2. Reinforcing members must provide sufficient strength to withstand the design pressure indicated.

G. Sealant:
   1. For sealants required within fabricated curtain wall system, provide permanently elastic, non-shrinking, and non-migrating type recommended by sealant manufacturer for joint size and movement.

H. Thermal Barrier:
   1. Thermal barrier consists of 1" (25.4 mm) separation between the interior and exterior metal members in a typical condition.
   2. Thermal barrier assembly shall be tested to the thermal cycling requirements of ASTM E2692 and show no sign of degradation following the test.

I. Tolerances:
   1. References to tolerances for wall thickness and other cross-sectional dimensions of glazed curtain wall members are nominal and in compliance with AA Aluminum Standards and Data.

## 2.3 CURTAIN WALL FRAMING

A. Framing Members:
   1. Manufacturer's standard extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads
   2. Glazing System: Two-sided SSG
   3. Glazing Plane: Front

B. Glass:
   1. 1" (25.4 mm) insulating glass option.
   2. 1" (25.4 mm) for spandrel applications.

C. Brackets and Reinforcements:
   1. Manufacturer's standard high-strength aluminum with non-staining, non-ferrous shims for aligning system components.

D. Framing Sealants:
   1. Shall be suitable for glazed aluminum curtain wall as recommended by sealant manufacturer.

E. Fasteners and Accessories:
   1. Manufacturer's standard corrosion-resistant, non-staining, non-bleeding fasteners and accessories must be compatible with adjacent materials.
   2. Where exposed, fasteners and accessories shall be stainless steel.

F. Perimeter Anchors:
   1. When steel anchors are used, provide insulation between steel material and aluminum material to prevent galvanic action.

G. Packing, Shipping, Handling, and Unloading:
   1. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

H. Storage and Protection:
   1. Store materials so that they are protected from exposure to harmful weather conditions.
   2. Handle material and components to avoid damage.
   3. Protect material against damage from elements, construction activities, and other hazards before, during, and after installation.

## 2.4 GLAZING

A. Glazing to meet requirements in Division 08 Glazing Section.

B. Available Glazing Options:
   1. Outside glazed structural silicone glazed (SSG) format with 1" (25.4 mm) double glazed.

C. Glazing Gaskets:
   1. Gaskets to meet requirements of ASTM C864.

D. Spacers and Setting Blocks:
   1. Manufacturer's standard elastomeric type

E. Bond-Breaker Tape:
   1. Manufacturer's standard TFE-fluorocarbon or polyethylene material to which sealants will not develop adhesion.

F. Glazing Sealants:
   1. As recommended by manufacturer for joint type.

## 2.5 FABRICATION

A. Extrude or form aluminum shapes before finishing.

B. 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
   3. Physical and thermal isolation of glazing from framing members
   4. Accommodations for thermal and mechanical movements of glazing and framing that 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 the

greatest extent possible

7. Internal weeping system or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior
8. Double seal design with primary air and vapor barrier at interior side of glazed aluminum curtain wall and secondary seal weeped and vented to exterior.

C. Curtain Wall Framing:
   1. Fabricate components for assembly using shear block system following manufacturer's standard installation instructions.

D. After fabrication, clearly mark components to identify their locations in project according to shop drawings.

## 2.6 ALUMINUM FINISHES

A. Finish designations that are prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Factory Finishing:
   1. Kawneer Permafluor™ (70% PVDF), AAMA 2605, Fluoropolymer Coating; Metallic mica color from manufacturer's full range.

## 2.7 ACCESSORIES

A. Refer to Section 09 22 16 - Non-Structural Metal Framing for partition gap closure system.

# PART 3 EXECUTION

## 3.1 EXAMINATION

A. With installer present, examine areas for compliance with requirements for installation tolerances and other conditions affecting performance of the work.

B. Proceed with installation only after correcting unsatisfactory conditions.

## 3.2 INSTALLATION

A. Curtain Wall System Installation:
   1. Install curtain wall systems plumb, level, and true to line, without warp or rack of frames, within manufacturer’s prescribed tolerances, and complying with installation instructions.
   2. Provide support and anchor in place.
   3. Dissimilar Materials:

a. Provide separation of aluminum materials from sources of corrosion or electrolytic action contact points.

4. Glazing:
   a. Glass shall be outside-glazed.
   b. Glass shall be held in place with extruded aluminum pressure plates anchored to the mullion using stainless steel fasteners that are spaced no more than 9" (228.6 mm) on center.
5. Water Drainage
   a. Each light of glass shall be compartmentalized using joint plugs and silicone sealant to divert water to the horizontal weep locations.
   b. Weep holes shall be located in the horizontal pressure plates and covers to divert water to the exterior of the building.

B. Related Products Installation:
   1. Sealants (Perimeter):
      a. Refer to Joint Treatment (Sealants) Section.
   2. Glass:
      a. Refer to Glass and Glazing Section.
      b. Reference: ANSI Z97.1, CPSC 16 CFR 1201, and GANA Glazing Manual.

## 3.3 FIELD QUALITY CONTROL

A. Field Tests:
   1. Architect shall select curtain wall units to be tested as soon as a representative portion of the project has been installed, glazed, perimeter-caulked, and cured.
   2. Conduct tests for air infiltration and water penetration with manufacturer’s representative present.
   3. Tests that do not meet the specified performance requirements and units that have deficiencies shall be corrected as part of the contract amount.
   4. Testing shall be performed per AAMA 503 by a qualified independent testing agency. Refer to Testing Section for payment of testing and testing requirements.
   5. Air Infiltration Tests:
      a. Conduct tests in accordance with ASTM E 783.
      b. Allowable air infiltration shall not exceed 1.5 times the amount indicated in the performance requirements or 0.09 cfm/ft2, whichever is greater.
   6. Water Infiltration Tests:
      a. Conduct tests in accordance with ASTM E 1105.
      b. No uncontrolled water leakage is permitted when tested at a static test pressure of two-thirds the specified water penetration pressure but not less than 8 psf (383 Pa).
   7. For each failed test, in addition to re-testing the failed window assembly, one additional window assembly will be selected by Architect for testing at no expense to the Owner.

B. Manufacturer's Field Services:
   1. Upon owner’s written request, provide periodic site visit by manufacturer’s field service representative.

## 3.4 ADJUSTING, CLEANING, AND PROTECTION

A. Adjusting: Not applicable.

B. Protection:
   1. Protect installed product's finish surfaces from damage during construction.
   2. Protect aluminum curtain wall system from damage from grinding and polishing compounds, plaster, lime, acid, cement, or other harmful contaminants.

C. Cleaning:
   1. Repair or replace damaged installed products.
   2. Clean installed products in accordance with manufacturer's instructions prior to owner's acceptance.
   3. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during the construction period.
   4. Remove construction debris from project site and legally dispose of debris.

**END OF SECTION**

# SECTION 087100 - DOOR HARDWARE

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. This Section includes commercial door hardware for the following:

1. Swinging doors.
2. Sliding doors.
3. Other doors to the extent indicated.

B. Door hardware includes, but is not necessarily limited to, the following:

1. Mechanical door hardware.
2. Electromechanical door hardware.
3. Cylinders specified for doors in other sections.

C. Related Sections:

1. Division 08 Section “Hollow Metal Doors and Frames”.
2. Division 08 Section “Flush Wood Doors”.
3. Division 08 Section “Sound Control Hollow Metal Door Assemblies”.
4. Division 08 Section “Sound Control Wood Door Assemblies”.
5. Division 08 Section “Aluminum-Framed Entrances and Storefronts”.
6. Division 08 Section “Fire-Rated Steel Framed Entrances”.

D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
2. ICC/IBC - International Building Code.
3. NFPA 70 - National Electrical Code.
4. NFPA 80 - Fire Doors and Windows.
5. NFPA 101 - Life Safety Code.
6. NFPA 105 - Installation of Smoke Door Assemblies.
7. State Building Codes, Local Amendments.

E. Standards: All hardware specified herein shall comply with the following industry standards as applicable. Any undated reference to a standard shall be interpreted as referring to the latest edition of that standard:

1. ANSI/BHMA Certified Product Standards - A156 Series.
2. UL10C - Positive Pressure Fire Tests of Door Assemblies.
3. ANSI/UL 294 - Access Control System Units.
4. UL 305 - Panic Hardware.
5. ANSI/UL 437- Key Locks.

1.3 SUBMITTALS

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

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing, fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
3. Content: Include the following information:

    a. Type, style, function, size, label, hand, and finish of each door hardware item.
    b. Manufacturer of each item.
    c. Fastenings and other pertinent information.
    d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
    e. Explanation of abbreviations, symbols, and codes contained in schedule.
    f. Mounting locations for door hardware.
    g. Door and frame sizes and materials.
    h. Warranty information for each product.

4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Shop Drawings: Details of electrified access control hardware indicating the following:

1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:

a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
b. Complete (risers, point-to-point) access control system block wiring diagrams.
c. Wiring instructions for each electronic component scheduled herein.

2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.

D. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.

E. Informational Submittals:

1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

## 1.4 CLOSEOUT SUBMITTALS

A. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Procedures.

B. Project Record Documents: Provide record documentation of as-built door hardware sets in digital format (.pdf, .docx, .xlsx, .csv) and as required in Division 01, Project Record Documents.

## 1.5 QUALITY ASSURANCE

A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.

B. Certified Products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).

C. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

D. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff

a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

E. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.

1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.

F. Each unit to bear third party permanent label indicating compliance with the referenced testing standards.

G. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:

1. Function of building, purpose of each area and degree of security required.
2. Plans for existing and future key system expansion.
3. Requirements for key control storage and software.
4. Installation of permanent keys, cylinder cores and software.
5. Address and requirements for delivery of keys.

H. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.

1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
3. Review sequence of operation narratives for each unique access controlled opening.
4. Review and finalize construction schedule and verify availability of materials.
5. Review the required inspecting, testing, commissioning, and demonstration procedures

I. At completion of installation, provide written documentation that components were applied according to manufacturer's instructions and recommendations and according to approved schedule.

1.6 DELIVERY, STORAGE AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.7 COORDINATION

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

B. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.8 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:

1. Structural failures including excessive deflection, cracking, or breakage.
2. Faulty operation of the hardware.
3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
4. Electrical component defects and failures within the systems operation.

C. Warranty Period: Unless otherwise indicated, warranty shall be one year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Hardware shall not have any visible manufacturer names on exposed materials, except cylinders, when the door is in a closed position.

2.2 BUTT HINGES

A. Hinges: ANSI/BHMA A156.1 butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.

1. Quantity: Provide the following hinge quantity:

a. Two Hinges: For doors with heights up to 60 inches.
b. Three Hinges: For doors with heights 61 to 90 inches.
c. Four Hinges: For doors with heights 91 to 120 inches.
d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.

2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:

a. Widths up to 3’0”: 4-1/2” standard or heavy weight as specified.
b. Sizes from 3’1” to 4’0”: 5” standard or heavy weight as specified.

3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:

a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.

4. Hinge Options: Comply with the following:

a. Non-removable Pins: With the exception of electric through wire hinges, provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for all out-swinging lockable doors.

5. Manufacturers:

a. Hager Companies (HA) - BB Series, 5-knuckle.
b. Ives (IV) - 5BB Series, 5-knuckle.
c. McKinney (MK) - TA/T4A Series, 5-knuckle.

2.3 CONTINUOUS HINGES

A. Pin and Barrel Continuous Hinges: ANSI/BHMA A156.26 Grade 1-600 pin and barrel continuous hinges with minimum 14 gauge Type 304 stainless steel hinge leaves, concealed stainless pin, and twin self-lubricated nylon bearings at each knuckle separation. Factory trim hinges to suit door height and prepare for electrical cut-outs.

1. Manufacturers:

a. Hager Companies (HA).
b. Markar Products; ASSA ABLOY Architectural Door Accessories (MR).
c. Pemko (PE).

2.4 FLOOR CLOSERS AND PIVOTS

A. Pivots: ANSI/BHMA A156.4, Grade 1; space intermediate pivots equally not less than 25 inches on center apart or not more than 35 inches on center for doors over 121 inches high. Pivot hinges to have oil impregnated bronze bearing in the top pivot and a radial roller and thrust bearing in the bottom pivot with the bottom pivot designed to carry the full weight of the door. Pivots to be UL listed for windstorm where applicable.

1. Manufacturers:

a. Architectural Builders Hardware (AH).
b. Ives (IV).
c. Norton Rixson (RF).

2.5 POWER TRANSFER DEVICES

A. Electrified Quick Connect Transfer Hinges: Provide electrified transfer hinges with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets with a 1-year warranty. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

1. Manufacturers:

a. Hager Companies (HA) - ETW-QC (# wires) Option.
b. Ives (IV) - Connect.
c. McKinney (MK) - QC (# wires) Option.

B. Electrified Quick Connect Stainless Steel Continuous Transfer Hinges: Provide electrified transfer stainless steel continuous hinges with electrical transfer access prep accessible without de-mounting door from the frame. Furnish with Molex™ standardized plug connectors with sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

1. Manufacturers:

    a. Ives (IV) - Connect.
    b. Markar Products; ASSA ABLOY Architectural Door Accessories (MR) - MP-ETAP-EL (# wires) Option.
    c. dormakaba BEST (ST) - C Option.

C. Electrified Quick Connect Intermediate Transfer Pivots: Provide electrified offset intermediate transfer pivot hinges with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

1. Manufacturers:

    a. Architectural Builders Hardware (AH) - EL019-EZ (# wires).
    b. Norton Rixson (RF) - E-M19-QC (# wires).

D. Electric Door Wire Harnesses: Provide electric/data transfer wiring harnesses with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number and type of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and from hinge to junction box above the opening. Wire nut connections are not acceptable. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified opening.

1. Provide one each of the following tools as part of the base bid contract:

    a. McKinney (MK) - Electrical Connecting Kit: QC-R001.
    b. McKinney (MK) - Connector Hand Tool: QC-R003.

2. Manufacturers:

    a. Hager Companies (HA) - Quick Connect.
    b. McKinney (MK) - QC-C Series.
    c. Von Duprin (VD) - Connect.

## 2.6 DOOR OPERATING TRIM

A. Flush Bolts and Surface Bolts: Provide products conforming to ANSI/BHMA A156.3 and A156.16, Grade 1.

1. Flush bolts to be furnished with top rod of sufficient length to allow bolt retraction device location approximately six feet from the floor.
2. Furnish dust proof strikes for bottom bolts.
3. Surface bolts to be minimum 8” in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable.

4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.
5. Manufacturers:

    a. Burns Manufacturing (BU).
    b. Ives (IV).
    c. Rockwood (RO).

B. Coordinators: ANSI/BHMA A156.3 door coordinators consisting of active-leaf, hold-open lever and inactive-leaf release trigger. Model as indicated in hardware sets.

1. Manufacturers:

    a. Burns Manufacturing (BU).
    b. Ives (IV).
    c. Rockwood (RO).

C. Door Push Plates and Pulls: ANSI/BHMA A156.6 door pushes and pull units of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.

1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.
3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
4. Pulls shall be provided with a 10” clearance from the finished floor on the push side to accommodate wheelchair accessibility.
5. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets. When through-bolt fasteners are in the same location as a push plate, countersink the fasteners flush with the door face allowing the push plate to sit flat against the door.
6. Manufacturers:

    a. Burns Manufacturing (BU).
    b. Ives (IV).
    c. Rockwood (RO).

## 2.7 CYLINDERS AND KEYING

A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.

B. Cylinder Types: Original manufacturer cylinders able to supply the following cylinder formats and types:

1. Threaded mortise cylinders with rings and cams to suit hardware application.

2. Rim cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
3. Bored or cylindrical lock cylinders with tailpieces as required to suit locks.
4. Tubular deadlocks and other auxiliary locks.
5. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
6. Keyway: Match Facility Standard.

C. Patented Cylinders: ANSI/BHMA A156.5, Grade 1 Certified Products Directory (CPD) listed cylinders employing a utility patented and restricted keyway requiring the use of a patented key. Cylinders are to be protected from unauthorized manufacture and distribution by manufacturer's United States patents. Cylinders are to be factory keyed with owner having the ability for on-site original key cutting.

1. Patented key systems shall not be established with products that have an expired patent. Expired systems shall only be specified and supplied to support existing systems.
2. Manufacturers:

a. Corbin Russwin (RU) - Access 3 AP.
b. Sargent (SA) - Degree DG1.
c. Schlage (SC) - Everest 29 SL.

D. Keying System: Each type of lock and cylinders to be factory keyed.

1. Supplier shall conduct a "Keying Conference" to define and document keying system instructions and requirements.
2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
3. New System: Key locks to a new key system as directed by the Owner.

E. Key Quantity: Provide the following minimum number of keys:

1. Change Keys per Cylinder: Two (2)
2. Master Keys (per Master Key Level/Group): Five (5).
3. Construction Keys (where required): Ten (10).

F. Construction Keying: Provide construction master keyed cylinders.

G. Key Registration List (Bitting List):

1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
2. Provide transcript list in writing or electronic file as directed by the Owner.

## 2.8 KEY CONTROL

A. Key Control Cabinet: Provide a key control system including envelopes, labels, and tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent

markers, and standard metal cabinet. Key control cabinet shall have expansion capacity of 150% of the number of locks required for the project.

1. Manufacturers:

    a. Lund Equipment (LU).
    b. MMF Industries (MM).
    c. Telkee (TK).

## 2.9 MORTISE LOCKS AND LATCHING DEVICES

A. Mortise Locksets, Grade 1 (Heavy Duty): Provide ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed mortise locksets. Listed manufacturers shall meet all functions and features as specified herein.

1. Manufacturers:

    a. Corbin Russwin Hardware (RU) - ML2000 Series.
    b. Sargent Manufacturing (SA) - 8200 Series.
    c. Schlage (SC) - L9000 Series.

## 2.10 DEADLOCKS AND LATCHES

A. Narrow Case Deadlocks and Deadlatches: ANSI/BHMA 156.13 Series 1000 Grade 1 narrow case deadlocks and deadlatches for swinging or sliding door applications. All functions shall be manufactured in a single sized case formed from 12 gauge minimum, corrosion resistant steel (option for fully stainless steel case and components). Provide minimum 2 7/8" throw laminated stainless steel bolt. Bottom rail deadlocks to have 3/8” diameter bolts.

1. Manufacturers:

    a. Adams Rite Manufacturing (AD) - MS1850S / MS1950 Series.
    b. Adams Rite Manufacturing (AD) - 4900 Series.

## 2.11 LOCK AND LATCH STRIKES

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

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.

B. Standards: Comply with the following:

1. Strikes for Mortise Locks and Latches: BHMA A156.13.
2. Strikes for Bored Locks and Latches: BHMA A156.2.
3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
4. Dustproof Strikes: BHMA A156.16.

2.12 CONVENTIONAL EXIT DEVICES

A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:

1. Exit devices shall have a five-year warranty.
2. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.
3. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer’s catalog and template book for specific requirements.
4. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.
5. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.
6. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.

    a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
    b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.

7. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.
8. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2” wide stiles.
9. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
10. Rail Sizing: Provide exit device rails factory sized for proper door width application.
11. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.

B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed exit devices. Listed manufacturers shall meet all functions and features as specified herein.

1. Electromechanical exit devices shall have the following functions and features:

a. Universal Molex plug-in connectors that have standardized color-coded wiring and are field configurable in fail safe or fail secure and operate from 12vdc to 24vdc regulated.
b. EcoFlex or equivalent technology that reduces energy consumption up to 92% as certified by GreenCircle.
c. Options to be available for request-to-exit or enter signaling, latchbolt and touchbar monitoring.
d. Field configurable electrified trim to fail-safe or fail-secure that operates from 12-24VDC.
e. Five-year limited warranty for electromechanical features.

2. Manufacturers:

a. Corbin Russwin Hardware (RU) - ED4000 / ED5000 Series.
b. Sargent Manufacturing (SA) - 80 Series.
c. Von Duprin (VD) - 35A/98 Series.

## 2.13 SURFACE DOOR CLOSERS

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

1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers.
2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
3. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the Americans with Disabilities Act, provide units complying with ANSI ICC/A117.1.
4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
5. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.

B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard..

1. Manufacturers:

a. Corbin Russwin Hardware (RU) - DC6000 Series.

b. LCN Closers (LC) - 4040 Series.
c. Norton Rixson (NO) - 7500 Series.

## 2.14 ARCHITECTURAL TRIM AND ACCESSORIES

A. Door Protective Trim:

1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1” LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.
3. Where plates are applied to fire rated doors with the top of the plate more than 16” above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer’s catalog and template book for specific requirements for size and applications.
4. Protection Plates: ANSI/BHMA A156.6 protection plates (kick, armor, or mop), fabricated from the following:

    a. Stainless Steel: 300 grade, 050-inch thick.

5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.
6. Manufacturers:

    a. Hager Companies (HA).
    b. Ives (IV).
    c. Rockwood (RO).

## 2.15 DOOR STOPS AND HOLDERS

A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.

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

1. Manufacturers:

    a. Hager Companies (HA).
    b. Ives (IV).
    c. Rockwood (RO).

C. Overhead Door Stops and Holders: ANSI/BHMA A156.8, Grade 1 Certified Products Directory (CPD) listed overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.

1. Manufacturers:

a. dormakaba (DO).
b. Norton Rixson (RF).
c. Rockwood (RO).

2.16 ARCHITECTURAL SEALS

A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.

B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.

1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.

C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.

1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NFPA 252, Standard Methods of Fire Tests of Door Assemblies.

D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.

E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

F. Manufacturers:

1. Pemko (PE).
2. Reese Enterprises, Inc. (RE).
3. Zero (ZE).

2.17 ELECTRONIC ACCESSORIES

A. Door Position Switches: Door position magnetic reed contact switches specifically designed for use in commercial door applications. On recessed models the contact and magnetic housing snap-lock into a 1" diameter hole. Surface mounted models include wide gap distance design complete with armored flex cabling. Provide SPDT, N/O switches with optional Rare Earth Magnet installation on steel doors with flush top channels.

1. Manufacturers:

a. Alarm Controls (AK) - CP1-1026 Series.
b. Security Door Controls (SD) - DPS Series.
c. Securitron (SU) - DPS Series.

B. Switching Power Supplies: Provide the least number of power supplies at the appropriate amperage level sufficient to exceed the required total draw for the specified electrified hardware and access control equipment.

1. Power supplies shall meet all functions and features as specified herein.

a. UL listed dual voltage 12 or 24 VDC field selectable continuous output.
b. Tolerates brownout or overvoltage input ± 15% of nominal voltage.
c. Thermal shutdown protection with auto restart.
d. Circuit breaker protection against overcurrent and reverse battery faults.
e. Integrated battery charging circuit to prevent overvoltage on locking devices.
f. Available with a single relay fire trigger or individually triggered relayed outputs.
g. Monitoring options as specified.

2. Manufacturers:

a. Altronix (AS) - Maximal 3.
b. Life Safety Power (LP).
c. Securitron (SU) - AQD Series.

2.18 FABRICATION

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

2.19 FINISHES

A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.

B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware

C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

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

B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 INSTALLATION

A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.

1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.

B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
2. DHI TDH-007-20: Installation Guide for Doors and Hardware.
3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.

C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and

reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

D. Push Plates and Door Pulls: When through-bolt fasteners are in the same location as a push plate, countersink the fasteners flush with the door face allowing the push plate to sit flat against the door.

E. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

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

## 3.4 ADJUSTING

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

## 3.5 CLEANING AND PROTECTION

A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.

B. Clean adjacent surfaces soiled by door hardware installation.

C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

## 3.6 DEMONSTRATION

A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

## 3.7 DOOR HARDWARE SETS

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

1. Quantities listed are for each pair of doors, or for each single door.

2. The supplier is responsible for handing and sizing all products.
3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.

B. Manufacturer's Abbreviations:

1. MK - McKinney
2. MR - Markar
3. RF - Rixson
4. RO - Rockwood
5. RU - Corbin Russwin
6. AD - Adams Rite
7. RS - RITE Slide
8. NO - Norton
9. PE - Pemko
10. OT - Other
11. SU - Securitron

**Hardware Sets**

**Set: 1.0**

| | | | | |
|---|---|---|---|---|
| 1 | Pivot Set | 147 | 626 | RF |
| | Intermediate Pivot | M19 | 626 | RF |
| 1 | Electrified Inter Pivot | EM19 x QC | 626 | RF |
| 1 | Exit Device | ED4200 K157ET M92 MELR | 630 | RU |
| 1 | Cylinder | AS REQUIRED x AP | 626 | RU |
| 1 | Door Pull | RM3310-24 Mtg-Type 12HD | US32D | RO |
| 1 | Surface Closer | DC6210 A11 x BRKTS REQ'D | 689 | RU |
| 1 | Set Weatherstrip | BY DOOR MANUFACTURER | | OT |
| 1 | Threshold | 171A | | PE |
| 1 | Wiring Harness | QC-C1500P (@ JAMB) | | MK |
| 1 | Wiring Harness | QC-C000P x LAR | | MK |
| 1 | Wiring Diagram | RISER/POINT TO POINT | | OT |
| 1 | Card Reader | FURNISHED IN OTHER SECTION | | OT |
| 1 | Door Position Switch | DPS-M-BK | | SU |
| 1 | Power Supply | AQD AS REQUIRED | | SU |

OPERATION: DOOR NORMALLY CLOSED AND LOCKED. PRESENTATION OF AUTHORIZED CREDENTIAL SIGNALS LATCH RETRACTION AND ALLOWS INGRESS. EGRESS BY EXIT DEIVCE PUSH BAR AT ALL TIMES.

**Set: 2.0**

| | | | | |
|---|---|---|---|---|
| 2 | Pivot Set | 147 | 626 | RF |
| | Intermediate Pivot | M19 | 626 | RF |
| 2 | Electrified Inter Pivot | EM19 x QC | 626 | RF |
| 1 | Exit Device | ED4800 K157ET M92 MELR | 630 | RU |
| 1 | Exit Device | ED4800 EO M92 MELR | 630 | RU |
| 1 | Cylinder | AS REQUIRED x AP | 626 | RU |
| 2 | Door Pull | RM3310-24 Mtg-Type 12HD | US32D | RO |
| 1 | Automatic Operator (pair) | D6060-DMY/D6070-DMY FURNISHED IN OTHER SECTION | 689 | NO |
| 1 | Set Weatherstrip | BY DOOR MANUFACTURER | | OT |
| 1 | Threshold | 171A | | PE |
| 2 | Wiring Harness | QC-C1500P (@ JAMB) | | MK |
| 2 | Wiring Harness | QC-C000P x LAR | | MK |
| 1 | Wiring Diagram | RISER/POINT TO POINT | | OT |
| 1 | Card Reader | FURNISHED IN OTHER SECTION | | OT |
| 2 | Door Position Switch | DPS-M-BK | | SU |
| 2 | Door Switch | 500 SERIES FURNISHED IN OTHER SECTION | | NO |
| 1 | Power Supply | AQD AS REQUIRED | | SU |

OPERATION: DOORS NORMALLY CLOSED AND LOCKED. PRESENTATION OF AUTHORIZED CREDENTIAL ACTIVATES DOOR SWITCH AND SIGNALS LATCH RETRACT ALLOWING INGRESS. INPUT FROM ACTIVATED DOOR SWITCH SIGNALS LATCH RETRACTION AND CYCLES AUTOMATIC OPERATOR. EGRESS BY EXIT DEVICE PUSH BAR AT ALL TIMES.

**Set: 3.0**

| | | | | |
|---|---|---|---|---|
| 2 | Pivot Set | 147 | 626 | RF |
| | Intermediate Pivot | M19 | 626 | RF |
| 2 | Electrified Inter Pivot | EM19 x QC | 626 | RF |
| 1 | Exit Device | ED4800 K157ET M92 MELR | 630 | RU |
| 1 | Exit Device | ED4800 EO M92 | 630 | RU |
| 1 | Cylinder | AS REQUIRED x AP | 626 | RU |
| 2 | Door Pull | RM3310-24 Mtg-Type 12HD | US32D | RO |
| 1 | Automatic Operator (pair) | D6060-DMY/D6070-DMY FURNISHED IN OTHER SECTION | 689 | NO |
| 1 | Set Weatherstrip | BY DOOR MANUFACTURER | | OT |
| 1 | Threshold | 171A | | PE |
| 2 | Wiring Harness | QC-C1500P (@ JAMB) | | MK |
| 2 | Wiring Harness | QC-C000P x LAR | | MK |
| 1 | Wiring Diagram | RISER/POINT TO POINT | | OT |
| 1 | Card Reader | FURNISHED IN OTHER SECTION | | OT |
| 2 | Door Position Switch | DPS-M-BK | | SU |
| 2 | Door Switch | 500 SERIES FURNISHED IN OTHER SECTION | | NO |
| 1 | Power Supply | AQD AS REQUIRED | | SU |

OPERATION: INPUT FROM ACTIVATED DOOR SWTICH SIGNALS LATCH RETRACTION AND CYCLES AUTOMATIC OPERATOR. EGRESS BY EXIT DEVICE PUSH BAR AT ALL TIMES.

**Set: 4.0**

| | | | | |
|---|---|---|---|---|
| 1 | Pivot Set | 147 | 626 | RF |
| | Intermediate Pivot | M19 | 626 | RF |
| 1 | Exit Device | ED4200 K157ET | 630 | RU |
| 1 | Cylinder | AS REQUIRED x AP | 626 | RU |
| 1 | Door Pull | RM3310-24 Mtg-Type 12HD | US32D | RO |
| 1 | Surface Closer | DC6210 A11 x BRKTS REQ'D | 689 | RU |
| 1 | Set Weatherstrip | BY DOOR MANUFACTURER | | OT |
| 1 | Threshold | 171A | | PE |

**Set: 5.0**

| | | | | |
|---|---|---|---|---|
| 1 | Pivot Set | 147 | 626 | RF |
| | Intermediate Pivot | M19 | 626 | RF |
| 1 | Mortise Deadlock | MS1850S | 628 | AD |
| 1 | Cylinder | AS REQUIRED x AP | 626 | RU |
| 1 | Thumbturn Cylinder | AS REQUIRED x M34 | 626 | RU |
| 1 | Door Pull | RM3310-24 Mtg-Type 12HD | US32D | RO |
| 1 | Push Bar | RM3102 Mtg-Type 12HD | US32D | RO |
| 1 | Surface Closer | DC6210 A11 x BRKTS REQ'D | 689 | RU |
| 1 | Set Weatherstrip | BY DOOR MANUFACTURER | | OT |
| 1 | Threshold | 171A | | PE |

**Set: 6.0**

| | | | | |
|---|---|---|---|---|
| 1 | Continuous Hinge | FM300 EL ETAP | 630 | MR |
| 1 | Exit Device | ED5200 K157ET M92 MELR | 630 | RU |
| 1 | Cylinder | AS REQUIRED x AP | 626 | RU |
| 1 | Door Pull | RM3310-12 Mtg-Type 12HD | US32D | RO |
| 1 | Surface Closer | DC6210 A4 | 689 | RU |
| 1 | Kick Plate | K1050 8" high CSK | US32D | RO |
| 1 | Set Weatherstrip | 303AS | | PE |
| 1 | Rain Guard | 346C | | PE |

| | | | |
|---|---|---|---|
| 1 | Door Sweep | 315CN | PE |
| 1 | Threshold | 2716A | PE |
| 1 | Wiring Harness | QC-C1500P (@ JAMB) | MK |
| 1 | Wiring Harness | QC-C000P x LAR | MK |
| 1 | Wiring Diagram | RISER/POINT TO POINT | OT |
| 1 | Card Reader | FURNISHED IN OTHER SECTION | OT |
| 1 | Door Position Switch | DPS-M-BK | SU |
| 1 | Power Supply | AQD AS REQUIRED | SU |

OPERATION: DOOR NORMALLY CLOSED AND LOCKED. PRESENTATION OF AUTHORIZED CREDENTIAL SIGNALS LATCH RETRACTION AND ALLOWS INGRESS. EGRESS BY EXIT DEIVCE PUSH BAR AT ALL TIMES.

**Set: 7.0**

| | | | | |
|---|---|---|---|---|
| 1 | Continuous Hinge | FM300 | 630 | MR |
| 1 | Exit Device | ED5200 K157ET | 630 | RU |
| 1 | Cylinder | AS REQUIRED x AP | 626 | RU |
| 1 | Door Pull | RM3310-12 Mtg-Type 12HD | US32D | RO |
| 1 | Surface Closer | DC6210 A4 | 689 | RU |
| 1 | Kick Plate | K1050 8" high CSK | US32D | RO |
| 1 | Set Weatherstrip | 303AS | | PE |
| 1 | Rain Guard | 346C | | PE |
| 1 | Door Sweep | 315CN | | PE |
| 1 | Threshold | 2716A | | PE |

**Set: 8.0**

| | | | | |
|---|---|---|---|---|
| 1 | Continuous Hinge | FM300 | 630 | MR |
| 1 | Storeroom Lock | ML2057 LWA AP | 630 | RU |
| 1 | Surface Closer | DC6210 A4 | 689 | RU |
| 1 | Kick Plate | K1050 8" high CSK | US32D | RO |
| 1 | Set Weatherstrip | 303AS | | PE |
| 1 | Rain Guard | 346C | | PE |
| 1 | Door Sweep | 315CN | | PE |
| 1 | Threshold | 2716A | | PE |

| | | | |
|---|---|---|---|
| 1 | Hardware | SEE NOTE BELOW | OT |

NOTE: DOOR ST1L5 - CYLINDER TO BE ON STAIR SIDE OF DOOR. FREE EGRESS FROM ROOF AT ALL TIMES.

**Set: 9.0**

| | | | | |
|---|---|---|---|---|
| 2 | Continuous Hinge | FM300 | 630 | MR |
| 2 | Flush Bolt | 555/557 | US26D | RO |
| 1 | Dust Proof Strike | 570 | US26D | RO |
| 1 | Storeroom Lock | ML2057 LWA AP | 630 | RU |
| 2 | Surface Closer | DC6210 A4 | 689 | RU |
| 2 | Kick Plate | K1050 8" high CSK | US32D | RO |
| 1 | Set Astragal | 18041CNB | | PE |
| 1 | Set Weatherstrip | 303AS | | PE |
| 1 | Rain Guard | 346C | | PE |
| 2 | Door Sweep | 315CN | | PE |
| 1 | Threshold | 2716A | | PE |

**Set: 9.5**

| | | | | |
|---|---|---|---|---|
| 2 | Pivot Set | 147 | 626 | RF |
| | Intermediate Pivot | M19 | 626 | RF |
| 2 | Electrified Inter Pivot | EM19 x QC | 626 | RF |
| 1 | Exit Device | ED4800 K157ET M92 MELR | 630 | RU |
| 1 | Exit Device | ED4800 EO M92 MELR | 630 | RU |
| 1 | Cylinder | AS REQUIRED x AP | 626 | RU |

| | | | | |
|---|---|---|---|---|
| 2 | Door Pull | RM3310-24 Mtg-Type 12HD | US32D | RO |
| 1 | Automatic Operator (pair) | D6060-DMY/D6070-DMY FURNISHED IN OTHER SECTION | 689 | NO |
| 1 | Set Door Seals | BY DOOR MANUFACTURER | | OT |
| 2 | Wiring Harness | QC-C1500P (@ JAMB) | | MK |
| 2 | Wiring Harness | QC-C000P x LAR | | MK |
| 1 | Wiring Diagram | RISER/POINT TO POINT | | OT |
| 1 | Card Reader | FURNISHED IN OTHER SECTION | | OT |
| 2 | Door Position Switch | DPS-M-BK | | SU |
| 2 | Door Switch | 500 SERIES FURNISHED IN OTHER SECTION | | NO |
| 1 | Power Supply | AQD AS REQUIRED | | SU |

OPERATION: DOORS NORMALLY CLOSED AND LOCKED. PRESENTATION OF AUTHORIZED CREDENTIAL ACTIVATES DOOR SWITCH AND SIGNALS LATCH RETRACT ALLOWING INGRESS. INPUT FROM ACTIVATED DOOR SWITCH SIGNALS LATCH RETRACTION AND CYCLES AUTOMATIC OPERATOR. EGRESS BY EXIT DEVICE PUSH BAR AT ALL TIMES.

**Set: 10.0**

| | | | | |
|---|---|---|---|---|
| 2 | Pivot Set | 147 | 626 | RF |
| | Intermediate Pivot | M19 | 626 | RF |
| 1 | Electrified Inter Pivot | EM19 x QC | 626 | RF |
| 1 | Exit Device | ED4800 K157ET MELR | 630 | RU |
| 1 | Exit Device | ED4800 EO | 630 | RU |
| 1 | Cylinder | AS REQUIRED x AP | 626 | RU |
| 1 | Mullion Cylinder | AS REQUIRED x AP | 626 | RU |
| 2 | Door Pull | RM3310-24 Mtg-Type 12HD | US32D | RO |
| 2 | Surface Closer | DC6210 A11 x BRKTS REQ'D | 689 | RU |
| 1 | Automatic Operator (pair) | D6060-DMY/D6070-DMY FURNISHED IN OTHER SECTION | 689 | NO |
| 1 | Set Weatherstrip | BY DOOR MANUFACTURER | | OT |
| 1 | Wiring Harness | QC-C1500P (@ JAMB) | | MK |
| 1 | Wiring Harness | QC-C000P x LAR | | MK |
| 1 | Wiring Diagram | RISER/POINT TO POINT | | OT |
| 2 | Door Switch | 500 SERIES FURNISHED IN OTHER SECTION | | NO |
| 1 | Power Supply | AQD AS REQUIRED | | SU |

OPERATION: INPUT FROM DOOR SWTICH SIGNALS LATCH RETRACTION AND CYCLES AUTOMATIC OPERATOR. EGRESS BY EXIT DEVICE PUSH BAR AT ALL TIMES.

**Set: 11.0**

| | | | | |
|---|---|---|---|---|
| 2 | Pivot Set | 147 | 626 | RF |
| | Intermediate Pivot | M19 | 626 | RF |
| 1 | Exit Device | ED4800 K157ET | 630 | RU |
| 1 | Exit Device | ED4800 EO | 630 | RU |
| 1 | Cylinder | AS REQUIRED x AP | 626 | RU |
| 2 | Door Pull | RM3310-24 Mtg-Type 12HD | US32D | RO |
| 2 | Surface Closer | DC6210 A11 x BRKTS REQ'D | 689 | RU |
| 1 | Set Door Seals | BY DOOR MANUFACTURER | | OT |

**Set: 12.0**

| | | | | |
|---|---|---|---|---|
| | Hinge | TA2714 | US26D | MK |
| 1 | Electric Hinge | TA2714 x QC | US26D | MK |
| 1 | Electrified Lock | ML20906-SEC LWA M92 AP | 630 | RU |
| 1 | Surface Closer | DC6200 | 689 | RU |
| 1 | Door Stop | 409/441CU | US26D | RO |
| 1 | Set Door Seals | BY DOOR MANUFACTURER | | OT |
| 1 | Wiring Harness | QC-C1500P (@ JAMB) | | MK |
| 1 | Wiring Harness | QC-C000P x LAR | | MK |
| 1 | Wiring Diagram | RISER/POINT TO POINT | | OT |
| 1 | Card Reader | FURNISHED IN OTHER SECTION | | OT |
| 1 | Door Position Switch | DPS-M-BK | | SU |
| 1 | Power Supply | AQD AS REQUIRED | | SU |

OPERATION: DOOR NORMALLY CLOSED AND LOCKED. PRESENTATION OF AUTHORIZED CREDENTIAL UNLOCKS OUTSIDE LEVER AND ALLOWS INGRESS. EGRESS BY INSIDE LEVER AT ALL TIMES.

**Set: 13.0**

| | | | | |
|---|---|---|---|---|
| | Hinge | TA2714 | US26D | MK |
| 1 | Passage Latch | ML2010 LWA | 630 | RU |
| 1 | Door Stop | 409/441CU | US26D | RO |
| 1 | Set Door Seals | BY DOOR MANUFACTURER | | OT |

**Set: 14.0**

| | | | | |
|---|---|---|---|---|
| | Hinge | TA2714 | US26D | MK |
| 1 | Passage Latch | ML2010 LWA | 630 | RU |
| 1 | Overhead Stop | 10 SERIES | 630 | RF |
| 1 | Set Door Seals | BY DOOR MANUFACTURER | | OT |

**Set: 15.0**

| | | | | |
|---|---|---|---|---|
| | Hinge | TA2714 | US26D | MK |
| 1 | Office Lock | ML2051 LWA AP | 630 | RU |
| 1 | Door Stop | 409/441CU | US26D | RO |
| 1 | Set Door Seals | BY DOOR MANUFACTURER | | OT |

**Set: 16.0**

| | | | | |
|---|---|---|---|---|
| | Hinge | TA2714 | US26D | MK |
| 1 | Classroom Lock | ML2055 LWA AP | 630 | RU |
| 1 | Door Stop | 409/441CU | US26D | RO |
| 1 | Set Door Seals | BY DOOR MANUFACTURER | | OT |

**Set: 17.0**

| | | | | |
|---|---|---|---|---|
| | Hinge | TA2714 | US26D | MK |
| 1 | Classroom Lock | ML2055 LWA AP | 630 | RU |
| 1 | Overhead Stop | 10 SERIES | 630 | RF |

| | | | | |
|---|---|---|---|---|
| 1 | Set Door Seals | BY DOOR MANUFACTURER | | OT |

**Set: 18.0**

| | | | | |
|---|---|---|---|---|
| | Hinge | TA2714 | US26D | MK |
| 1 | Office Lock | ML2051 LWA AP | 630 | RU |
| 1 | Surface Closer | DC6200 x BRKTS REQ'D | 689 | RU |
| 1 | Door Stop | 409/441CU | US26D | RO |
| 1 | Set Door Seals | BY DOOR MANUFACTURER | | OT |

**Set: 19.0**

| | | | | |
|---|---|---|---|---|
| | Hinge | TA2714 | US26D | MK |
| 1 | Office Lock | ML2051 LWA AP | 630 | RU |
| 1 | Surface Closer | DC6210 A3 x BRKTS REQ'D | 689 | RU |
| 1 | Door Stop | 409/441CU | US26D | RO |
| 1 | Set Door Seals | BY DOOR MANUFACTURER | | OT |

**Set: 20.0**

| | | | | |
|---|---|---|---|---|
| | Hinge | TA2714 | US26D | MK |
| 1 | Electric Hinge | TA2714 x QC | US26D | MK |
| 1 | Exit Device | ED5200A L9903ET M92 | 630 | RU |
| 1 | Cylinder | AS REQUIRED x AP | 626 | RU |
| 1 | Surface Closer | DC6200 | 689 | RU |
| 1 | Kick Plate | K1050 8" high CSK | US32D | RO |
| 1 | Door Stop | 409/441CU | US26D | RO |
| 1 | Set Door Seals | S88BL | | PE |
| 1 | Wiring Harness | QC-C1500P (@ JAMB) | | MK |
| 1 | Wiring Harness | QC-C000P x LAR | | MK |
| 1 | Wiring Diagram | RISER/POINT TO POINT | | OT |
| 1 | Card Reader | FURNISHED IN OTHER SECTION | | OT |
| 1 | Door Position Switch | DPS-M-BK | | SU |
| 1 | Power Supply | AQD AS REQUIRED | | SU |
| 1 | Hardware | SEE NOTE BELOW | | OT |

OPERATION: DOOR NORMALLY CLOSED AND LOCKED. PRESENTATION OF AUTHORIZED CREDENTIAL UNLOCKS OUTSIDE LEVER AND ALLOWS INGRESS. EGRESS BY EXIT DEVICE PUSH BAR AT ALL TIMES.

NOTE: DOOR TO BE TIED INTO BUILDING'S FIRE ALARM SYSTEM.

**Set: 21.0**

| | | | | |
|---|---|---|---|---|
| | Hinge | TA2714 | US26D | MK |
| 1 | Electric Hinge | TA2714 x QC | US26D | MK |
| 1 | Exit Device | ED5200A L9903ET M92 | 630 | RU |
| 1 | Cylinder | AS REQUIRED x AP | 626 | RU |
| 1 | Overhead Stop | 10 SERIES | 630 | RF |
| 1 | Surface Closer | DC6200 | 689 | RU |
| 1 | Kick Plate | K1050 8" high CSK | US32D | RO |
| 1 | Set Door Seals | S88BL | | PE |
| 1 | Wiring Harness | QC-C1500P (@ JAMB) | | MK |
| 1 | Wiring Harness | QC-C000P x LAR | | MK |
| 1 | Wiring Diagram | RISER/POINT TO POINT | | OT |
| 1 | Card Reader | FURNISHED IN OTHER SECTION | | OT |
| 1 | Door Position Switch | DPS-M-BK | | SU |
| 1 | Power Supply | AQD AS REQUIRED | | SU |
| 1 | Hardware | SEE NOTE BELOW | | OT |

OPERATION: DOOR NORMALLY CLOSED AND LOCKED. PRESENTATION OF AUTHORIZED CREDENTIAL UNLOCKS OUTSIDE LEVER AND ALLOWS INGRESS. EGRESS BY EXIT DEVICE PUSH BAR AT ALL TIMES.

NOTE: DOOR TO BE TIED INTO BUILDING'S FIRE ALARM SYSTEM.

**Set: 22.0**

| | | | | |
|---|---|---|---|---|
| | Hinge | TA2714 | US26D | MK |
| 1 | Exit Device | ED5200A L910ET | 630 | RU |
| 1 | Surface Closer | DC6200 | 689 | RU |
| 1 | Kick Plate | K1050 8" high CSK | US32D | RO |
| 1 | Door Stop | 409/441CU | US26D | RO |
| 1 | Set Door Seals | S88BL | | PE |

**Set: 23.0**

| | | | | |
|---|---|---|---|---|
| | Hinge | TA2714 | US26D | MK |
| 1 | Exit Device | ED5200A L910ET | 630 | RU |
| 1 | Surface Closer | DC6210 A4 | 689 | RU |
| 1 | Kick Plate | K1050 8" high CSK | US32D | RO |
| 1 | Set Door Seals | S88BL | | PE |

**Set: 24.0**

| | | | | |
|---|---|---|---|---|
| | Hinge | TA2714 | US26D | MK |
| 1 | Exit Device | ED5200 L955ET | 630 | RU |
| 1 | Cylinder | AS REQUIRED x AP | 626 | RU |
| 1 | Surface Closer | DC6210 A4 | 689 | RU |
| 2 | Kick Plate | K1050 8" high CSK | US32D | RO |
| 1 | Set Door Seals/Silencers | S88BL/608 AS REQUIRED | | PE |

**Set: 25.0**

| | | | | |
|---|---|---|---|---|
| | Hinge | T4A3786 | US26D | MK |
| 1 | Exit Device | ED5470B L957ET M55 | 630 | RU |
| 1 | Exit Device | ED5470B EO M55 | 630 | RU |
| 1 | Cylinder | AS REQUIRED x AP | 626 | RU |
| 2 | Surface Closer | DC6210 A3 | 689 | RU |
| 2 | Kick Plate | K1050 8" high CSK | US32D | RO |
| 2 | Door Stop | 409/441CU | US26D | RO |
| 1 | Set Astragal | 18041CNB | | PE |
| 1 | Set Door Seals | S88BL | | PE |

**Set: 26.0**

| | | | | |
|---|---|---|---|---|
| | Hinge | TA2714 | US26D | MK |
| 1 | Electric Hinge | TA2714 x QC | US26D | MK |
| 1 | Electrified Lock | ML20906-SEC LWA M92 AP | 630 | RU |
| 1 | Surface Closer | DC6200 | 689 | RU |
| 1 | Kick Plate | K1050 8" high CSK | US32D | RO |
| 1 | Door Stop | 409/441CU | US26D | RO |
| 1 | Set Door Seals/Silencers | S88BL/608 AS REQUIRED | | PE |
| 1 | Wiring Harness | QC-C1500P (@ JAMB) | | MK |
| 1 | Wiring Harness | QC-C000P x LAR | | MK |
| 1 | Wiring Diagram | RISER/POINT TO POINT | | OT |
| 1 | Card Reader | FURNISHED IN OTHER SECTION | | OT |
| 1 | Door Position Switch | DPS-M-BK | | SU |
| 1 | Power Supply | AQD AS REQUIRED | | SU |

OPERATION: DOOR NORMALLY CLOSED AND LOCKED. PRESENTATION OF AUTHORIZED CREDENTIAL UNLOCKS OUTSIDE LEVER AND ALLOWS INGRESS. EGRESS BY INSIDE LEVER AT ALL TIMES.

**Set: 26.1**

| | | | | |
|---|---|---|---|---|
| | Hinge | T4A3786 | US26D | MK |
| 1 | Hinge | T4A3786 x QC | US26D | MK |
| 1 | Electrified Lock | ML20906-SEC LWA M92 AP | 630 | RU |
| 1 | Surface Closer | DC6200 | 689 | RU |
| 1 | Kick Plate | K1050 8" high CSK | US32D | RO |
| 1 | Door Stop | 409/441CU | US26D | RO |
| 1 | Set Door Seals/Silencers | S88BL/608 AS REQUIRED | | PE |
| 1 | Wiring Harness | QC-C1500P (@ JAMB) | | MK |
| 1 | Wiring Harness | QC-C000P x LAR | | MK |
| 1 | Wiring Diagram | RISER/POINT TO POINT | | OT |
| 1 | Card Reader | FURNISHED IN OTHER SECTION | | OT |
| 1 | Door Position Switch | DPS-M-BK | | SU |
| 1 | Power Supply | AQD AS REQUIRED | | SU |

OPERATION: DOOR NORMALLY CLOSED AND LOCKED. PRESENTATION OF AUTHORIZED CREDENTIAL UNLOCKS OUTSIDE LEVER AND ALLOWS INGRESS. EGRESS BY INSIDE LEVER AT ALL TIMES.

**Set: 27.0**

| | | | | |
|---|---|---|---|---|
| | Hinge | TA2714 | US26D | MK |
| 1 | Electric Hinge | TA2714 x QC | US26D | MK |
| 1 | Electrified Lock | ML20906-SEC LWA M92 AP | 630 | RU |
| 1 | Overhead Stop | 10 SERIES | 630 | RF |
| 1 | Surface Closer | DC6200 | 689 | RU |
| 1 | Kick Plate | K1050 8" high CSK | US32D | RO |
| 1 | Set Door Seals/Silencers | S88BL/608 AS REQUIRED | | PE |
| 1 | Wiring Harness | QC-C1500P (@ JAMB) | | MK |
| 1 | Wiring Harness | QC-C000P x LAR | | MK |
| 1 | Wiring Diagram | RISER/POINT TO POINT | | OT |
| 1 | Card Reader | FURNISHED IN OTHER SECTION | | OT |
| 1 | Door Position Switch | DPS-M-BK | | SU |
| 1 | Power Supply | AQD AS REQUIRED | | SU |

OPERATION: DOOR NORMALLY CLOSED AND LOCKED. PRESENTATION OF AUTHORIZED CREDENTIAL UNLOCKS OUTSIDE LEVER AND ALLOWS INGRESS. EGRESS BY INSIDE LEVER AT ALL TIMES.

**Set: 27.1**

| | | | | |
|---|---|---|---|---|
| | Hinge | T4A3786 | US26D | MK |
| 1 | Hinge | T4A3786 x QC | US26D | MK |
| 1 | Electrified Lock | ML20906-SEC LWA M92 AP | 630 | RU |
| 1 | Overhead Stop | 10 SERIES | 630 | RF |
| 1 | Surface Closer | DC6200 | 689 | RU |
| 1 | Kick Plate | K1050 8" high CSK | US32D | RO |
| 1 | Set Door Seals/Silencers | S88BL/608 AS REQUIRED | | PE |
| 1 | Wiring Harness | QC-C1500P (@ JAMB) | | MK |
| 1 | Wiring Harness | QC-C000P x LAR | | MK |
| 1 | Wiring Diagram | RISER/POINT TO POINT | | OT |
| 1 | Card Reader | FURNISHED IN OTHER SECTION | | OT |
| 1 | Door Position Switch | DPS-M-BK | | SU |
| 1 | Power Supply | AQD AS REQUIRED | | SU |

OPERATION: DOOR NORMALLY CLOSED AND LOCKED. PRESENTATION OF AUTHORIZED CREDENTIAL UNLOCKS OUTSIDE LEVER AND ALLOWS INGRESS. EGRESS BY INSIDE LEVER AT ALL TIMES.

**Set: 28.0**

| | | | | |
|---|---|---|---|---|
| | Hinge | TA2714 | US26D | MK |
| 1 | Electric Hinge | TA2714 x QC | US26D | MK |
| 1 | Electrified Lock | ML20906-SEC LWA M92 AP | 630 | RU |
| 1 | Surface Closer | DC6210 A3 | 689 | RU |
| 1 | Kick Plate | K1050 8" high CSK | US32D | RO |
| 1 | Door Stop | 409/441CU | US26D | RO |
| 1 | Set Door Seals/Silencers | S88BL/608 AS REQUIRED | | PE |
| 1 | Wiring Harness | QC-C1500P (@ JAMB) | | MK |
| 1 | Wiring Harness | QC-C000P x LAR | | MK |
| 1 | Wiring Diagram | RISER/POINT TO POINT | | OT |
| 1 | Card Reader | FURNISHED IN OTHER SECTION | | OT |
| 1 | Door Position Switch | DPS-M-BK | | SU |

| | | | | |
|---|---|---|---|---|
| 1 | Power Supply | AQD AS REQUIRED | | SU |

OPERATION: DOOR NORMALLY CLOSED AND LOCKED. PRESENTATION OF AUTHORIZED CREDENTIAL UNLOCKS OUTSIDE LEVER AND ALLOWS INGRESS. EGRESS BY INSIDE LEVER AT ALL TIMES.

**Set: 29.0**

| | | | | |
|---|---|---|---|---|
| | Hinge | TA2714 | US26D | MK |
| 1 | Electric Hinge | TA2714 x QC | US26D | MK |
| 1 | Electrified Lock | ML20906-SEC LWA M92 AP | 630 | RU |
| 1 | Surface Closer | DC6210 A4 | 689 | RU |
| 1 | Kick Plate | K1050 8" high CSK | US32D | RO |
| 1 | Set Door Seals/Silencers | S88BL/608 AS REQUIRED | | PE |
| 1 | Wiring Harness | QC-C1500P (@ JAMB) | | MK |
| 1 | Wiring Harness | QC-C000P x LAR | | MK |
| 1 | Wiring Diagram | RISER/POINT TO POINT | | OT |
| 1 | Card Reader | FURNISHED IN OTHER SECTION | | OT |
| 1 | Door Position Switch | DPS-M-BK | | SU |
| 1 | Power Supply | AQD AS REQUIRED | | SU |

OPERATION: DOOR NORMALLY CLOSED AND LOCKED. PRESENTATION OF AUTHORIZED CREDENTIAL UNLOCKS OUTSIDE LEVER AND ALLOWS INGRESS. EGRESS BY INSIDE LEVER AT ALL TIMES.

**Set: 30.0**

| | | | | |
|---|---|---|---|---|
| | Hinge | TA2714 | US26D | MK |
| 1 | Passage Latch | ML2010 LWA | 630 | RU |
| 1 | Door Stop | 409/441CU | US26D | RO |
| 1 | Set Door Seals/Silencers | S88BL/608 AS REQUIRED | | PE |

**Set: 31.0**

| | | | | |
|---|---|---|---|---|
| | Hinge | T4A3786 | US26D | MK |
| 1 | Passage Latch | ML2010 LWA | 630 | RU |
| 1 | Door Stop | 409/441CU | US26D | RO |
| 1 | Set Door Seals/Silencers | S88BL/608 AS REQUIRED | | PE |

**Set: 32.0**

| | | | | |
|---|---|---|---|---|
| | Hinge | TA2714 | US26D | MK |
| 1 | Passage Latch | ML2010 LWA | 630 | RU |
| 1 | Overhead Stop | 10 SERIES | 630 | RF |
| 1 | Set Door Seals/Silencers | S88BL/608 AS REQUIRED | | PE |

**Set: 33.0**

| | | | | |
|---|---|---|---|---|
| | Hinge | TA2714 | US26D | MK |
| 1 | Passage Latch | ML2010 LWA | 630 | RU |
| 1 | Overhead Stop | 10 SERIES | 630 | RF |
| 1 | Set Door Seals | S88BL | | PE |
| 1 | Door Bottom | 411ARL | | PE |

**Set: 34.0**

| | | | | |
|---|---|---|---|---|
| | Hinge | TA2714 | US26D | MK |
| 1 | Passage Latch | ML2010 LWA | 630 | RU |
| 1 | Surface Closer | DC6200 | 689 | RU |
| 1 | Kick Plate | K1050 8" high CSK | US32D | RO |
| 1 | Door Stop | 409/441CU | US26D | RO |
| 1 | Set Door Seals/Silencers | S88BL/608 AS REQUIRED | | PE |

**Set: 35.0**

| | | | | |
|---|---|---|---|---|
| | Hinge | TA2714 | US26D | MK |
| 1 | Passage Latch | ML2010 LWA | 630 | RU |
| 1 | Overhead Stop | 10 SERIES | 630 | RF |
| 1 | Surface Closer | DC6200 | 689 | RU |
| 1 | Set Door Seals/Silencers | S88BL/608 AS REQUIRED | | PE |

**Set: 36.0**

| | | | | |
|---|---|---|---|---|
| | Hinge | TA2714 | US26D | MK |
| 1 | Passage Latch | ML2010 LWA | 630 | RU |

| | | | | |
|---|---|---|---|---|
| 1 | Surface Closer | DC6210 A3 | 689 | RU |
| 1 | Kick Plate | K1050 8" high CSK | US32D | RO |
| 1 | Door Stop | 409/441CU | US26D | RO |
| 1 | Set Door Seals/Silencers | S88BL/608 AS REQUIRED | | PE |

**Set: 37.0**

| | | | | |
|---|---|---|---|---|
| | Hinge | TA2714 | US26D | MK |
| 1 | Passage Latch | ML2010 LWA | 630 | RU |
| 1 | Surface Closer | DC6210 A4 | 689 | RU |
| 1 | Kick Plate | K1050 8" high CSK | US32D | RO |
| 1 | Set Door Seals/Silencers | S88BL/608 AS REQUIRED | | PE |

**Set: 38.0**

| | | | | |
|---|---|---|---|---|
| | Hinge | TA2714 | US26D | MK |
| 1 | Privacy Lock | ML2060 LWA M34 V21 | 630 | RU |
| 1 | Surface Closer | DC6200 | 689 | RU |
| 1 | Kick Plate | K1050 8" high CSK | US32D | RO |
| 1 | Door Stop | 409/441CU | US26D | RO |
| 1 | Set Door Seals/Silencers | S88BL/608 AS REQUIRED | | PE |

**Set: 39.0**

| | | | | |
|---|---|---|---|---|
| | Hinge | TA2714 | US26D | MK |
| 1 | Privacy Lock | ML2060 LWA M34 V21 | 630 | RU |
| 1 | Overhead Stop | 10 SERIES | 630 | RF |
| 1 | Surface Closer | DC6200 | 689 | RU |
| 1 | Kick Plate | K1050 8" high CSK | US32D | RO |
| 1 | Set Door Seals/Silencers | S88BL/608 AS REQUIRED | | PE |

**Set: 40.0**

| | | | | |
|---|---|---|---|---|
| | Hinge | TA2714 | US26D | MK |

| | | | | |
|---|---|---|---|---|
| 1 | Privacy Lock | ML2060 LWA M34 V21 | 630 | RU |
| 1 | Surface Closer | DC6210 A3 | 689 | RU |
| 1 | Kick Plate | K1050 8" high CSK | US32D | RO |
| 1 | Door Stop | 409/441CU | US26D | RO |
| 1 | Set Door Seals/Silencers | S88BL/608 AS REQUIRED | | PE |

**Set: 41.0**

| | | | | |
|---|---|---|---|---|
| | Hinge | TA2714 | US26D | MK |
| 1 | Office Lock | ML2051 LWA AP | 630 | RU |
| 1 | Door Stop | 409/441CU | US26D | RO |
| 1 | Set Door Seals/Silencers | S88BL/608 AS REQUIRED | | PE |

**Set: 41.1**

| | | | | |
|---|---|---|---|---|
| | Hinge | TA2714 | US26D | MK |
| 1 | Office Lock | ML2051 LWA AP | 630 | RU |
| 1 | Overhead Stop | 10 SERIES | 630 | RF |
| 1 | Door Stop | 409/441CU | US26D | RO |
| 1 | Set Door Seals/Silencers | S88BL/608 AS REQUIRED | | PE |

**Set: 42.0**

| | | | | |
|---|---|---|---|---|
| | Hinge | TA2714 | US26D | MK |
| 1 | Classroom Lock | ML2055 LWA AP | 630 | RU |
| 1 | Door Stop | 409/441CU | US26D | RO |
| 1 | Set Door Seals/Silencers | S88BL/608 AS REQUIRED | | PE |

**Set: 43.0**

| | | | | |
|---|---|---|---|---|
| | Hinge | TA2714 | US26D | MK |
| 1 | Classroom Lock | ML2055 LWA AP | 630 | RU |
| 1 | Overhead Stop | 10 SERIES | 630 | RF |

| | | | | |
|---|---|---|---|---|
| 1 | Set Door Seals/Silencers | S88BL/608 AS REQUIRED | | PE |

**Set: 44.0**

| | | | | |
|---|---|---|---|---|
| | Hinge | T4A3786 | US26D | MK |
| 1 | Classroom Lock | ML2055 LWA AP | 630 | RU |
| 1 | Overhead Stop | 10 SERIES | 630 | RF |
| 1 | Set Door Seals/Silencers | S88BL/608 AS REQUIRED | | PE |

**Set: 45.0**

| | | | | |
|---|---|---|---|---|
| | Hinge | TA2714 | US26D | MK |
| 1 | Classroom Lock | ML2055 LWA AP | 630 | RU |
| 1 | Surface Closer | DC6200 | 689 | RU |
| 1 | Kick Plate | K1050 8" high CSK | US32D | RO |
| 1 | Door Stop | 409/441CU | US26D | RO |
| 1 | Set Door Seals/Silencers | S88BL/608 AS REQUIRED | | PE |

**Set: 46.0**

| | | | | |
|---|---|---|---|---|
| | Hinge | TA2714 | US26D | MK |
| 1 | Classroom Lock | ML2055 LWA AP | 630 | RU |
| 1 | Overhead Stop | 10 SERIES | 630 | RF |
| 1 | Surface Closer | DC6200 | 689 | RU |
| 1 | Kick Plate | K1050 8" high CSK | US32D | RO |
| 1 | Set Door Seals/Silencers | S88BL/608 AS REQUIRED | | PE |

**Set: 47.0**

| | | | | |
|---|---|---|---|---|
| | Hinge | TA2714 | US26D | MK |
| 1 | Classroom Lock | ML2055 LWA AP | 630 | RU |
| 1 | Surface Closer | DC6210 A3 | 689 | RU |
| 1 | Kick Plate | K1050 8" high CSK | US32D | RO |
| 1 | Door Stop | 409/441CU | US26D | RO |
| 1 | Set Door Seals/Silencers | S88BL/608 AS REQUIRED | | PE |

**Set: 48.0**

| | | | | |
|---|---|---|---|---|
| | Hinge | T4A3786 | US26D | MK |

| | | | | |
|---|---|---|---|---|
| 1 | Flush Bolt | 2805/2905 | US26D | RO |
| 1 | Classroom Lock | ML2055 LWA AP | 630 | RU |
| 1 | Coordinator | 2600 x FILLER BAR x CLOSER MTG BRKTS | Black | RO |
| 2 | Surface Closer | DC6210 A3 | 689 | RU |
| 2 | Kick Plate | K1050 8" high CSK | US32D | RO |
| 2 | Door Stop | 409/441CU | US26D | RO |
| 1 | Set Door Seals/Silencers | S88BL/608 AS REQUIRED | | PE |

**Set: 49.0**

| | | | | |
|---|---|---|---|---|
| | Hinge | TA2714 | US26D | MK |
| 1 | Storeroom Lock | ML2057 LWA AP | 630 | RU |
| 1 | Door Stop | 409/441CU | US26D | RO |
| 1 | Set Door Seals/Silencers | S88BL/608 AS REQUIRED | | PE |

**Set: 50.0**

| | | | | |
|---|---|---|---|---|
| | Hinge | TA2714 | US26D | MK |
| 1 | Storeroom Lock | ML2057 LWA AP | 630 | RU |
| 1 | Overhead Stop | 10 SERIES | 630 | RF |
| 1 | Set Door Seals/Silencers | S88BL/608 AS REQUIRED | | PE |

**Set: 51.0**

| | | | | |
|---|---|---|---|---|
| | Hinge | TA2714 | US26D | MK |
| 1 | Storeroom Lock | ML2057 LWA AP | 630 | RU |
| 1 | Surface Closer | DC6200 | 689 | RU |
| 1 | Kick Plate | K1050 8" high CSK | US32D | RO |
| 1 | Door Stop | 409/441CU | US26D | RO |
| 1 | Set Door Seals/Silencers | S88BL/608 AS REQUIRED | | PE |

**Set: 52.0**

| | | | | |
|---|---|---|---|---|
| | Hinge | TA2714 | US26D | MK |

| | | | | |
|---|---|---|---|---|
| 1 | Storeroom Lock | ML2057 LWA AP | 630 | RU |
| 1 | Overhead Stop | 10 SERIES | 630 | RF |
| 1 | Surface Closer | DC6200 | 689 | RU |
| 1 | Kick Plate | K1050 8" high CSK | US32D | RO |
| 1 | Set Door Seals/Silencers | S88BL/608 AS REQUIRED | | PE |

**Set: 53.0**

| | | | | |
|---|---|---|---|---|
| | Hinge | TA2714 | US26D | MK |
| 1 | Flush Bolt | 555/557 | US26D | RO |
| 1 | Storeroom Lock | ML2057 LWA AP | 630 | RU |
| 2 | Overhead Stop | 10 SERIES | 630 | RF |
| 1 | Set Door Seals/Silencers | S88BL/608 AS REQUIRED | | PE |

**Set: 54.0**

| | | | | |
|---|---|---|---|---|
| | Hinge | TA2714 | US26D | MK |
| 1 | Push Plate | 70F | US32D | RO |
| 1 | Pull Plate | BF 111x70C | US32D | RO |
| 1 | Surface Closer | DC6200 | 689 | RU |
| 1 | Kick Plate | K1050 8" high CSK | US32D | RO |
| 1 | Door Stop | 409/441CU | US26D | RO |
| 1 | Set Door Seals/Silencers | S88BL/608 AS REQUIRED | | PE |

**Set: 55.0**

| | | | | |
|---|---|---|---|---|
| | Hinge | TA2714 | US26D | MK |
| 1 | Push Plate | 70F | US32D | RO |
| 1 | Pull Plate | BF 111x70C | US32D | RO |
| 1 | Overhead Stop | 10 SERIES | 630 | RF |
| 1 | Surface Closer | DC6200 | 689 | RU |
| 1 | Kick Plate | K1050 8" high CSK | US32D | RO |
| 1 | Set Door Seals/Silencers | S88BL/608 AS REQUIRED | | PE |

**Set: 56.0**

| | | | | |
|---|---|---|---|---|
| 1 | Passage | S9610 x MUNICH LEVER | 630 | RS |
| 1 | Hardware | SEE NOTE BELOW | | OT |

NOTE: SLIDING DOOR SYSTEM - DOOR TO BE PART OF RITE SLIDE ASSEMBLY.

**Set: 57.0**

| | | | | |
|---|---|---|---|---|
| 1 | Privacy Lock | S9640 x MUNICH LEVER | 630 | RS |
| 1 | Hardware | SEE NOTE BELOW | | OT |

NOTE: SLIDING DOOR SYSTEM - DOOR TO BE PART OF RITE SLIDE ASSEMBLY.

**Set: 58.0**

| | | | | |
|---|---|---|---|---|
| 1 | Storeroom Lock | S9680 x MUNICH LEVER | 630 | RS |
| 1 | Cylinder | AS REQUIRED x AP | 626 | RU |
| 1 | Hardware | SEE NOTE BELOW | | OT |

NOTE: SLIDING DOOR SYSTEM - DOOR TO BE PART OF RITE SLIDE ASSEMBLY.

**Set: 59.0**

| | | | | |
|---|---|---|---|---|
| 1 | Hardware | SEE NOTE BELOW | | OT |

NOTE: OVERHEAD DOOR - ALL HARDWARE TO BE SUPPLIED BY DOOR MANUFACTURER.

**Set: 60.0**

| | | | | |
|---|---|---|---|---|
| | Hinge | TA2714 | US26D | MK |
| 1 | Electric Hinge | TA2714 x QC | US26D | MK |
| 1 | Exit Device | ED5200 D L910ET M93 | 630 | RU |
| 1 | Cylinder | AS REQUIRED x AP | 626 | RU |
| 1 | Surface Closer | DC6200/DC6210 | 689 | RU |
| 1 | Kick Plate | K1050 8" high CSK | US32D | RO |
| 1 | Door Stop | 409/441CU | US26D | RO |
| 1 | Set Door Seals/Silencers | S88BL/608 AS REQUIRED | | PE |
| 1 | Wiring Harness | QC-C1500P (@ JAMB) | | MK |

| | | | |
|---|---|---|---|
| 1 | Wiring Harness | QC-C000P x LAR | MK |
| 1 | Wiring Diagram | RISER/POINT TO POINT | OT |
| 1 | Card Reader | FURNISHED IN OTHER SECTION | OT |
| 1 | Door Position Switch | DPS-M-BK | SU |
| 1 | Power Supply | AQD AS REQUIRED | SU |
| 1 | Hardware | SEE NOTE BELOW | OT |

OPERATION: DOOR NORMALLY CLOSED AND LOCKED. PRESENTATION OF AUTHORIZED CREDENTIAL SHUNTS DELAYED EGRESS FOR AUTHORIZED EGRESS. WHEN ARMED - DEPRESSING EXIT DEVICE PUSH BAR WITHOUT AUTHORIZED CREDENTIAL WILL INITITATE DELAYED EGRESS. LEVER TRIM MONITOR (M93) TO SHUNT DELAYED EGRESS FOR AUTHORIZED INGRESS AT ALL TIMES.

NOTE: DOOR TO BE TIED INTO BUILDING'S FIRE ALARM SYSTEM.

**Set: 61.0**

| | | | | |
|---|---|---|---|---|
| | Hinge | TA2714 | US26D | MK |
| 2 | Electric Hinge | TA2714 x QC | US26D | MK |
| 2 | Exit Device | ED5470 D L910ET M55 M93 | 630 | RU |
| 2 | Cylinder | AS REQUIRED x AP | 626 | RU |
| 2 | Surface Closer | DC6210 A4 | 689 | RU |
| 2 | Kick Plate | K1050 8" high CSK | US32D | RO |
| 1 | Set Door Seals/Silencers | S88BL/608 AS REQUIRED | | PE |
| 2 | Wiring Harness | QC-C1500P (@ JAMB) | | MK |

| | | | |
|---|---|---|---|
| 2 | Wiring Harness | QC-C000P x LAR | MK |
| 1 | Wiring Diagram | RISER/POINT TO POINT | OT |
| 1 | Card Reader | FURNISHED IN OTHER SECTION | OT |
| 2 | Door Position Switch | DPS-M-BK | SU |
| 1 | Power Supply | AQD AS REQUIRED | SU |
| 1 | Hardware | SEE NOTE BELOW | OT |

OPERATION: DOOR NORMALLY CLOSED AND LOCKED. PRESENTATION OF AUTHORIZED CREDENTIAL SHUNTS DELAYED EGRESS FOR AUTHORIZED EGRESS. WHEN ARMED - DEPRESSING EXIT DEVICE PUSH BAR WITHOUT AUTHORIZED CREDENTIAL WILL INITITATE DELAYED EGRESS. LEVER TRIM MONITOR (M93) TO SHUNT DELAYED EGRESS FOR AUTHORIZED INGRESS AT ALL TIMES.

NOTE: DOOR TO BE TIED INTO BUILDING'S FIRE ALARM SYSTEM.

**Set: 62.0**

| | | | | |
|---|---|---|---|---|
| | Hinge | TA2714 | US26D | MK |
| 1 | Electric Hinge | TA2714 x QC | US26D | MK |
| 1 | Flush Bolt | 2805/2905 | US26D | RO |
| 1 | Electrified Lock | ML20906-SEC LWA M92 AP | 630 | RU |
| 1 | Coordinator | 2600 x FILLER BAR x CLOSER MTG BRKTS | Black | RO |
| 2 | Surface Closer | DC6210 A4 | 689 | RU |

| | | | | |
|---|---|---|---|---|
| 2 | Kick Plate | K1050 8" high CSK | US32D | RO |
| 1 | Set Door Seals/Silencers | S88BL/608 AS REQUIRED | | PE |
| 1 | Wiring Harness | QC-C1500P (@ JAMB) | | MK |
| 1 | Wiring Harness | QC-C000P x LAR | | MK |
| 1 | Wiring Diagram | RISER/POINT TO POINT | | OT |
| 1 | Card Reader | FURNISHED IN OTHER SECTION | | OT |
| 2 | Door Position Switch | DPS-M-BK | | SU |
| 1 | Power Supply | AQD AS REQUIRED | | SU |

OPERATION: DOOR NORMALLY CLOSED AND LOCKED. PRESENTATION OF AUTHORIZED CREDENTIAL UNLOCKS OUTSIDE LEVER AND ALLOWS INGRESS. EGRESS BY INSIDE LEVER AT ALL TIMES.

END OF SECTION 087100

# SECTION 08 71 13

# POWER DOOR OPERATORS

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Low-energy door operators for swinging doors.

### 1.2 DEFINITIONS

A. AAADM: American Association of Automatic Door Manufacturers.

B. Activation Device: A control that, when actuated, sends an electrical signal to the door operator to open the door.

C. Double-Egress (Doors): A pair of doors that simultaneously swing, with the two doors moving in opposite directions with no mullion between them.

D. Double-Swing (Doors): A pair of doors that swing, with the two doors moving in opposite directions with a mullion between them; each door functioning as a single-swing door.

E. Safety Device: A control that, to avoid injury, prevents a door from opening or closing.

F. For automatic door terminology, see BHMA A156.10 for definitions of terms.

### 1.3 COORDINATION

A. Coordinate sizes and locations of recesses in concrete floors for recessed control mats that control power door operators. Concrete, reinforcement, and formwork requirements are specified elsewhere.

B. Templates: Distribute for doors, frames, and other work specified to be factory prepared and reinforced for installing power door operators.

C. Coordinate hardware for doors with operators to ensure proper size, thickness, hand, function, and finish.

D. Electrical System Roughing-in: Coordinate layout and installation of power door operators with connections to the following:
   1. Power supplies.

2. Access-control system.
3. Remote activation devices.
4. Remote monitoring 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 construction details, material descriptions, dimensions of individual components and profiles, and finishes for power door operators.
   2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For power door operators.
   1. Include plans, elevations, sections, hardware mounting heights, and attachment details.
   2. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Indicate locations of activation and safety devices.
   4. Include diagrams for power, signal, and control wiring.
   5. Include plans, elevations, sections, and attachment details for guide rails.

C. Samples: For each exposed product and for each color and texture specified, manufacturer's standard size.

## 1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

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

## 1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For power door operators, safety devices, and control systems, to include in maintenance manuals.

## 1.8 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer for installation and maintenance of units required for this Project.
   1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

## 1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of power door operators that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Faulty or sporadic operation of power door operator, including controls.
      b. Deterioration of metals, metal finishes, and other materials beyond normal weathering or use.
   2. Warranty Period: Two 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. ASSA ABLOY Entrance Systems; ASSA ABLOY.
   2. LCN; Allegion plc.
   3. STANLEY Access Technologies LLC; STANLEY Security Solutions, Inc.

B. Source Limitations: Obtain power door operators, including activation and safety devices, from single source from single manufacturer.

## 2.2 POWER DOOR OPERATORS, GENERAL

A. General: Provide operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; and for long-term, maintenance-free operation under normal traffic load for occupancy type indicated; and in accordance with UL 325. Coordinate operator mechanisms with door operation, hinges, and activation and safety devices.
   1. Emergency Breakaway: Where indicated for center-pivoted doors, provide emergency breakaway feature for reverse swing of doors. Equip system to discontinue power to power door operator when door is in emergency breakaway position, to return door to closed position after breakaway, and to automatically reset.
   2. Fire-Rated Doors: Provide door operators for fire-rated door assemblies that comply with NFPA 80 for fire-rated door components and are listed and labeled by a qualified testing agency.
   3. Wind Load: Provide door operators on exterior doors that will open and close doors and maintain them in fully closed position when subjected to wind load indicated on Structural Drawings.

B. Electromechanical Operating System: Self-contained unit powered by permanent-magnet dc motor; with closing speed controlled mechanically by gear train and dynamically by braking action of electric motor, connections for power and activation- and safety-device wiring, and manual operation, including spring closing when power

is off.

C. Hinges: See Section 08 71 00 "Door Hardware" for hinge type for each door that door operator shall accommodate.

D. Housing for Overhead Concealed Operators: Fabricated from minimum 0.125-inch-thick, extruded or formed aluminum and extending full width of door opening, including door jambs, to conceal door operators and controls. Provide hinged or removable access panels for service and adjustment of door operators and controls. Secure panels to prevent unauthorized access.

E. Cover for Surface-Mounted Operators: Fabricated from 0.125-inch- thick, extruded or formed aluminum; manufacturer's standard width; with enclosed end caps, provision for maintenance access, and fasteners concealed when door is in closed position.

F. Brackets and Reinforcements: Fabricated from aluminum with nonstaining, nonferrous shims for aligning system components.

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

## 2.3 LOW-ENERGY DOOR OPERATORS FOR SWINGING DOORS

A. Standard: BHMA A156.19.

B. Performance Requirements:
   1. Opening Force if Power Fails: Not more than 15 lbf required to release latch if provided, not more than 30 lbf required to manually set door in motion, and not more than 15 lbf required to fully open door.
   2. Entrapment-Prevention Force: Not more than 15 lbf required to prevent stopped door from closing or opening.

C. Configuration, Single: Operator to control single swinging door.
   1. Traffic Pattern: Two way.
   2. Operator Mounting: Surface.

D. Configuration, Pair: Operator to control pair of swinging doors.
   1. Traffic Pattern: Two way.
   2. Operator Mounting: Surface.

E. Operation: Power opening and spring closing. Provide time delay for door to remain open before initiating closing cycle as required by BHMA A156.19. When not in automatic mode, door operator shall function as manual door closer, with or without electrical power.

F. Operating System: Electromechanical.

G. Microprocessor Control Unit: Solid-state controller.

H. Activation Device: Push-plate switch on each side of door to activate door operator.

I. Exposed Finish: Finish matching door and frame.

## 2.4 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
   1. Extrusions: ASTM B221.
   2. Sheet: ASTM B209.

B. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304, stretcher-leveled standard of flatness, in manufacturer's standard thickness.

C. Fasteners and Accessories: Corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

## 2.5 CONTROLS

A. General: Provide controls, including activation and safety devices, in accordance with BHMA standards; for condition of exposure; and for long-term, maintenance-free operation under normal traffic load for occupancy type indicated. Coordinate activation and safety devices with door operation and door operator mechanisms.

B. Push-Plate Switch: Momentary-contact door control switch with flat push-plate actuator with contrasting-colored, engraved message.
   1. Configuration:
      a. Square push plate with 4-by-4-inch junction box.
         1) Mounting: As indicated on Drawings.
   2. Push-Plate Material: Stainless steel as selected by Architect from manufacturer's full range.
   3. Message: International symbol of accessibility and "Push to Open."

C. Electrical Interlocks: Unless units are equipped with self-protecting devices or circuits, provide electrical interlocks to prevent activation of operator when door is locked, latched, or bolted.

D. At all times, free egress from the building interior to exterior shall be provided.

## 2.6 FABRICATION

A. Factory fabricate power door operators to comply with indicated standards.

B. Form aluminum shapes before finishing.

C. Fabricate exterior components to drain condensation and water-passing joints within operator enclosure to the exterior.

D. Use concealed fasteners to greatest extent possible. Where exposed fasteners are required, use countersunk Phillips flat-head machine screws, finished to match operator.

E. Provide metal cladding, completely covering visible surfaces before shipment to Project site. Fabricate cladding with concealed fasteners and connection devices, with accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion, and with allowance for thermal expansion at exterior doors.

## 2.7 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying strippable, temporary, protective covering before shipping.

B. Apply organic and anodic finishes to formed metal after fabrication unless otherwise indicated.

C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within range of approved Samples and are assembled or installed to minimize contrast.

## 2.8 ALUMINUM FINISHES

A. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

# PART 3 EXECUTION

## 3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances, door and frame preparation and reinforcements, and other conditions affecting performance of power door operators.

B. Examine roughing-in for electrical systems to verify actual locations of power connections before power door operator installation.

C. Verify that full-height finger guards are installed at each door with pivot hinges, where door has a clearance at hinge side greater than 1/4 inch and less than 3/4 inch with door in any position.

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

## 3.2 INSTALLATION, GENERAL

A. Install power door operators in accordance with manufacturer's written instructions and cited BHMA standard for type of door operation and direction of pedestrian travel, including signage, controls, wiring, remote power units if any, and connection to building's power supply.
   1. Do not install damaged components. Fit joints to produce hairline joints free of burrs and distortion.
   2. Install operators true in alignment with established lines and door geometry without warp or rack. Anchor securely in place.

B. Controls: Install activation and safety devices in accordance with manufacturer's written instructions and cited BHMA standard for operator type and direction of pedestrian travel. Connect control wiring in accordance with Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

C. Access-Control System: Connect operators to access-control system as specified in Section 28 15 00 "Access Control Hardware Devices."

D. Signage: Apply on both sides of each door as required by cited BHMA standard for type of door operator and direction of pedestrian travel.

## 3.3 FIELD QUALITY CONTROL

A. Certified Inspector: Engage a Certified Inspector to test and inspect components, assemblies, and installations, including connections.

B. Perform the following tests and inspections:
   1. Test and inspect each power door operator installation, using AAADM inspection forms, to determine compliance of installed systems with applicable BHMA standards.

C. Power door operators will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

## 3.4 ADJUSTING

A. Adjust power door operators to function smoothly, and lubricate as recommended by manufacturer; comply with requirements of applicable BHMA standards.
   1. Adjust operators on exterior doors for tight closure.

B. After completing installation of power door operators, inspect exposed finishes on doors and operators. Repair damaged finish to match original finish.

C. Readjust power door operators and controls after repeated operation of completed installation equivalent to three days' use by normal traffic (100 to 300 cycles).

D. Occupancy Adjustment: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

## 3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain power door operators.

**END OF SECTION**

# SECTION 08 80 00

# GLAZING

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Glass products.
   2. Insulating glass.
   3. Spandrel insulated glass.
   4. Glazing sealants.
   5. Miscellaneous glazing materials.

### 1.2 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. IBC: International Building Code.

D. Interspace: Space between lites of an insulating-glass unit.

### 1.3 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.

### 1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Glass Samples: For each type of the following products; 12 inches square.
   1. Insulating glass.
   2. Spandrel glass.

## 1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturers of fabricated glass units and sealant testing agency.

B. Product Test Reports: For fabricated glass and glazing sealants, for tests performed by a qualified testing agency.
   1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.

C. Sample Warranties: For special warranties.

## 1.6 QUALITY ASSURANCE

A. Fabricated-Glass Manufacturer Qualifications: A qualified manufacturer of fabricated glass units who is approved and certified by primary glass manufacturer.

B. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.

## 1.7 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.

B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

## 1.8 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.

### 1.9 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.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

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

B. Source Limitations for Glazing Accessories: For each product and installation method, obtain from single source from single manufacturer.

### 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. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined in accordance with the IBC and ASTM E1300:
   1. Design Wind Pressures: Determine design wind pressures applicable to Project in accordance with ASCE/SEI 7, based on heights above grade indicated on Drawings.
      a. Wind Design Data: As indicated on Drawings.
   2. 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 times the short-side length or 1 inch, whichever is less.
   3. Thermal Loads: Design glazing to resist thermal stress breakage induced by differential temperature conditions and limited air circulation within individual glass lites and insulated glazing units.

C. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

## 2.3 GLASS PRODUCTS, GENERAL

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: "Glazing Manual."
   2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction or manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the IGCC.

D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than thickness indicated.
   1. Minimum Glass Thickness for Exterior Lites: 6 mm.
   2. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.

E. Strength: 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" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

## 2.4 GLASS PRODUCTS

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. Reflective- and Low-E-Coated Vision Glass: ASTM C1376.

D. Ceramic-Coated Spandrel Glass: ASTM C1048, Type I, Condition B, Quality-Q3.

## 2.5 INSULATING GLASS

A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified in accordance with ASTM E2190.
   1. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.
   2. Perimeter Spacer: Manufacturer's standard spacer material and construction.
   3. Desiccant: Molecular sieve or silica gel, or a blend of both.

## 2.6 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.
   3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range of industry colors.

B. Neutral-Curing Silicone Glazing Sealant, Class 100/50: Complying with ASTM C920, Type S, Grade NS, Use NT.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. GE Construction Sealants; Momentive Performance Materials Inc.
      b. Pecora Corporation.
      c. Sika Corporation.
      d. The Dow Chemical Company.
      e. Tremco Incorporated.

C. Neutral-Curing Silicone Glazing Sealant, Class 50: Complying with ASTM C920, Type S, Grade NS, Use NT.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. GE Construction Sealants; Momentive Performance Materials Inc.
      b. Pecora Corporation.
      c. Sika Corporation.
      d. The Dow Chemical Company.
      e. Tremco Incorporated.

D. Neutral-Curing Silicone Glazing Sealant, Class 25: Complying with ASTM C920, Type S, Grade NS, Use NT.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. GE Construction Sealants; Momentive Performance Materials Inc.
      b. Pecora Corporation.

c. Sika Corporation.
d. The Dow Chemical Company.
e. Tremco Incorporated.

E. Acid-Curing Silicone Glazing Sealant, Class 25: Complying with ASTM C920, Type S, Grade NS, Use NT.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. GE Construction Sealants; Momentive Performance Materials Inc.
b. Pecora Corporation.
c. Sika Corporation.
d. The Dow Chemical Company.
e. Tremco Incorporated.

## 2.7 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. Type recommended in writing by sealant or glass manufacturer.

D. Spacers:
1. Type recommended in writing by sealant or glass manufacturer.

E. Edge Blocks:
1. Type recommended in writing by sealant or glass manufacturer.

F. 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.

## 2.8 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
a. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square

edges with slight chamfers at junctions of edges and faces.

C. Grind smooth and polish exposed glass edges and corners.

## PART 3 EXECUTION

### 3.1 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
   1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
   2. Presence and functioning of weep systems.
   3. Minimum required face and edge clearances.
   4. Effective sealing between joints of glass-framing members.

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

### 3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

### 3.3 GLAZING, GENERAL

A. 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.

B. 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.

C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

D. 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.

E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass

lites.

F. 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.

G. 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.

H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

J. 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.

K. 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 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.

## 3.5 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.

## 3.6 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.

## 3.7 MONOLITHIC GLASS SCHEDULE

A. Clear Glass Type : Annealed Fully tempered float glass.
   1. Minimum Thickness: 6 mm.
   2. Safety glazing required.

## 3.8 INSULATING GLASS SCHEDULE

A. Low-E-Coated, Clear Insulating Glass Type :
   1. Basis-of-Design Product: Vitro; Solarban 90.
   2. Overall Unit Thickness: 1 inch.
   3. Minimum Thickness of Each Glass Lite: 6 mm.
   4. Outdoor Lite: Annealed Fully tempered float glass.
   5. Interspace Content: Argon.
   6. Indoor Lite: Annealed Fully tempered float glass.
   7. Low-E Coating: Pyrolytic or sputtered on second or third surface.
   8. Visible Light Transmittance: 50 percent minimum.
   9. SGHC: 0.25 maximum.
   10. Safety glazing required.

B. Ceramic -Coated, Low-E, Insulating Spandrel Glass Type :
   1. Basis-of-Design Product: <Insert manufacturer's name; product name or designation>.
   2. Coating Color: As selected by Architect from manufacturer's full range.
   3. Overall Unit Thickness: 1 inch.
   4. Minimum Thickness of Each Glass Lite: 6 mm.
   5. Outdoor Lite: Clear fully tempered float glass.
   6. Interspace Content: Argon.
   7. Indoor Lite: Clear fully tempered float glass.
   8. Low-E Coating: Pyrolytic or sputtered on second or third surface.
   9. Opaque Coating Location: Fourth surface.

**END OF SECTION**

# SECTION 08 88 16

# VISION CONTROL INSULATING GLASS UNITS WITH INTEGRATED CORDLESS LOUVERS

## PART 1 GENERAL

### 1.1 SUMMARY

A. Vision Control Glass: Control vision through insulating glass unit assemblies by means of rotating, cordless, interlocking, horizontal extruded aluminum louvers with rotation controlled manually, designed to fit within interior hollow metal frames by others.

### 1.2 SUBMITTALS

A. Action Submittals:
   1. Product Data: Descriptive data and performance attributes for vision control glass.
   2. Project Specific shop drawings

B. Closeout Submittals:
   1. Maintenance Instructions.

### 1.3 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Provide tempered safety glass for locations subject to human impact
   2. Safety glass: Tested and labeled to CPSC 16 CFR 1201.

B. Installer Qualifications: Minimum 2 years' experience in work of this Section.

C. Mockup:
   1. Provide in-place mockup of vision control glass unit.
   2. Approved mockup may remain as part of the Work.

### 1.4 WARRANTIES

A. Vision Control Glass in Interior Locations: Manufacturer's 20 year warranty against malfunction, mechanism failure and premature wear of internal parts, and material obstruction of glass units by dust or film formation due to failure of hermetic seal.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

A. Contract Documents are based on Vision Control by Unicel Architectural Corp., 800-668-1580, www.unicelarchitectural.com.

B. Substitutions: Under provisions of Division 01.

### 2.2 MATERIALS - GLASS

A. Clear Tempered Glass: ASTM C1048, Type 1 transparent flat, Class 1 clear, Quality q3 glazing select, Kind FT fully tempered.

### 2.3 MATERIALS - LOUVERS, FRAMES, AND OPERATORS

A. Louvers: Hollow extruded aluminum, interlocking profile to fit scheduled glazing thickness. Color as selected from manufacturer’s full range.

B. Manual Operators: Thumbwheel type.

C. Glass Frame (Trim Kit): Extruded aluminum, factory glazed, sized to accept ±2-1/2 inch thick glass for insertion into scheduled Rabbitt-less hollow metal frames. Color as selected by Architect from manufacturers full range. Corners cut at 45 degrees and mechanically fastened with concealed fasteners.

### 2.4 ACCESSORIES

A. Setting Blocks: ASTM C864, neoprene or EPDM, or ASTM C1115, silicone; 70 to 90 Shore A durometer hardness.

B. Spacers: ASTM C864, neoprene or EPDM, or ASTM C1115, silicone; 50 to 60 Shore A durometer hardness.

C. Glazing Gaskets: ASTM C864, neoprene or EPDM, or ASTM C1115, silicone or thermoplastic polyolefin rubber, molded or extruded shape to fit glazing channel retaining slot.

D. Glazing Sealant:
   1. ASTM C920, Type M, Grade NS, Class 25; two component silicone type, low modulus, non-sag.
   2. Sealant backing: ASTM C1330, Type O, size and density to control glazing sealant depth and produce optimum glazing sealant performance.
   3. Compatible with glass unit edge seals; tested to ASTM C1294.

## 2.5 FABRICATION

A. Sealed Insulating Glass Units: Comply with ASTM E2190.

## PART 3 EXECUTION

## 3.1 INSTALLATION

A. Install in accordance with glass manufacturer's instructions, approved Shop Drawings, and GANA Manual.

**END OF SECTION**

# SECTION 08 91 19

# FIXED LOUVERS

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Fixed extruded-aluminum louvers.
   2. Blank-off panels for louvers

### 1.2 DEFINITIONS

A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.

B. Horizontal Louver: Louver with horizontal blades (i.e., the axis of the blades are horizontal).

C. Vertical Louver: Louver with vertical blades (i.e., the axis of the blades are vertical).

D. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.

E. Wind-Driven-Rain-Resistant Louver: Louver that provides specified wind-driven-rain performance, as determined by testing in accordance with AMCA 500-L.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.
   1. Show weep paths, gaskets, flashings, sealants, and other means of preventing water intrusion.
   2. Show mullion profiles and locations.

C. Samples: For each type of metal finish required.

## 1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on evaluation of comprehensive tests performed in accordance with AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.

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

## 1.5 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

## 1.6 WARRANTY

A. Special Finish Warranty, Factory-Applied Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of baked enamel, powder coat, or organic finishes within specified warranty period.
   1. Deterioration includes, but is not limited to, the following:
      a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
      b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
      c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
   2. Warranty Period: 20 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 D2244.
      b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
      c. Cracking, peeling, or chipping.
   2. Warranty Period: 10 years from date of Substantial Completion.

## PART 2 PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Louvers withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures are considered to act normal to the face of the building.
   1. Wind Loads:
      a. Determine loads based on pressures as indicated on Drawings.

B. Seismic Performance:
   1. As indicated on Drawings.
   2. Louvers, including attachments to other construction, withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7.

C. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width in accordance with AMCA 500-L.

D. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

### 2.2 FIXED EXTRUDED-ALUMINUM LOUVERS

A. Horizontal Drainable-Blade Louver, Extruded Aluminum :
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Ruskin; Air Distribution Technologies, Inc.
      b. Airolite Company, LLC (The).
      c. Construction Specialties, Inc.
      d. Greenheck Fan Corporation.
   2. Louver Depth: 4 inches.
   3. Frame and Blade Nominal Thickness: Not less than 0.080 inch.
   4. Mullion Type: Exposed.
   5. Louver Performance Ratings:
      a. Free Area: 50 percent.
   6. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

### 2.3 LOUVER SCREENS

A. General: Provide screen at each exterior louver.
   1. Screen Location for Fixed Louvers: Interior face.
   2. Screening Type: Bird screening.

B. Secure screen frames to louver frames with stainless steel machine screws, spaced a

maximum of 6 inches from each corner and at 12 inches o.c.

C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.
   1. Metal: Same type and form of metal as indicated for louver to which screens are attached. Reinforce extruded-aluminum screen frames at corners with clips.
   2. Finish: Same finish as louver frames to which louver screens are attached.
   3. Type: Rewirable frames with a driven spline or insert.

D. Louver Screening for Aluminum Louvers:
   1. Bird Screening, Stainless Steel: 1/2-inch- square mesh, 0.047-inch wire.

## 2.4 BLANK-OFF PANELS

A. Insulated Blank-Off Panels: Laminated panels consisting of an insulating core surfaced on back and front with metal sheets and attached to back of louver.
   1. Thickness: 2 inches.
   2. Metal Facing Sheets, Aluminum: Not less than 0.032-inch nominal thickness.
   3. Insulating Core: Rigid, glass-fiber-board insulation.
   4. Edge Treatment: Trim perimeter edges of blank-off panels with louver manufacturer's standard channel frames, with corners mitered and with same finish as panels.
   5. Seal perimeter joints between panel faces and louver frames with gaskets or sealant.
   6. Panel Finish: Same finish applied to louvers.
   7. Attach blank-off panels with sheet metal screws.

## 2.5 MATERIALS

A. Aluminum Extrusions: ASTM B221, Alloy 6063-T5, T-52, or T6.

B. Aluminum Sheet: ASTM B209, Alloy 3003 or 5005, with temper as required for forming, or as otherwise recommended by metal producer for required finish.

C. Fasteners: Use types and sizes to suit unit installation conditions.
   1. Use Phillips flat-head screws for exposed fasteners unless otherwise indicated.
   2. For fastening aluminum, use aluminum or 300 series stainless steel fasteners.
   3. For fastening galvanized steel, use hot-dip-galvanized-steel or 300 series stainless steel fasteners.
   4. For fastening stainless steel, use 300 series stainless steel fasteners.
   5. For color-finished louvers, use fasteners with heads that match color of louvers.

## 2.6 FABRICATION

A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Vertical Assemblies: Where height of louver units exceeds fabrication and handling limitations, fabricate units to permit field-bolted assembly with close-fitting joints in jambs and mullions, reinforced with splice plates.
   1. Continuous Vertical Assemblies: Fabricate units without interrupting blade-spacing pattern.
   2. Horizontal Mullions: Provide horizontal mullions at joints.

C. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.

D. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
   1. Frame Type: Channel unless otherwise indicated.

E. Include supports, anchorages, and accessories required for complete assembly.

F. Provide vertical mullions of type and at spacings indicated, but not more than is recommended by manufacturer, or 72 inches o.c., whichever is less.
   1. Fully Recessed Mullions: Where indicated, provide mullions fully recessed behind louver blades. Where length of louver exceeds fabrication and handling limitations, fabricate with close-fitting blade splices designed to permit expansion and contraction.
   2. Semirecessed Mullions: Where indicated, provide mullions partly recessed behind louver blades, so louver blades appear continuous. Where length of louver exceeds fabrication and handling limitations, fabricate with interlocking split mullions and close-fitting blade splices designed to permit expansion and contraction.
   3. Exposed Mullions: Where indicated, provide units with exposed mullions of same width and depth as louver frame. Where length of louver exceeds fabrication and handling limitations, provide interlocking split mullions designed to permit expansion and contraction.

G. Provide subsills made of same material as louvers or extended sills for recessed louvers.

H. Join frame members to each other and to fixed louver blades with fillet welds concealed from view unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

## 2.7 ALUMINUM FINISHES

A. High-Performance Organic Finish, Two-Coat PVDF: Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat.
   1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
   2. Color and Gloss: As selected by Architect from manufacturer's full range.

## 2.8 STAINLESS STEEL SHEET FINISHES

A. Repair sheet finish by grinding and polishing irregularities, weld spatter, scratches, and forming marks to match surrounding finish.

# PART 3 EXECUTION

## 3.1 EXAMINATION

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

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

## 3.2 PREPARATION

A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

## 3.3 INSTALLATION

A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

C. Form closely fitted joints with exposed connections accurately located and secured.

D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. Protect unpainted galvanized- and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

F. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 07 92 00 "Joint Sealants" for sealants applied during louver installation.

## 3.4 ADJUSTING AND CLEANING

A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.

B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

C. Restore louvers damaged during installation and construction, so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.
   1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

**END OF SECTION**

# SECTION 09 05 61

# COMMON WORK RESULTS FOR FLOORING PREPARATION

## PART 1 GENERAL

### 1.1 SECTION INCLUDES

A. This section applies to all floors identified in the contract documents to receive the following types of floor coverings:
   1. Resilient tile and sheet flooring.
   2. Ceramic tile flooring.
   3. Carpet tile.

B. Preparation of new and existing concrete floor slabs for installation of floor coverings.

C. Testing of concrete floor slabs for moisture and alkalinity (pH).

D. Remediation of concrete floor slabs due to unsatisfactory moisture or alkalinity (pH) conditions.

E. Contractor shall perform all specified remediation of concrete floor slabs. If such remediation is indicated by testing agency's report and is due to a condition not under Contractor's control or could not have been predicted by examination prior to entering into the contract, a contract modification will be issued.

F. Patching compound.

G. Remedial floor coatings; if determined to be required by Owner's request.

### 1.2 PRICE AND PAYMENT PROCEDURES

A. Unit Price for Remedial Floor Coating or Moisture Mitigtion Topping: Do not include the cost of the floor coating or underlayment in the base bid; state on the bid form the unit price per square foot for the floor coating or underlayment, installed, in the event such remediation is required.

B. Base the unit price on the assumption that the floor area to be treated is primarily open, not divided into rooms and corridors.

C. Base the unit price on a total quantity calculated by assuming that only 20 percent of the flooring will require the alternate adhesive.

## 1.3 REFERENCE STANDARDS

A. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 50 mm 2 in. Cube Specimens); 2023.

B. ASTM C472 - Standard Test Methods for Physical Testing of Gypsum, Gypsum Plasters, and Gypsum Concrete; 2020.

C. ASTM D4259 - Standard Practice for Preparation of Concrete by Abrasion Prior to Coating Application; 2018.

D. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2022.

E. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2023.

F. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.

## 1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordinate scheduling of cleaning and testing, so that preliminary cleaning has been completed for at least 24 hours prior to testing.

## 1.5 SUBMITTALS

A. Visual Observation Report: For existing floor coverings to be removed.

B. Floor Covering and Adhesive Manufacturers' Product Literature: For each specific combination of substrate, floor covering, and adhesive to be used; showing:
   1. Moisture and alkalinity (pH) limits and test methods.
   2. Manufacturer's required bond/compatibility test procedure.
   3. Remedial Materials Product Data: Manufacturer's published data on each product to be used for remediation.

C. Manufacturer's qualification statement.
   1. Test reports indicating compliance with specified performance requirements, performed by nationally recognized independent testing agency.
   2. Manufacturer's installation instructions.

D. Specimen Warranty: Copy of warranty to be issued by coating manufacturer and certificate of underwriter's coverage of warranty.

E. Testing Agency's Report:
   1. Description of areas tested; include floor plans and photographs if helpful.
   2. Summary of conditions encountered.

3. Moisture and alkalinity (pH) test reports.
4. Copies of specified test methods.
5. Recommendations for remediation of unsatisfactory surfaces.
6. Product data for recommended remedial coating.
7. Submit report to Architect.
8. Submit report not more than two business days after conclusion of testing.
9. Adhesive Bond and Compatibility Test Report.

F. Floor Moisture Testing Technician Certificate: International Concrete Repair Institute (ICRI) Concrete Slab Moisture Testing Technician- Grade I certificate.

G. Concrete Testing Standard: Submit a copy of ASTM F710.

## 1.6 QUALITY ASSURANCE

A. Moisture and alkalinity (pH) testing shall be performed by an independent testing agency employed and paid by Contractor.

B. Contractor may perform adhesive and bond test with Contractor's own personnel or hire a testing agency.

C. Testing Agency Qualifications: Independent testing agency experienced in the types of testing specified.

D. Submit evidence of experience consisting of at least three test reports of the type required, with project Owner's project contact information.

E. Contractor's Responsibility Relating to Independent Agency Testing:
1. Provide access for and cooperate with testing agency.
2. Confirm date of start of testing at least 10 days prior to actual start.
3. Allow at least 4 business days on site for testing agency activities.
4. Achieve and maintain specified ambient conditions.

F. Notify Architect when specified ambient conditions have been achieved and when testing will start.

G. Remedial Coating Installer Qualifications: Company specializing in performing work of the type specified in this section, trained by or employed by coating manufacturer, and able to provide at least 3 project references showing at least three years' experience installing moisture emission coatings.

## 1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, handle, and protect products in accordance with manufacturer’s instructions and recommendations.

B. Deliver materials in manufacturer’s packaging; include installation instructions.

C. Keep materials from freezing.

## 1.8 FIELD CONDITIONS

A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 65 degrees F or more than 85 degrees F.

B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 40 percent and not more than 60 percent.

# PART 2 PRODUCTS

## 2.1 MATERIALS

A. Patching Compound: Floor covering manufacturer's recommended product, suitable for conditions, and compatible with adhesive and floor covering. In the absence of any recommendation from flooring manufacturer, provide a product with the following characteristics:

B. Cementitious moisture-, mildew-, and alkali-resistant compound, compatible with floor, floor covering, and floor covering adhesive, and capable of being feathered to nothing at edges.

C. Compressive Strength: 3000 psi, minimum, after 28 days, when tested in accordance with ASTM C109/C109M or ASTM C472, whichever is appropriate.

D. See Section 03 54 00 - Cast Underlayment

E. Products:
   1. Basis-of-Design Product: Subject to compliance with requirements, provide ARDEX Americas; Feather finish, or comparable product by one of the following:
      a. Henry 459 Feather Finish.
      b. Sika; SikaLevel Skim Coat.
   2. Substitutions: See Section 01 25 00 - Substitution Procedures.

F. Alternate Flooring Adhesive: Floor covering manufacturer's recommended product, suitable for the moisture and pH conditions present; low-VOC. In the absence of any recommendation from flooring manufacturer, provide a product recommended by adhesive manufacturer as suitable for substrate and floor covering and for conditions present.

G. Remedial Floor Coating: Single- or multi-layer coating or coating/overlay combination intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring manufacturer's emission limits, resistant to the level of alkalinity (pH) found, and suitable for adhesion of flooring without further treatment.
   1. Thickness: As required for application and in accordance with manufacturer's installation instructions.
   2. Products:
      a. Basis of Design: ARDEX Engineered Cement; ARDEX MC ULTRA, or other manufacturers who meet requirements of this Section including, but not limited to the following:
         1) Custom Building Products; Custom Tech MVC 100% Solids Epoxy Moisture Vapor Control.
         2) GCP Applied Technologies; Kovara AB 300.
         3) Laticrete International, Inc.; Super Cap or Vapor Ban.
      b. Other Manufacturers: Shall be compatible with the products provided for patching compound.
      c. Substitutions: See Section 01 25 00 - Substitution Procedures.

## PART 3 EXECUTION

### 3.1 CONCRETE SLAB PREPARATION

A. Follow recommendations of testing agency.

B. Perform following operations in the order indicated:
   1. Existing concrete slabs (on-grade and elevated) with existing floor coverings:
      a. Visual observation of existing floor covering, for adhesion, water damage, alkaline deposits, and other defects.

C. Existing concrete slabs with coatings or penetrating sealers/hardeners/dustproofers:
   1. Remove existing coatings and curing agents from surface according to recommendations of remedial coating manufacturer.
   2. Prepare surface according to recommendations of remedial coating manufacturer and according to ASTM D4259.
   3. Preliminary cleaning.

D. Moisture vapor emission tests; 3 tests in the first 1000 square feet and one test in each additional 1000 square feet, unless otherwise indicated or required by flooring manufacturer.
   1. Internal relative humidity tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
   2. Alkalinity (pH) tests; in same locations as moisture vapor emission tests, unless otherwise indicated.

E. Adhesive bond and compatibility test. Preform tests on concrete using the adhesive recommended by the flooring manufacturer prior to installation of flooring. Continue with remedial activities to bring concrete to acceptable measurements or provide high

moisture adhesives.

F. Remediations:
   1. Active Water Leaks or Continuing Moisture Migration to Surface of Slab: Correct this condition before doing any other remediation; re-test after correction.
   2. Excessive Moisture Emission or Relative Humidity: If an adhesive that is resistant to the level of moisture present is available and acceptable to flooring manufacturer, use that adhesive for installation of the flooring; if not, apply remedial floor coating or remedial sheet membrane over entire suspect floor area.
   3. Excessive Alkalinity (pH): If remedial floor coating is necessary to address excessive moisture, no additional remediation is required; if not, if an adhesive that is resistant to the level present is available and acceptable to the flooring manufacturer, use that adhesive for installation of the flooring; otherwise, apply a skim coat of specified patching compound over entire suspect floor area.
   4. Provide manufacturer's written moisture remediation process and procedures for installation of products including testing after application of the products.
   5. Remedial Floor Coating: Single- or multi-layer coating or coating/overlay combination intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring manufacturer's emission limits, resistant to the level of alkalinity (pH) found, and suitable for adhesion of flooring without further treatment.

## 3.2 PRELIMINARY CLEANING

A. Clean floors of dust, solvents, paint, wax, oil, grease, asphalt, residual adhesive, adhesive removers, film-forming curing compounds, sealing compounds, alkaline salts, excessive laitance, mold, mildew, and other materials that might prevent adhesive bond.

B. Do not use solvents or other chemicals for cleaning.

## 3.3 MOISTURE VAPOR EMISSION TESTING

A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.

B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.

C. Test in accordance with ASTM F1869 and as follows.

D. Plastic sheet test and mat bond test may not be substituted for the specified ASTM test method, as those methods do not quantify the moisture content sufficiently.

E. In the event that test values exceed floor covering manufacturer's limits, perform

remediation as indicated. In the absence of manufacturer limits, perform remediation if test values exceed 3 pounds per 1000 square feet per 24 hours.

F. Report: Report the information required by the test method.

## 3.4 INTERNAL RELATIVE HUMIDITY TESTING

A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.

B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.

C. Test in accordance with ASTM F2170 Procedure A and as follows.

D. Testing with electrical impedance or resistance apparatus may not be substituted for the specified ASTM test method, as the values determined are not comparable to the ASTM test values and do not quantify the moisture content sufficiently.

E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if any test value exceeds 75 percent relative humidity.

F. Report: Report the information required by the test method.

## 3.5 ALKALINITY TESTING

A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.

B. The following procedure is the equivalent of that described in ASTM F710, repeated here for the Contractor's convenience.

C. Use a wide range alkalinity (pH) test paper, its associated chart, and distilled or deionized water.

D. Place several drops of water on a clean surface of concrete, forming a puddle approximately 1 inch in diameter. Allow the puddle to set for approximately 60 seconds, then dip the alkalinity (pH) test paper into the water, remove it, and compare immediately to chart to determine alkalinity (pH) reading.

E. Use of a digital pH meter with probe is acceptable; follow meter manufacturer's instructions.

F. In the event that test values exceed floor covering manufacturer's limits, perform

remediation as indicated. In the absence of manufacturer limits, perform remediation if alkalinity (pH) test value is over 10.

## 3.6 PREPARATION

A. See individual floor covering section(s) for additional requirements.

B. Comply with recommendations of testing agency.

C. Comply with requirements and recommendations of floor covering manufacturer.

D. Fill and smooth surface cracks, grooves, depressions, control joints and other non-moving joints, and other irregularities with patching compound.

E. Do not fill expansion joints, isolation joints, or other moving joints.

## 3.7 ADHESIVE BOND AND COMPATIBILITY TESTING

A. Comply with requirements and recommendations of floor covering manufacturer.

## 3.8 APPLICATION OF REMEDIAL FLOOR TREATMENT

A. Comply with requirements and recommendations of treatment manufacturer.

## 3.9 PROTECTION

A. Cover prepared floors with durable covering.

**END OF SECTION**

# SECTION 09 05 61.13

# MOISTURE VAPOR EMISSION CONTROL

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Fluid-applied, resin-based, membrane-forming systems that control the moisture-vapor-emission rate of high-moisture, interior concrete to prepare it for floor covering installation.

### 1.2 DEFINITIONS

A. MVE: Moisture vapor emission.

B. MVER: Moisture vapor emission rate.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

### 1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each MVE-control system, for tests performed by manufacturer and witnessed by a qualified testing agency.

C. Field quality-control reports.

### 1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Employs factory-trained personnel who are available for consultation and Project-site inspection.

B. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

## 1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating directions for storage and mixing with other components.

## 1.7 FIELD CONDITIONS

A. Environmental Limitations: Comply with MVE-control system manufacturer's written instructions for substrate and ambient temperatures, humidity, ventilation, and other conditions affecting system installation.
   1. Store system components in a temperature-controlled environment and protected from weather and at ambient temperature of not less than 65 deg F and not more than 85 deg F at least 48 hours before use.
   2. Maintain ambient temperature and relative humidity in installation areas within range recommended in writing by MVE-control system manufacturer, but not less than 65 deg F or more than 85 deg F and not less than 40 or more than 60 percent relative humidity, for 48 hours before installation, during installation, and for 48 hours after installation unless longer period is recommended in writing by manufacturer.
   3. Install MVE-control systems where concrete surface temperatures will remain a minimum of 5 deg F higher than the dew point for ambient temperature and relative humidity conditions in installation areas for 48 hours before installation, during installation, and for 48 hours after installation unless longer period is recommended in writing by manufacturer.

# PART 2 PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

A. MVE-Control System Capabilities: Capable of suppressing MVE without failure where installed on concrete that exhibits the following conditions:
   1. MVER: Maximum 15 lb of water/1000 sq. ft. when tested according to ASTM F1869.
   2. Relative Humidity: Maximum 100 percent when tested according to ASTM F2170 using in situ probes.

B. Water-Vapor Transmission: Through MVE-control system, maximum 0.10 perm when tested according to ASTM E96/E96M.

C. Tensile Bond Strength: For MVE-control system, greater than 200 psi with failure in the concrete according to ASTM D7234.

## 2.2 MVE-CONTROL SYSTEM

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. Basis-of-Design:
      a. ARDEX Americas; ARDEX MC™ RAPID One-Coat Moisture Control System For Concrete to Receive ARDEX Products.
   2. Other Manufacturers include but are not limited to the following as approved by flooring manufacturers:
      a. Custom Building Products; CustomTech™ TechMVC™ 100% Solids Epoxy Moisture Vapor Control.
      b. Laticrete International, Inc.; LATICRETE NXT® Vapor Reduction Coating

B. MVE-Control System: ASTM F3010-qualified, fluid-applied, two-component, epoxy-resin, membrane-forming system; formulated for application on concrete substrates to reduce MVER to level required for installation of floor coverings indicated and acceptable to manufacturers of floor covering products indicated, including adhesives.
   1. Substrate Primer: Provide MVE-control system manufacturer's concrete-substrate primer if required for system indicated by substrate conditions.
   2. Cementitious Underlayment Primer: If required for subsequent installation of cementitious underlayment products, provide MVE-control system manufacturer's primer to ensure adhesion of products to MVE-control system.

## 2.3 ACCESSORIES

A. Patching and Leveling Material: Moisture-, mildew-, and alkali-resistant product recommended in writing by MVE-control system manufacturer and with minimum of 3000-psi compressive strength after 28 days when tested according to ASTM C109/C109M.

B. Crack-Filling Material: Resin-based material recommended in writing by MVE-control system manufacturer for sealing concrete substrate crack repair.

# PART 3 EXECUTION

## 3.1 EXAMINATION

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

B. Proceed with installation only after unsatisfactory conditions have been corrected.
   1. Installation of system indicates acceptance of surfaces and conditions.

## 3.2 PREPARATION

A. Preinstallation Testing:
   1. Testing Agency: Engage a qualified testing agency to perform tests.
   2. Alkalinity Testing: Perform pH testing according to ASTM F710. Install MVE-control system in areas where pH readings are less than 7.0 and in areas where pH readings are greater than 8.5.
   3. 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. Install MVE-control system in locations where concrete substrate MVER exceeds 3 lb of water/1000 sq. ft. in 24 hours.
      b. Internal Relative Humidity Test: Using in situ probes, ASTM F2170. Install MVE-control system in locations where concrete substrates exhibit relative humidity level greater than 75 percent.

B. Concrete Substrates: Prepare and clean substrates according to MVE-control system manufacturer's written instructions to ensure adhesion of system to concrete.
   1. Remove coatings and other substances that are incompatible with MVE-control system and that contain soap, wax, oil, or silicone, using mechanical methods recommended in writing by MVE-control system manufacturer. Do not use solvents.
   2. Provide concrete surface profile complying with ICRI 310.2R CSP 3 by shot blasting using apparatus that abrades the concrete surface with shot, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
   3. After shot blasting, repair damaged and deteriorated concrete according to MVE-control system manufacturer's written instructions.
   4. Protect substrate voids and joints to prevent resins from flowing into or leaking through them.
   5. Fill surface depressions and irregularities with patching and leveling material.
   6. Fill surface cracks, grooves, control joints, and other nonmoving joints with crack-filling material.
   7. Allow concrete to dry, undisturbed, for period recommended in writing by MVE-control system manufacturer after surface preparation, but not less than 24 hours.
   8. Before installing MVE-control systems, broom sweep and vacuum prepared concrete.

C. Protect walls, floor openings, electrical openings, door frames, and other obstructions during installation.

## 3.3 INSTALLATION

A. Install MVE-control system according to ASTM F3010 and manufacturer's written instructions to produce a uniform, monolithic surface free of surface deficiencies such as pin holes, fish eyes, and voids.
   1. Install primers as required to comply with manufacturer's written instructions.

B. Do not apply MVE-control system across substrate expansion, isolation, and other moving joints.

C. Apply system, including component coats if any, in thickness recommended in writing by MVE-control system manufacturer for MVER indicated by preinstallation testing.

D. Cure MVE-control system components according to manufacturer's written instructions. Prevent contamination or other damage during installation and curing processes.

E. After curing, examine MVE-control system for surface deficiencies. Repair surface deficiencies according to manufacturer's written instructions.

F. Install cementitious underlayment over cured membrane if required to maintain manufacturer's warranty and in thickness required to maintain the warranty.

## 3.4 FIELD QUALITY CONTROL

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

B. Installation Inspections: Inspect substrate preparation and installation of system components to ensure compliance with manufacturer's written instructions and to ensure that a complete MVE-control system is installed without deficiencies.
   1. Verify that surface preparation meets requirements.
   2. Verify that component coats and complete MVE-control-system film thicknesses comply with manufacturer's written instructions.
   3. Verify that MVE-control-system components and installation areas that evidence deficiencies are repaired according to manufacturer's written instructions.

C. MVE-control system will be considered defective if it does not pass inspections.

## 3.5 PROTECTION

A. Protect MVE-control system from damage, wear, dirt, dust, and other contaminants before floor covering installation. Use protective methods and materials, including temporary coverings, recommended in writing by MVE-control system manufacturer.

B. Do not allow subsequent preinstallation examination and testing for floor covering installation to damage, puncture, or otherwise compromise the MVE-control system membrane.

**END OF SECTION**

# SECTION 09 21 16.23

# GYPSUM BOARD SHAFT WALL ASSEMBLIES

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes: Gypsum board shaft wall assemblies.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each component of gypsum board shaft wall assembly.

### 1.3 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For shaft wall assemblies and firestop tracks, from ICC-ES.

### 1.4 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.

### 1.5 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or with gypsum board manufacturer's written recommendations, whichever are more stringent.

B. Do not install interior products until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, moisture damaged, or mold damaged.
   1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and 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. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: Provide materials and construction identical to those of assemblies tested according to ASTM E 90 and classified according to ASTM E 413 by a testing and inspecting agency.

### 2.2 GYPSUM BOARD SHAFT WALL ASSEMBLIES

A. Fire-Resistance Rating: As indicated.

B. STC Rating: As indicated.

C. Studs: Manufacturer's standard profile for repetitive members, corner and end members, and fire-resistance-rated assembly indicated.
   1. Depth: As indicated.
   2. Minimum Base-Metal Thickness: 0.033 inch.

D. Runner Tracks: Manufacturer's standard J-profile track with manufacturer's standard long-leg length, but at least 2 inches long and matching studs in depth.
   1. Minimum Base-Metal Thickness: 0.018 inch.

E. Firestop Tracks: Provide firestop track at head of shaft wall on each floor level.

F. Elevator Hoistway Entrances: Manufacturer's standard J-profile jamb strut with long-leg length of 3 inches, matching studs in depth, and not less than 0.033 inch thick.

G. Room-Side Finish: As indicated.

H. Shaft-Side Finish: Gypsum shaftliner board, moisture- and mold-resistant Type X.

I. Insulation: Sound attenuation blankets.

### 2.3 PANEL PRODUCTS

A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

B. Gypsum Shaftliner Board, Moisture- and Mold-Resistant Type X:
ASTM C 1396/C 1396M; manufacturer's proprietary fire-resistive liner panels with moisture- and mold-resistant core and surfaces.
   1. Thickness: 1 inch.

2. Long Edges: Double bevel.
3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

C. Gypsum Board: As specified in Section 09 29 00 "Gypsum Board."

D. Cementitious Backer Units: As specified in Section 09 29 00 "Gypsum Board."

## 2.4 NON-LOAD-BEARING STEEL FRAMING

A. Steel Framing Members: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
1. Protective Coating: ASTM A 653/A 653M, G60, hot-dip galvanized unless otherwise indicated.

B. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.

## 2.5 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with manufacturer's written recommendations.

B. Trim Accessories: Cornerbead, edge trim, and control joints of material and shapes as specified in Section 09 29 00 "Gypsum Board" that comply with gypsum board shaft wall assembly manufacturer's written recommendations for application indicated.

C. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.

D. Track Fasteners: Power-driven fasteners of size and material required to withstand loading conditions imposed on shaft wall assemblies without exceeding allowable design stress of track, fasteners, or structural substrates in which anchors are embedded.
1. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing according to ASTM E 488 conducted by a qualified testing agency.

E. Sound Attenuation Blankets: As specified in Section 09 29 00 "Gypsum Board" and as required to match tested assembly requirements.

F. Acoustical Sealant: As specified in Section 07 92 19 "Acoustical Joint Sealants."

## PART 3 EXECUTION

### 3.1 EXAMINATION

A. Examine substrates to which gypsum board shaft wall assemblies attach or abut, with Installer present, including hollow-metal frames, elevator hoistway door frames, cast-in anchors, and structural framing. Examine for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, or mold damaged.

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

### 3.2 PREPARATION

A. Sprayed Fire-Resistive Materials: Coordinate with gypsum board shaft wall assemblies so both elements of Work remain complete and undamaged. Patch or replace sprayed fire-resistive materials removed or damaged during installation of shaft wall assemblies to comply with requirements specified in Section 07 81 00 "Applied Fireproofing."

B. After sprayed fire-resistive materials are applied, remove only to extent necessary for installation of gypsum board shaft wall assemblies and without reducing the fire-resistive material thickness below that which is required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

### 3.3 INSTALLATION

A. General: Install gypsum board shaft wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated, manufacturer's written installation instructions, and ASTM C 754 other than stud-spacing requirements.

B. Do not bridge building expansion joints with shaft wall assemblies; frame both sides of expansion joints with furring and other support.

C. Install supplementary framing in gypsum board shaft wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, wall-mounted door stops, and similar items that cannot be supported directly by shaft wall assembly framing.
   1. Elevator Hoistway: At elevator hoistway-entrance door frames, provide jamb struts on each side of door frame.
   2. Reinforcing: Where handrails directly attach to gypsum board shaft wall assemblies, provide galvanized steel reinforcing strip with 0.033-inch minimum thickness of base metal (uncoated), accurately positioned and secured behind at least one layer of face panel.

D. Penetrations: At penetrations in shaft wall, maintain fire-resistance rating of shaft wall assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons, elevator floor indicators, and similar items.

E. Isolate perimeter of gypsum panels from building structure to prevent cracking of panels, while maintaining continuity of fire-rated construction.

F. Firestop Tracks: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.

G. Control Joints: Install control joints at locations indicated on Drawings and if not indicated, install according to ASTM C 840 and in specific locations approved by Architect while maintaining fire-resistance rating of gypsum board shaft wall assemblies.

H. Sound-Rated Shaft Wall Assemblies: Seal gypsum board shaft walls with acoustical sealant at perimeter of each assembly where it abuts other work and at joints and penetrations within each assembly.

I. Cant Panels: At projections into shaft exceeding 4 inches, install 1/2- or 5/8-inch-thick gypsum board cants covering tops of projections.
   1. Slope cant panels at least 75 degrees from horizontal. Set base edge of panels in adhesive and secure top edges to shaft walls at 24 inches o.c. with screws fastened to shaft wall framing.
   2. Where steel framing is required to support gypsum board cants, install framing at 24 inches o.c. and extend studs from the projection to shaft wall framing.

J. 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 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. Remove and replace panels that are wet, moisture damaged, or mold damaged.
   1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
   2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

**END OF SECTION**

# SECTION 09 22 16

# NON-STRUCTURAL METAL FRAMING

## PART 1 GENERAL

### 1.1 SUMMARY

A. Work Results:

B. Principal Products:

C. Section Includes:
   1. Framing systems.
   2. Grid suspension systems.

### 1.2 ACTION SUBMITTALS

A. Product Data:
   1. Framing systems.
   2. Grid suspension systems.

### 1.3 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For firestop tracks, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

### 1.4 DELIVERY, STORAGE, AND HANDLING

A. Notify manufacturer of damaged materials received prior to installation.

B. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

C. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling as required by AISI S202, "Code of Standard Practice for Cold-Formed Steel Structural Framing."

## PART 2 PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

A. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, in accordance with ASTM E90 and classified in accordance with ASTM E413 by an independent testing agency.

B. Horizontal Deflection: For composite wall assemblies, limited to 1/360 of the wall height based on horizontal loading of 10 lbf/sq. ft.

C. Design framing systems in accordance with AISI S220, "North American Specification for the Design of Cold-Formed Steel Framing - Nonstructural Members," unless otherwise indicated.

D. Design Loads: As indicated on architectural Drawings or 5 lbf/sq. ft. minimum as required by the IBC.

### 2.2 FRAMING SYSTEMS

A. Studs and Track: AISI S220.
   1. HYPERLINK "http://www.specagent.com/LookUp/?ulid=12028&mf=04&src=wd" Manufacturers: Subject to compliance with requirements, undefined:
      a. ClarkDietrich.
      b. Marino\WARE.
      c. MBA Metal Framing.
      d. SCAFCO Steel Stud Company; Stone Group of Companies.
      e. Steel Network, Inc. (The).
      f. TELLING Industries.
   2. Minimum Base-Steel Thickness: 0.0296 inch.
   3. Depth: As indicated on Drawings.

B. Slip-Type Head Joints: Where indicated, provide one of the following:
   1. Clip System: Clips designed for use in head-of-wall deflection conditions that provide a positive attachment of studs to tracks while allowing 3-inch minimum vertical movement.
      a. HYPERLINK "http://www.specagent.com/LookUp/?ulid=12031&mf=04&src=wd" Manufacturers: Subject to compliance with requirements, undefined:
         1) ClarkDietrich.
         2) Marino\WARE.
         3) MBA Metal Framing.
         4) Steel Network, Inc. (The).
   2. Single Long-Leg Track System: Top track with 2-inch- deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top track and with continuous bridging located within 12 inches of the top of studs to provide

lateral bracing.

3. Double-Track System: Top outer tracks, inside track with 2-inch- deep flanges in thickness not less than indicated for studs and fastened to studs, and outer track sized to friction-fit over inner track.
4. Deflection Track: Steel sheet top track manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.

C. Firestop Tracks: Top track manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
   1. HYPERLINK "http://www.specagent.com/LookUp/?ulid=12033&mf=04&src=wd" Manufacturers: Subject to compliance with requirements, undefined:
      a. ClarkDietrich.
      b. Fire Trak Corp.
      c. Marino\WARE.
      d. Steel Network, Inc. (The).
      e. TELLING Industries.

D. Hat-Shaped, Rigid Furring Channels:
   1. HYPERLINK "http://www.specagent.com/LookUp/?ulid=12036&mf=04&src=wd" Manufacturers: Subject to compliance with requirements, undefined:
      a. ClarkDietrich.
      b. Marino\WARE.
      c. MRI Steel Framing, LLC.
      d. Steel Network, Inc. (The).
      e. TELLING Industries.
   2. Minimum Base-Steel Thickness: 0.0296 inch.
   3. Depth: As indicated on Drawings.

E. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 3/4 inch, minimum uncoated-steel thickness of 0.0179 inch, and depth required to fit insulation thickness indicated.
   1. HYPERLINK "http://www.specagent.com/LookUp/?ulid=12037&mf=04&src=wd" Manufacturers: Subject to compliance with requirements, undefined:
      a. ClarkDietrich.
      b. Marino\WARE.
      c. MRI Steel Framing, LLC.
      d. SCAFCO Steel Stud Company; Stone Group of Companies.
      e. Steel Network, Inc. (The).
      f. TELLING Industries.

## 2.3 ACCESSORIES

A. Extruded Aluminum Partition Gap Closure:
   1. Partition Gap Closure shall meet specified performance requirements listed in

ASTM E1399/E1399M-97 for the joint width minimum and maximum dimension verification as well as the cyclic movement performance for Class IV – Combined movement which encompasses Seismic, Thermal and Wind Sway, movement at a cycling rate greater than or equal to 10 cycles per minute.

2. Fire Performance: Products shall be classified as Class A interior finish per NFPA 101 and IBC Section 803.1.1 with a maximum flame spread index of 0 and a maximum smoke-developed index of 15, when tested in accordance with ASTM E84.
3. Basis-of-Design: Subject to compliance with requirements, provide Mullion Mate® Plus - 5 (Against the Mullion / Against the Glass) Extruded Aluminum Partition Gap Closures manufactured by Gordon, Inc.
    a. Other manufacturers as approved by the Architect.
        1) The listed Manufacturer shall not be construed as closing specifications to other prospective Manufacturers, but rather as establishing a level of quality in a metal system. Other systems may be submitted for approval, as provided for in the specifications at least ten (10) working days prior to submission of bids. Companies desiring to submit a proposal shall submit all descriptive information of the system proposed including photographs and Shop Drawings of at least ten (10) projects within the past five (5) years, utilizing systems, materials, and techniques as herein specified.
4. Materials: Aluminum extrusions: 6063-T5 or T6 temper alloy and Aluminum sheet, 3000 series alloy.
5. All material shall be in a finish chosen from one of the following options as selected by the Architect:
    a. High-Performance Organic Finish, Two-Coat PVDF: Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat.
        1) Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions
        2) Color: Match color of adjacent aluminum window frames.

## 2.4 GRID SUSPENSION SYSTEMS

A. Grid Suspension Systems for Gypsum Board Ceilings: ASTM C645, direct-hung system composed of main beams and cross-furring members that interlock.
    1. Manufacturers: Subject to compliance with requirements, undefined:
        a. Armstrong World Industries.
        b. Rockfon; ROCKWOOL International.
        c. USG Corporation.

## 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 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
   1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

B. Coordination with Sprayed Fire-Resistive Materials:
   1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling tracks to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches o.c.
   2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of non-load-bearing steel framing. Do not reduce thickness of fire-resistive materials below that are required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

### 3.3 INSTALLATION, GENERAL

A. Installation Standard: ASTM C754.
   1. Gypsum Plaster Assemblies: Also comply with requirements in ASTM C841 that apply to framing installation.
   2. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C1063 that apply to framing installation.
   3. Gypsum Veneer Plaster Assemblies: Also comply with requirements in ASTM C844 that apply to framing installation.
   4. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.

B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.

C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

D. Install bracing at terminations in assemblies.

E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

## 3.4 INSTALLATION OF FRAMING SYSTEMS

A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

B. Install studs so flanges within framing system point in same direction.

C. 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. Slip-Type Head Joints: Where framing extends to overhead structural supports, install 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.
   3. 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.
      a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
   4. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.

D. Direct Furring:
   1. Screw to wood framing.
   2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

E. Z-Shaped Furring Members:
   1. Erect insulation, specified in Section 07 21 00 "Thermal Insulation," vertically and hold in place with Z-shaped furring members spaced 24 inches o.c.
   2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
   3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.

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.

## 3.5 INSTALLATION OF GRID SUSPENSION SYSTEMS

A. Grid Suspension Systems: 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.

## 3.6 PARTITION GAP CLOSURE INSTALLATION

A. Examination of Surfaces: Installer must examine conditions under which work is to be performed and must notify Contractor in writing of unsatisfactory conditions. Verify that field measurements and block-out dimensions are as shown on Shop Drawings.

B. Clean surfaces thoroughly prior to installation. Prepare surfaces using the methods recommended by the Manufacturer to achieve the best result for the project conditions.

C. Install Mullion Mate® Plus (Against the Mullion / Against the Glass) Extruded Aluminum Partition Gap Closures in accordance with Manufacturer’s written Installation Instructions and Details.

D. Space Enclosure: Do not install any work until space is enclosed and weatherproofed, wet-work in space is completed and nominally dry, work above ceilings is complete, and temperature and humidity shall be continuously maintained at values near those of final occupancy.

E. Protection Procedures: Advise the Contractor of procedures required to protect the finished work from damage during the remainder of the construction period.

**END OF SECTION**

# SECTION 09 29 00

# GYPSUM BOARD

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Interior gypsum board.
   2. Tile backing panels.

### 1.2 ACTION SUBMITTALS

A. Product Data: For the following:
   1. Gypsum board, Type X.
   2. Mold-resistant gypsum board.
   3. Glass-mat, water-resistant backing board.
   4. Interior trim.
   5. Joint treatment materials.

B. Shop Drawings: Show locations and installation of control and expansion joints, including plans, elevations, sections, details of components, and attachments to other work.

### 1.3 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.

### 1.4 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 paper-faced 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. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated in accordance with ASTM E119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated in accordance with ASTM E90 and classified in accordance with ASTM E413 by an independent testing agency.

### 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 INTERIOR GYPSUM BOARD

A. Gypsum Board, Type X: ASTM C1396/C1396M.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. American Gypsum.
      b. CertainTeed; SAINT-GOBAIN.
      c. Georgia-Pacific Gypsum LLC.
      d. Gold Bond Building Products, LLC provided by National Gypsum Company.
      e. USG Corporation.
   2. Thickness: 5/8 inch.
   3. Long Edges: Tapered and featured (rounded or beveled) for prefilling.

B. Impact-Resistant Gypsum Board: ASTM C1396/C1396M gypsum board, tested in accordance with ASTM C1629/C1629M.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. American Gypsum.
      b. CertainTeed; SAINT-GOBAIN.
      c. Georgia-Pacific Gypsum LLC.
      d. Gold Bond Building Products, LLC provided by National Gypsum Company.
      e. USG Corporation.

2. Core: 5/8 inch, Type X.
3. Surface Abrasion: ASTM C1629/C1629M, meets or exceeds Level 1 requirements.
4. Indentation: ASTM C1629/C1629M, meets or exceeds Level 1 requirements.
5. Soft-Body Impact: ASTM C1629/C1629M, meets or exceeds Level 1 requirements.
6. Hard-Body Impact: ASTM C1629/C1629M, meets or exceeds Level 1 requirements in accordance with test in Annex A1.
7. Long Edges: Tapered.
8. Mold Resistance: ASTM D3273, score of 10 as rated in accordance with ASTM D3274.

C. Mold-Resistant Gypsum Board: ASTM C1396/C1396M. With moisture- and mold-resistant core and paper surfaces.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. American Gypsum.
      b. CertainTeed; SAINT-GOBAIN.
      c. Georgia-Pacific Gypsum LLC.
      d. Gold Bond Building Products, LLC provided by National Gypsum Company.
      e. USG Corporation.
   2. Core: 5/8 inch, Type X.
   3. Long Edges: Tapered.
   4. Mold Resistance: ASTM D3273, score of 10 as rated in accordance with ASTM D3274.

## 2.4 TILE BACKING PANELS

A. Glass-Mat, Water-Resistant Backing Board: ASTM C1178/C1178M, with manufacturer's standard edges.
   1. Products: Subject to compliance with requirements, provide products by one of the following:
      a. CertainTeed; SAINT-GOBAIN; GlasRoc Tile Backer.
      b. Georgia-Pacific Gypsum LLC.
      c. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond® eXP® Fire-Shield® Tile Backer.
      d. USG Corporation; Durock™ Brand Glass-Mat Tile Backerboard.
   2. Core: 5/8 inch, Type X.
   3. Mold Resistance: ASTM D3273, score of 10 as rated in accordance with ASTM D3274.

## 2.5 TRIM ACCESSORIES

A. Interior Trim: ASTM C1047.
   1. Material: Paper-faced galvanized-steel sheet.
   2. Shapes:
      a. Cornerbead.

## 2.6 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C475/C475M.

B. Joint Tape:
   1. Interior Gypsum Board: Paper.
   2. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.

C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
   1. Prefilling: At open joints, rounded or beveled panel edges, 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.
      a. Use setting-type compound for installing paper-faced metal trim accessories.
   3. Fill Coat: For second coat, use setting-type, sandable topping compound.
   4. Finish Coat: For third coat, use drying-type, all-purpose compound.

D. Joint Compound for Tile Backing Panels:
   1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.
   2. Cementitious Backer Units: As recommended by backer unit manufacturer.
   3. Water-Resistant Gypsum Backing Board: Use setting-type taping compound and setting-type, sandable topping compound.

## 2.7 AUXILIARY MATERIALS

A. Steel Drill Screws: ASTM C1002 unless otherwise indicated.
   1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
   2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

B. Sound-Attenuation Blankets: ASTM C665, Type I (blankets without membrane facing) 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.

C. Acoustical Sealant: As specified in Section 07 92 19 "Acoustical 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.

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 INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:
   1. Type X: Vertical surfaces unless otherwise indicated.
   2. Impact-Resistant Type: First 4 feet of main corridors and walkways.
   3. Mold-Resistant Type: As indicated on Drawings.

B. 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. On Z-shaped furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
   4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

## 3.4 INSTALLATION OF TILE BACKING PANELS

A. Glass-Mat, Water-Resistant Backing Panels: Comply with manufacturer's written installation instructions and install at locations indicated to receive tile. Install with 1/4-inch gap where panels abut other construction or penetrations.

B. 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 in accordance with ASTM C840 and in specific locations approved by Architect for visual effect.

C. Interior Trim: Install in the following locations:
   1. Cornerbead: Use at outside corners.

## 3.6 FINISHING OF 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, rounded or beveled edges, 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 in accordance with ASTM C840:
   1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
   2. Level 2: Panels that are substrate for tile.
   3. Level 3: Where indicated on Drawings.
   4. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
      a. Primer and its application to surfaces are specified in Section 09 91 23 "Interior Painting."
   5. Level 5: All walls scheduled for accent wall color or covering.
      a. Primer and its application to surfaces are specified in Section 09 91 23 "Interior Painting."

E. Glass-Mat Faced 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.

**END OF SECTION**

# SECTION 09 30 13

# CERAMIC TILING

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Porcelain tile.
   2. Glazed wall tile.
   3. Waterproof membranes.
   4. Crack isolation membranes.
   5. Setting material.
   6. Grout materials.

### 1.2 DEFINITIONS

A. General: Definitions in ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.

B. Face Size: Actual tile size, excluding spacer lugs.

C. Large Format Tile: Tile with at least one edge 15 inches or longer.

D. Module Size: Actual tile size plus joint width indicated.

### 1.3 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.

### 1.4 ACTION SUBMITTALS

A. Product Data:
   1. Porcelain tile.
   2. Glazed wall tile.
   3. Waterproof membranes.
   4. Crack isolation membranes.
   5. Setting material.
   6. Grout materials.

B. Shop Drawings: Show locations, plans, and elevations, of each type of tile and tile pattern. Show widths, details, and locations of movement joints in tile substrates and finished tile surfaces.

## 1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Material: Furnish extra materials, from the same production run, to Owner that match 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 3 percent of amount installed for each type, composition, color, pattern, and size indicated.
   2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

## 1.6 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Per ASNI A108.19 and A108.20, Installation of large-format tile requires pre-qualified installers.
   2. Installer employs at least one installer for Project that has completed the Advanced Certification for Tile Installers (ACT) certification for installation of large format tile.

## 1.7 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.

## 1.8 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" Article in the Evaluations and manufacturer's written instructions.

### 1.9 WARRANTY

A. System Warranty: Manufacturer's non-prorated comprehensive warranty that agrees to repair and replace defective installation areas, material, and labor that fail under normal usage within specified warranty period.
   1. Warranty Period: 25 years from date of Product Purchase.

## PART 2 PRODUCTS

### 2.1 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 unless otherwise indicated.

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 schedules, and other requirements specified.

### 2.2 PORCELAIN TILE

A. Porcelain Tile Type : Unglazed.
   1. Certification: Tile certified by the Porcelain Tile Certification Agency.
   2. Face Size Variation: Rectified.
   3. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:
      a. External Corners: Surface bullnose, module size same as adjoining flat tile.
      b. Internal Corners: Field-butted square corners.

### 2.3 GLAZED WALL TILE

A. Glazed Wall Tile Type :
   1. Face Size Variation: Rectified.
   2. Thickness: 5/16 inch.
   3. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:
      a. Base for Thinset Mortar Installations: Straight, module size 6 by 2 inches.

## 2.4 GAUGED PORCELAIN TILES AND GAUGED PORCELAIN TILE PANELS/SLABS

A. Gauged porcelain tiles (GPT) and gauged porcelain tile panels/slabs (GPTPS) are tiles that have been manufactured to a specific nominal thickness, and for which its thickness characteristic is largely associated with how it is installed and/or used.
   1. Products shall comply with ANSI A137.3.

B. Basis-of-Design: Refer to Interior Finish Schedule on Drawings.

## 2.5 WATERPROOF MEMBRANES

A. General: Manufacturer's standard product, selected from the following, that complies with ANSI A118.10 and ANSI A118.12 and is recommended by manufacturer for application indicated. Include reinforcement and accessories recommended by manufacturer.

B. Waterproof Membrane, Fluid Applied: Liquid-latex rubber or elastomeric polymer with continuous fabric reinforcement.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ARDEX Americas.
      b. Custom Building Products.
      c. Laticrete International, Inc.
      d. MAPEI Corporation.
      e. Parex, a Sika brand.

## 2.6 CRACK ISOLATION MEMBRANES

A. General: Manufacturer's standard product, selected from the following, that complies with ANSI A118.12 for high performance and is recommended by manufacturer for application indicated. Include reinforcement and accessories recommended by manufacturer.

B. Crack Isolation Membrane, Fluid Applied: Liquid-latex rubber or elastomeric polymer with continuous fabric reinforcement.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Custom Building Products.
      b. Laticrete International, Inc.
      c. MAPEI Corporation.
      d. Parex, a Sika brand.
      e. Sika Corporation.

## 2.7 SETTING MATERIALS

A. Improved Modified Dry-Set Mortar (Thinset): ANSI A118.15.
   1. Manufacturers: Subject to compliance with requirements, provide products by

one of the following:
a. ARDEX Americas.
b. Custom Building Products.
c. Laticrete International, Inc.
d. MAPEI Corporation.
e. Parex, a Sika brand.

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. Provide prepackaged, dry-mortar mix combined with acrylic resin or styrene-butadiene-rubber liquid-latex additive at Project site.
4. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to other requirements in ANSI A118.15.

B. Water-Cleanable, Tile-Setting Epoxy: ANSI A118.3 -American National Standard Specifications for Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy and Water Cleanable Tile-Setting Epoxy Adhesive.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. ARDEX Americas.
b. Bostik; Arkema.
c. Custom Building Products.
d. Laticrete International, Inc.
e. Parex, a Sika brand.

C. Organic Adhesive: ANSI A136.1- American National Standard Specifications for Organic Adhesives for Installation of Ceramic Tile; Type I.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. ARDEX Americas.
b. Custom Building Products.
c. Laticrete International, Inc.
d. MAPEI Corporation.
e. Parex, a Sika brand.
f. Southern Grouts & Mortars, Inc.

## 2.8 GROUT MATERIALS

A. Sand-Portland Cement Grout: ANSI A108.10, consisting of white or gray cement and white or colored aggregate as required to produce color indicated.

B. Water-Cleanable Epoxy Grout: ANSI A118.3.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. ARDEX Americas.
b. Custom Building Products.
c. Laticrete International, Inc.
d. MAPEI Corporation.
e. Parex, a Sika brand.

f. Sika Corporation.

2. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 and 212 deg F, respectively, and certified by manufacturer for intended use.

## 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.
   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. Remove coatings, including curing compounds or other coatings, that are incompatible with tile-setting materials.

B. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

C. Where indicated, prepare substrates to receive waterproof membrane by applying a reinforced mortar bed that complies with ANSI A108.1 and is sloped 1/4 inch per foot toward drains.

D. 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.

E. Substrate Flatness:
   1. For tile shorter than 15 inches, confirm that structure or substrate is limited to variation of 1/4 inch in 10 ft. from the required plane, and no more than 1/16 inch in 12 inches when measured from tile surface high points.
   2. For large format tile, tile with at least one edge 15 inches or longer, confirm that structure or substrate is limited to 1/8 inch in 10 ft. from the required plane, and no more than 1/16 inch in 24 inches when measured from tile surface high points.

## 3.3 INSTALLATION OF CERAMIC TILE SYSTEM

A. Install tile backing panels and treat joints in accordance with ANSI A108.11 and manufacturer's written instructions for type of application indicated.

B. Install waterproof membrane to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.
   1. Allow waterproof membrane to cure and verify by testing that it is watertight before installing tile or setting materials over it.

C. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.
   1. Allow crack isolation membrane to cure before installing tile or setting materials over it.

D. Mix mortars and grouts to comply with "Referenced Standards" Article in the Evaluations and mortar and grout manufacturers' written instructions.
   1. Add materials, water, and additives in accurate proportions.
   2. 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.

E. Install tile in accordance with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of ANSI A108 series that are referenced in TCNA installation methods and specified in tile installation schedules, and apply to types of setting and grouting materials used.
   1. 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.
   2. 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.
   3. Provide manufacturer's standard trim shapes where necessary to eliminate

exposed tile edges.

4. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.

F. Movement Joints: Provide movement joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated on Drawings. Form joints during installation of setting materials, mortar beds, and tile. Keep joints free of dirt, debris, and setting materials prior to filling with sealants. Do not saw-cut joints after installing tiles.
   1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.

## 3.4 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 in accordance with tile and grout manufacturer's written instructions. 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.

## 3.5 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.

## 3.6 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

A. Interior Floor Installations, Concrete Subfloor:
   1. TCNA F125-Full : Thinset mortar on crack isolation membrane.
      a. Ceramic Tile Type: <Insert tile-type designation>.
      b. Thinset Mortar: Improved modified dry-set mortar.
      c. Grout: Water-cleanable epoxy grout.

d. Crack Isolation Membrane: Fabric-reinforced, fluid-applied membrane.
e. Joint Width: 1/8 inch.
f. Movement Joints: Types located on Drawings.

B. Interior Wall Installations, Wood or Metal Studs or Furring:
1. TCNA W245 <Insert designation>: Thinset mortar on glass-mat, water-resistant gypsum backer board.
a. Ceramic Tile Type: <Insert tile-type designation>.
b. Thinset Mortar: Improved modified dry-set mortar.
c. Grout: Water-cleanable epoxy grout.
d. Joint Width: 1/8 inch.
e. Movement Joints: Types located on Drawings.

**END OF SECTION**

# SECTION 09 51 13

# ACOUSTICAL PANEL CEILINGS

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Acoustical panels.
   2. Metal suspension system.
   3. Metal edge moldings and trim.

B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

### 1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

### 1.3 ACTION SUBMITTALS

A. Product Data:
   1. Acoustical panels.
   2. Metal suspension system.
   3. Metal edge moldings and trim.

### 1.4 INFORMATIONAL SUBMITTALS

A. 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.
      a. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.
   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 the following:

a. Lighting fixtures.
b. Diffusers.
c. Grilles.
d. Speakers.
e. Sprinklers.
f. Access panels.
g. Perimeter moldings.

7. Show operation of hinged and sliding components covered by or adjacent to acoustical panels.

B. Product Test Reports: For each acoustical panel ceiling, for tests performed by manufacturer and witnessed by a qualified testing agency.

## 1.5 CLOSEOUT SUBMITTALS

## 1.6 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: Full-size panels equal to 2 percent of quantity installed.

## 1.7 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.

## 1.8 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.

## PART 2 PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Suspended ceilings to withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7.

B. 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 in accordance with ASTM E1264.
   2. Smoke-Developed Index: 50 or less.

### 2.2 ACOUSTICAL PANELS

A. Acoustical Panel Standard: Provide manufacturer's standard panels in accordance with ASTM E1264 and designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.

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 in accordance with ASTM D3273, ASTM D3274, or ASTM G21 and evaluated in accordance with ASTM D3274 or ASTM G21.

### 2.3 METAL SUSPENSION SYSTEM

A. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories in accordance with ASTM C635/C635M and designated by type, structural classification, and finish indicated.

B. Narrow-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 9/16-inch-wide metal caps on flanges.
   1. Structural Classification: Heavy-duty system.
   2. Cap Material: Cold-rolled steel.

### 2.4 ACCESSORIES

A. Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, 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 in accordance with ASTM E488/E488M or ASTM E1512 as applicable, conducted by a qualified testing and inspecting agency.
a. Type: Postinstalled expansion anchors.
b. Corrosion Protection, Carbon Steel: Components zinc plated in accordance with ASTM B633, Class SC 1 (mild) service condition.
c. Corrosion Protection, Stainless Steel: Components complying with ASTM F593 and ASTM F594, Group 1 Alloy 304 or 316.
d. Corrosion Protection, Nickel-Copper Alloy: Components fabricated from nickel-copper-alloy rods complying with ASTM B164 for UNS No. N04400 alloy.

B. Wire Hangers, Braces, and Ties: Provide wires as follows:
1. Zinc-Coated, Carbon-Steel Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.
2. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C635/C635M, 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/A653M, G90 coating designation; with bolted connections and 5/16-inch- diameter bolts.

F. Hold-Down Clips: Manufacturer's standard hold-down.

G. Impact Clips: Manufacturer's standard impact-clip system designed to absorb impact forces against acoustical panels.

H. Seismic Clips: Manufacturer's standard seismic clips designed to secure acoustical panels in place during a seismic event.

I. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.

J. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.

## 2.5 METAL EDGE MOLDINGS AND TRIM

A. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.
1. Edge moldings to fit acoustical panel edge details and suspension systems indicated and match width and configuration of exposed runners unless otherwise indicated.

## 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 OF ACOUSTICAL PANEL CEILINGS

A. Install acoustical panel ceilings in accordance with ASTM C636/C636M, seismic design requirements, 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 roof 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. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.

D. 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.

E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. 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. Arrange directionally patterned acoustical panels as follows:
    a. As indicated on reflected ceiling plans.
    b. Install panels with pattern running in one direction parallel to long axis of space.
    c. Install panels in a basket-weave pattern.
2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
3. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
4. 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.
5. Protect lighting fixtures and air ducts in accordance with requirements indicated

for fire-resistance-rated assembly.

## 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**

# SECTION 09 65 13

# RESILIENT BASE AND ACCESSORIES

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Thermoset-rubber base.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. 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.

C. Product Schedule: For resilient base and accessory products. Use same designations indicated on Drawings.

### 1.3 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
   1. Coordinate mockups in this Section with mockups specified in other Sections.
   2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
   3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

### 1.4 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 or more than 90 deg F.

### 1.5 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 THERMOSET-RUBBER BASE

A. Product Standard: ASTM F 1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).
   1. Style and Location:
      a. Style A, Straight: Provide in areas with carpet.
      b. Style B, Cove: Provide in areas with resilient floor coverings.

B. Thickness: 0.125 inch.

C. Height: 4 inches.

D. Type: Sculpted base and Commercial cove base.

E. Outside Corners: Preformed.

F. Inside Corners: Preformed.

### 2.2 INSTALLATION MATERIALS

A. 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. 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.

C. 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. Preformed Corners: Install preformed corners before installing straight pieces.

## 3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.

B. Perform the following operations immediately after completing resilient-product installation:
   1. Remove adhesive and other blemishes from surfaces.

C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

**END OF SECTION**

# SECTION 09 65 16

# RESILIENT SHEET FLOORING

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Unbacked vinyl sheet flooring.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For each type of resilient sheet flooring.
   1. Include sheet 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 each exposed product and for each color, texture, and pattern specified, in manufacturer's standard size, but not less than 6-by-9-inch sections.

D. Welded-Seam Samples: For seamless-installation technique indicated and for each resilient sheet flooring product, color, and pattern required; with seam running lengthwise and in center of 6-by-9-inch Sample applied to a rigid backing and prepared by Installer for this Project.

E. Product Schedule: For resilient sheet flooring. Use same designations indicated on Drawings.

### 1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

### 1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of resilient sheet flooring to include in maintenance manuals.

## 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 Sheet Flooring: Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, in roll form and in full roll width for each type, color, and pattern of flooring installed.

## 1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for resilient sheet flooring installation and seaming method indicated.
   1. Engage an installer who employs workers for this Project who are trained or certified by resilient sheet flooring manufacturer for installation techniques required.

## 1.7 DELIVERY, STORAGE, AND HANDLING

A. Store resilient sheet flooring 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 or more than 90 deg F. Store rolls upright.

## 1.8 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 85 deg F, in spaces to receive resilient sheet flooring 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. Close spaces to traffic during resilient sheet flooring installation.

D. Close spaces to traffic for 48 hours after resilient sheet flooring installation.

E. Install resilient sheet flooring after other finishing operations, including painting, have been completed.

## PART 2 PRODUCTS

### 2.1 UNBACKED VINYL SHEET FLOORING

A. Product Standard: ASTM F 1913.

B. Wearing Surface: Smooth.

C. Seamless-Installation Method: Chemically bonded.

### 2.2 INSTALLATION MATERIALS

A. Adhesives: Water-resistant type recommended by flooring and adhesive manufacturers to suit resilient sheet flooring and substrate conditions indicated.

B. Seamless-Installation Accessories:
   1. Chemical-Bonding Compound: Manufacturer's product for chemically bonding seams.

C. Integral-Flash-Cove-Base Accessories:
   1. Cove Strip: 1-inch radius provided or approved by resilient sheet flooring manufacturer.
   2. Cap Strip: Square metal, vinyl, or rubber cap provided or approved by resilient sheet flooring manufacturer.
   3. Corners: Metal inside and outside corners and end stops provided or approved by resilient sheet flooring manufacturer.

## 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 sheet flooring.

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

### 3.2 PREPARATION

A. Prepare substrates according to resilient sheet flooring manufacturer's written instructions to ensure adhesion of resilient sheet flooring.

B. Concrete Substrates: Prepare according to ASTM F 710.
   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 adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by resilient sheet flooring manufacturer. Do not use solvents.
   3. Alkalinity and Adhesion Testing: Perform tests recommended by resilient sheet 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.

C. Do not install resilient sheet flooring until materials are the same temperature as space where they are to be installed.
   1. At least 48 hours in advance of installation, move flooring and installation materials into spaces where they will be installed.

D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient sheet flooring.

## 3.3 RESILIENT SHEET FLOORING INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient sheet flooring.

B. Unroll resilient sheet flooring and allow it to stabilize before cutting and fitting.

C. Lay out resilient sheet flooring as follows:
   1. Maintain uniformity of flooring direction.
   2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least 6 inches away from parallel joints in flooring substrates.
   3. Match edges of flooring for color shading at seams.
   4. Avoid cross seams.

D. Scribe and cut resilient sheet flooring to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

E. Extend resilient sheet flooring into toe spaces, door reveals, closets, and similar openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on resilient sheet flooring as marked on substrates. Use chalk or other nonpermanent marking device.

G. Install resilient sheet 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.

H. Adhere resilient sheet 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.

I. Seamless Installation:
   1. Chemically Bonded Seams: Bond seams with chemical-bonding compound to fuse sections permanently into a seamless flooring installation. Prepare seams and apply compound to produce tightly fitted seams without gaps, overlays, or excess bonding compound on flooring surfaces.

J. Integral-Flash-Cove Base: Cove resilient sheet flooring 6 inches up vertical surfaces. Support flooring at horizontal and vertical junction with cove strip. Butt at top against cap strip.
   1. Install metal corners at inside and outside corners.

## 3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting resilient sheet flooring.

B. Perform the following operations immediately after completing resilient sheet 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 resilient sheet flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Cover resilient sheet flooring until Substantial Completion.

**END OF SECTION**

# SECTION 09 65 19

# RESILIENT TILE FLOORING

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Solid vinyl floor tile.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For each type of resilient floor tile.
   1. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
   2. Show details of special patterns.

C. Product Schedule: For floor tile. Use same designations indicated on Drawings.

### 1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

### 1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

### 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. Floor Tile: Furnish one box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

## 1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.
   1. Engage an installer who employs workers for this Project who are trained or certified by floor tile manufacturer for installation techniques required.

## 1.7 DELIVERY, STORAGE, AND HANDLING

A. Store floor tile 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 or more than 90 deg F. Store floor tiles on flat surfaces.

## 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 floor tile 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. Close spaces to traffic during floor tile installation.

D. Close spaces to traffic for 48 hours after floor tile installation.

E. Install floor tile after other finishing operations, including painting, have been completed.

# PART 2 PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For resilient floor tile, as determined by testing identical products according to ASTM E 648 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 SOLID VINYL FLOOR TILE

A. Tile Standard: ASTM F 1700.
   1. Type: A, Smooth Surface.

B. Thickness: 0.080 inch.

## 2.3 INSTALLATION MATERIALS

A. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile 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 floor tile.

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

## 3.2 PREPARATION

A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F 710.
   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 adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.

C. Do not install floor tiles 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 floor tile and installation materials into spaces where they will be installed.

D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

## 3.3 FLOOR TILE INSTALLATION

A. Comply with manufacturer's written instructions for installing floor tile.

B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so 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.

C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.

## 3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.

B. Perform the following operations immediately after completing floor tile 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 floor tile from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Cover floor tile until Substantial Completion.

**END OF SECTION**

# SECTION 09 65 36

# STATIC-CONTROL RESILIENT FLOORING

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Static-control, solid vinyl floor tile.

### 1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
   1. Review methods and procedures related to static-control resilient flooring including, but not limited to, the following:
      a. Examination and preparation of substrates to receive static-control resilient flooring.
      b. Installation techniques required for specified products.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For each type of static-control resilient flooring. Include floor-covering layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
   1. Show details of special patterns.
   2. Show locations of inscribed maintenance floor tiles in conductive, solid vinyl floor tile installation areas.
   3. Show grounding locations of grounding strips and connections.

C. Samples: For each type of static-control resilient flooring and in each color, pattern, and texture required, in manufacturer's standard size, but not less than 6 by 9 inches.

### 1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Field quality-control reports.

## 1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of static-control resilient flooring 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. Floor Tile: Furnish one box for every 50 boxes, or fraction thereof, of each type, color, and pattern of floor tile installed.

## 1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in installation techniques required by manufacturer for specified static-control resilient flooring.
   1. Engage an installer who employs workers for this Project who are trained or certified by manufacturer for installation techniques required for specified products.

## 1.8 DELIVERY, STORAGE, AND HANDLING

A. Store static-control resilient flooring and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended in writing by manufacturer, but not less than 50 deg F or more than 90 deg F.
   1. Floor Tile: Store on flat surfaces.
   2. Sheet Floor Covering: Store rolls upright.

## 1.9 PROJECT CONDITIONS

A. Maintain ambient temperatures in spaces to receive static-control resilient flooring within range recommended by manufacturer, but not less than 70 deg F or more than 85 deg F, during the following time periods:
   1. Period recommended in writing by manufacturer before installation.
   2. During installation.
      a. Period recommended in writing by manufacturer after installation.

B. Until Substantial Completion, maintain ambient temperatures in installation areas within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

C. Close spaces to traffic during static-control resilient flooring installation.

D. Close spaces to traffic for period recommended in writing by manufacturer after static-control resilient flooring installation.

E. Install static-control resilient flooring after other finishing operations, including painting, have been completed.

## PART 2 PRODUCTS

### 2.1 STATIC-CONTROL, SOLID VINYL FLOOR TILE

A. Source Limitations: Obtain floor tile from single source from single manufacturer.

B. Static-Control Properties: As determined by testing identical products in accordance with test method indicated by an independent testing and inspecting agency.
   1. Electrical Resistance:
      a. Material in Combination with a Person: Maximum resistance of _____ ohms when tested in accordance with ESD STM97.1.
   2. Static Generation:
      a. ESD STM97.2: Less than 30 V when tested at 12 percent relative humidity with static-control footwear.
   3. Static Decay: 5000 to 0 V in less than 0.25 seconds when tested in accordance with FED-STD-101C, Method 4046.1.

C. Critical Radiant Flux: 0.22 W/sq. cm or greater when tested in accordance with ASTM E648 or NFPA 253.

D. Construction: Manufacturer's standard, high-density vinyl resin with smooth surface.

E. Thickness: Manufacturer's standard, but not less than 0.08 inch.

F. Maintenance Floor Tiles: Special floor tiles inscribed "Conductive floor. Do not wax."

### 2.2 INSTALLATION MATERIALS

A. Static-Control Adhesive: Provided or approved by manufacturer; type that maintains electrical continuity of floor-covering system to ground connection.

## PART 3 EXECUTION

### 3.1 EXAMINATION

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

B. 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 installation or static-control characteristics of floor coverings.

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

## 3.2 PREPARATION

A. Prepare substrates in accordance with manufacturer's written instructions to ensure successful installation of static-control resilient flooring and electrical continuity of floor-covering systems.

B. Concrete Substrates: Prepare in accordance with 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 floor-covering adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.

C. Access Flooring Panels: Remove protective film of oil or other coating using method recommended by access flooring manufacturer.

D. Do not install static-control resilient flooring until it is same temperature as space where it is to be installed.
   1. Move static-control resilient flooring and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

E. Sweep and vacuum substrates to be covered by static-control resilient flooring immediately before installation.

## 3.3 INSTALLATION, GENERAL

A. Install static-control resilient flooring in accordance with manufacturer's written instructions.

B. Extend grounding strips beyond perimeter of static-control resilient floor-covering surfaces to ground connections.
   1. For adhesively installed flooring, embed grounding strips in static-control adhesive.

C. Scribe, cut, and fit static-control resilient flooring to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
   1. Extend static-control resilient flooring below built-in items and permanent, but movable, items that allow for a flexible layout where indicated on Drawings.

D. Extend static-control resilient flooring into toe spaces, door reveals, closets, and similar openings.

E. Extend static-control resilient flooring to center of door openings where flooring or color transitions occur.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on static-control resilient flooring as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.

G. Install static-control resilient flooring on covers for telephone and electrical ducts, and similar items in installation areas. Maintain overall continuity of color and pattern with pieces of static-control resilient flooring installed on covers. Tightly adhere static-control resilient flooring edges to substrates that abut covers and to cover perimeters.

H. Adhesive Installation: Adhere static-control resilient flooring to substrates using a full spread of static-control 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.

## 3.4 INSTALLATION OF FLOOR TILE

A. Lay out 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 floor tile at perimeter.
   1. Lay floor tiles in pattern indicated on Drawings.

B. Match floor tiles for color and pattern by selecting floor tiles from cartons in same sequence as manufactured and packaged if so numbered. Discard broken, cracked, chipped, or deformed floor tiles.
   1. Lay vinyl composition floor tiles in pattern of colors and sizes indicated on Drawings.

C. In each space where conductive, solid vinyl floor tile is installed, install maintenance floor tile identifying conductive floor tile in locations approved by Architect.

## 3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to test electrical resistance of static-control resilient flooring in accordance with ESD STM7.1 for compliance with requirements.
   1. Arrange for testing after the following:
      a. Static-control adhesives have fully cured.
      b. Static-control resilient flooring has stabilized to ambient conditions.
      c. Ground connections are completed.

B. Static-control resilient flooring will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

## 3.6 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of static-control resilient flooring.

B. Perform the following operations immediately after completing static-control resilient flooring:
   1. Remove static-control adhesive from exposed surfaces.
   2. Remove dirt and blemishes from exposed surfaces.
   3. Sweep and vacuum surfaces thoroughly.
   4. Damp-mop surfaces to remove marks and soil.

C. Protect static-control resilient flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
   1. Do not wax static-control resilient flooring.

D. Cover static-control resilient flooring and protect from rolling loads until Substantial Completion.

**END OF SECTION**

# SECTION 09 66 00

# PRECAST EPOXY TERRAZZO STAIR TREADS

## PART 1 GENERAL

### 1.1 SUMMARY

A. Types of Precast Terrazzo work included:
   1. Precast Terrazzo Stairs

B. Setting material, grouts, sealants and caulks

C. Installation of precast terrazzo stairs, base, sills, etc.

D. Related work not specified under this section
   1. Installation of steel stairs to receive precast terrazzo

### 1.2 REFERENCES

A. American Society for Testing and Materials (ASTM)
   1. ASTM C-150
   2. ASTM C-33
   3. ASTM C-140
   4. ASTM C-293
   5. ASTM C-1028

B. National Terrazzo and Mosaic Association Inc. (NTMA)

C. Federal Register Part III
   1. 28 CFR Part 36

### 1.3 SUBMITTALS

A. Shop Drawings
   1. Submit shop drawings of all precast terrazzo items showing detail sections and profile for all precast items. Details shall show all reinforcing and special hardware for fastening.

B. Samples:
   1. Submit maximum of 3 samples 3" x 6" size for all color.
      a. Color to be selected from Wausau Tile color pallet.
   2. Submit two copies of NTMA maintenance literature.

3. Quality Assurance and Procedure Program

C. Performance Requirements:
   1. Compressive Strength 10,000 p.s.i.
   2. Flexural Strength 3,000 p.s.i.

D. Certification:
   1. Suppliers shall furnish certification attesting that materials meet specification requirements.

## 1.4 QUALITY ASSURANCE

A. NTMA Standards: Comply with specified provisions and recommendations of the National Terrazzo & Mosaic Association, Inc. (NTMA).

B. Manufacturer's Instructions: In addition to specified requirements, comply with precast terrazzo manufacturer's instructions and recommendations for substrate preparation, materials storage, mixing and application, finishing and curing.

C. Qualifications: Precast Terrazzo Manufacturer and Trade Contractor must have a minimum of 5 years of successful experience on projects of similar magnitude and complexity to that indicated project. Manufacturer and contractor to be prequalified by Architect prior to bidding. Failure to prequalify will void bid.

D. Manufacturer to supply a written Quality Assurance Program and Procedure manual.

## 1.5 DELIVERY, STORAGE AND HANDLING

A. Packaging and Shipping: Precast terrazzo to be palletized and shrink wrapped, delivered in original unopened packaging with legible manufacturer identification, including size, piece number, quantities, manufacturer date and inspector initials.

B. Storage and Protection: Precast terrazzo to be stored indoors, in a climate-controlled environment, sheltered from moisture in original packaging. Protect from damage by other trades.

C. Report all damage due to shipment immediately. Customer is required to sign the Bill of Lading slip noting damaged product. Picture proof is required.

## 1.6 WARRANTY

A. Manufacturer/Installer shall warrant installed system for a period of 1 year from date of substantial completion against failure of workmanship and materials.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

A. Acceptable Manufacturer:
   1. Wausau Tile, Inc.

B. Clarification Note: Drawings and specifications are based on manufacturer's proprietary literature from Wausau Tile, Inc. Other manufacturers shall comply with minimum levels of material specifications and detailing indicated on the drawings of specified herein.

### 2.2 MATERIALS

A. Epoxy Resin.

B. Aggregates: All aggregates to meet ASTM C-33 specifications, cleaned and properly graded to size. Aggregate shall be blended to meet individual project requirements.

C. Marble chips, size to conform with NTMA gradation standards.

D. Abrasive Inserts: Shall consist of silica carbide and black epoxy. Specify one to three lines.

E. Caulks & Sealants:
   1. Urethane or Polyurethane Sealant
   2. Color to be selected by Architect from standard color pallet.

F. Cleaner: Liquid neutral chemical cleaner, with pH factor between 7 and 8, of formulation recommended by sealer manufacture for type of precast terrazzo used and complying with NTMA requirements.

G. Sealer: Colorless, slip and stain-resistant penetrating sealer with pH factor between 7 and 8, that does not affect color or physical properties of precast terrazzo surface. Flash point (ASTM D56): 80 degrees F, Minimum.

### 2.3 MANUFACTURED UNITS

A. Sizing Tolerances:
   1. All units to conform to shop drawings with a 1/16" tolerance in dimension.

B. Precast Surfaces and Edges:
   1. All exposed edges to be ground and polished with a minimum of 1/16" bevel.
   2. All finished surfaces to be ground and polished, free of holes and to have overall uniformity in matrix and aggregate.
   3. All precast epoxy terrazzo finished surfaces to be sealed with a sealer approved by manufacturer.

## PART 3 EXECUTION

### 3.1 INSPECTION

A. Examine areas to receive precast terrazzo for the following:
   1. Defects in existing work.
   2. Deviations beyond allowable tolerances for the substrate.

B. Start work only when all defects have been corrected by others.

### 3.2 INSTALLATION

A. Setting:
   1. Setting methods will vary per product. Set accurately as shown on the approved shop drawings. Contact your setting material manufacturer with any questions on proper bonding of all materials.
      a. Setting methods are:
         1) Epoxy based setting materials: Contact your selected manufacturer as recommended or specified. Setting materials can change without notice.
         2) Weld attachment: Contact Wausau Tile for recommended welding guidelines as provided by the structural engineer. DO NOT run a continuous weld when attaching terrazzo to avoid over-heating and cracking of the terrazzo.
   2. All thinset materials, whether cement or epoxy based, will require a full setting bed be applied to all appropriate surfaces of the precast terrazzo, vertical and horizontal, where contact is made with the substrate or structural base.
   3. Alignment of precast should be straight and true to all dimensions. It may not vary more than 1/8" in length, height or width.
   4. Install anchors as shown on details, if required.
   5. Fill joints between with manufacturer - approved caulk or as specified.

B. Protection:
   1. Upon completion, the work shall be ready for final inspection and acceptance by owner or owner agent.
   2. General Contractor shall protect the finished work from the time the terrazzo contractor completes the work.

C. Finish: All precast epoxy terrazzo finished surfaces to be sealed with a sealer approved by manufacturer.

**END OF SECTION**

# SECTION 09 66 23

# RESINOUS MATRIX TERRAZZO FLOORING

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Thin-set, epoxy-resin terrazzo flooring, including elevator floor.
   2. Precast epoxy-resin terrazzo units, including stair treads where indicated.

### 1.2 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.

### 1.3 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. Accessory strips.
   4. Abrasive strips.
   5. Stair treads, risers, and landings.
   6. Precast terrazzo jointing and edge configurations.
   7. Terrazzo patterns.

C. Samples: For each exposed product and for each color and texture specified, 6 inches in size.

## 1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Installer Certificates: Signed by manufacturers certifying that installers comply with requirements.

C. Preinstallation moisture-testing reports.

## 1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For terrazzo to include in maintenance manuals.

## 1.6 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Engage 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.

## 1.7 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.

## 1.8 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. Field Measurements: Verify actual dimensions of construction contiguous with precast terrazzo by field measurements before fabrication.

C. Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during terrazzo installation.

D. Close spaces to traffic during terrazzo application and for not less than 24 hours after application unless manufacturer recommends a longer period.

E. Control and collect water and dust produced by grinding operations. Protect adjacent

construction from detrimental effects of grinding operations.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

A. Source Limitations: Obtain primary terrazzo materials from single source from single manufacturer. Provide secondary materials including patching and fill material, joint sealant, and repair materials of type and from source recommended by manufacturer of primary materials.

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.

B. Mix Color and Pattern: As selected by Architect from manufacturer's full range.

C. Materials:
1. Primer: Manufacturer's product recommended for substrate and use indicated.
2. 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 D 2240, Shore D.
        2) Minimum Tensile Strength: 3000 psi per ASTM D 638 for a 2-inch specimen made using a "C" die per ASTM D 412.
        3) Minimum Compressive Strength: 10,000 psi per ASTM D 695, Specimen B cylinder.
        4) Chemical Resistance: No deleterious effects by contaminants listed below after seven-day immersion at room temperature per ASTM D 1308.
            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.

b. Physical Properties with Aggregates: For terrazzo blended according to manufacturer's recommendations with one part epoxy resin with three parts marble aggregate consisting of 60 percent No. 1 chips and 40 percent No. 0 chips that is ground and grouted to a 1/4-inch nominal thickness, and cured for 7 days at 75 deg F plus or minus 2 deg F and at 50 percent plus or minus 2 percent relative humidity.
   1) Flammability: Self-extinguishing, maximum extent of burning 1/4 inch according to ASTM D 635.
   2) Thermal Coefficient of Linear Expansion: 0.0025 inch/inch per deg F according to ASTM C 531.

3. Aggregates: Comply with NTMA gradation standards for mix indicated and contain no deleterious or foreign matter.
   a. Abrasion and Impact Resistance: Less than 40 percent loss per ASTM C 131/C 131M.
   b. 24-Hour Absorption Rate: Less than 0.75 percent.
   c. Dust Content: Less than 1.0 percent by weight.
4. Finishing Grout: Resin based.

## 2.4 PRECAST EPOXY-RESIN TERRAZZO

A. Precast Terrazzo Base : Minimum 3/8-inch- thick, epoxy terrazzo units cast in maximum lengths possible, but not less than 36 inches. Comply with manufacturer's written instructions for fabricating precast terrazzo base units in sizes and profiles indicated.
   1. Type: Straight.
   2. Top Edge: Radius edge with polished top surface.
   3. Outside Corner Units: With finished returned edges at outside corner.
   4. Color, Pattern, and Finish: As selected by Architect from full range of industry colors.

B. Precast Terrazzo Units : Minimum 3/4-inch thick, epoxy terrazzo units. Comply with manufacturer's written instructions for fabricating precast units in sizes and profiles indicated. Reinforce units as required by unit sizes, profiles, and thicknesses and as recommended by manufacturer. Finish exposed-to-view edges and reveals to match face finish. Ease exposed edges to 1/8-inch radius.
   1. Color, Pattern, and Finish: As selected by Architect from full range of industry colors Match adjacent poured-in-place terrazzo flooring.

## 2.5 STRIP MATERIALS

A. 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.

B. 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. Base-bead strips for exposed top edge of terrazzo base.
   2. Edge-bead strips for exposed edges of terrazzo.
   3. Nosings for terrazzo stair treads and landings.

C. Abrasive Strips: Abrasive nosing strip and two-line abrasive inserts at nosings. Silicon carbide or aluminum oxide, or combination of both, in epoxy-resin binder and set in channel.
   1. Width: 1/2 inch.
   2. Depth: As required by terrazzo thickness.
   3. Length: 4 inches less than stair width.
   4. Color: As selected by Architect from full range of industry colors.

## 2.6 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.
   2. Precast Terrazzo: Provide mechanical anchoring devices as recommended by fabricator for proper anchorage and support of units for conditions of installation and support.

C. 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.

# 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. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.

D. Preinstallation Moisture Testing:
   1. Testing Agency: Engage a qualified testing agency to perform tests.

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 in locations indicatedon approved shop drawings.
      b. Install control-joint strips in locations indicated.
      c. Install control-joint strips with 1/4-inch gap between strips, and install sealant in gap.
      d. 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 required to provide a complete installation.
   3. Abrasive Strips: Install with surface of abrasive strip positioned 1/16 inch higher than terrazzo surface.

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: As indicated on Drawings nominal.

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.

E. Install and finish poured-in-place terrazzo stairs at the same time the adjacent terrazzo flooring is installed.

F. Install and finish poured-in-place terrazzo base at the same time the adjacent terrazzo flooring is installed.

## 3.4 PRECAST TERRAZZO INSTALLATION

A. Install precast terrazzo units using method recommended in writing by NTMA and manufacturer unless otherwise indicated.

B. Do not install units that are chipped, cracked, discolored, or improperly finished.

C. Seal joints between units with joint compound matching precast terrazzo matrix.

## 3.5 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.

## 3.6 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. 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**

# SECTION 09 67 23

# RESINOUS FLOORING

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Resinous flooring.
   2. Integral cove base accessories.

### 1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
   1. Review manufacturer's written instructions for substrate preparation and environmental conditions affecting resinous flooring installation.
   2. Review details of integral cove bases.
   3. Review manufacturer's written instructions for installing resinous flooring systems.
   4. Review protection measures for adjacent construction and installed flooring, floor drainage requirements, curbs, base details, and so forth.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include manufacturer's technical data, installation instructions, and recommendations for each resinous flooring component required.

B. Samples for Verification: For each resinous flooring system required and for each color and texture specified, 6 inches square, applied to a rigid backing by Installer for this Project.

### 1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Material Certificates: For each resinous flooring component.

C. Field quality-control reports.

## 1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For resinous flooring to include in maintenance manuals.

## 1.6 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
   1. Engage an installer who is certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated.

## 1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.

## 1.8 FIELD CONDITIONS

A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring installation.

B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring installation.

C. Close spaces to traffic during resinous flooring installation and for 24 hours after installation unless manufacturer recommends a longer period.

# PART 2 PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

A. Flammability: Self-extinguishing in accordance with ASTM D635.

## 2.2 RESINOUS FLOORING

A. Resinous Flooring System: Abrasion-, impact-, and chemical-resistant, aggregate-filled, resin-based monolithic floor surfacing designed to produce a seamless floor and integral cove base.

B. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from single manufacturer. Obtain secondary materials, including patching and fill material,

joint sealant, and repair materials, of type and from manufacturer recommended in writing by manufacturer of primary materials.

C. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended in writing by manufacturer for installation indicated.

D. Body Coats:
   1. Resin: Epoxy.
   2. Formulation Description: High solids.
   3. Type: Clear.
   4. Installation Method: Self-leveling slurry with broadcast aggregates.
   5. Thickness of Coats: 1/16 inch.
   6. Aggregates: Vinyl flakes.

E. Grout Coat:
   1. Resin: Epoxy.
   2. Formulation Description: High solids.
   3. Type: Clear.
   4. Thickness of Coat: 1/16 inch.

F. Topcoats: Sealing or finish coats.
   1. Resin: Epoxy.
   2. Formulation Description: High solids.
   3. Type: Pigmented.
   4. Thickness of Coats: 1/16 inch.
   5. Finish: Matte.

## 2.3 INTEGRAL COVE BASE ACCESSORIES

A. Precast, Integral Cove Base: Impact-resistant, polymer-resin, cove base moldings with a grit profile to promote adhesion of resinous flooring and recommended in writing by resinous flooring manufacturer.
   1. Radius Cove: Cove molding with approximately 1-inch radius for adhesive installation at floor-to-wall joint as substrate to receive resinous flooring system to form an integral cove base.
   2. Radius Cove Base: 4-inch- high base molding that provides approximately 1-inch radius cove at floor-to-wall joint; for adhesive installation as substrate for resinous flooring system to form an integral cove base.
      a. Preformed Inside and Outside Corners: Provide manufacturer's standard square inside and 3/4- to 1-inch bullnose outside corners.

B. Installation Adhesive: As recommended in writing by accessory manufacturer.

## 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 resinous flooring systems.

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

### 3.2 PREPARATION

A. Prepare and clean substrates in accordance with resinous flooring manufacturer's written instructions for substrate indicated to ensure adhesion.

B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.
   1. Roughen concrete substrates as follows:
      a. Comply with requirements in SSPC-SP 13/NACE No. 6, with a Concrete Surface Profile of 3 or greater in accordance with ICRI Technical Guideline No. 310.2R, unless manufacturer's written instructions are more stringent.
   2. Repair damaged and deteriorated concrete in accordance with resinous flooring manufacturer's written instructions.
   3. 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. Patching and Filling: Use patching and fill material to fill holes and depressions in substrates in accordance with manufacturer's written instructions.
   1. Control Joint Treatment: Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring in accordance with manufacturer's written instructions.

D. Resinous Materials: Mix components and prepare materials in accordance with resinous flooring manufacturer's written instructions.

## 3.3 INSTALLATION

A. Apply components of resinous flooring system in accordance with manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness specified.
   1. Coordinate installation of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
   2. Cure resinous flooring components in accordance with manufacturer's written instructions. Prevent contamination during installation and curing processes.
   3. Expansion and Isolation Joint Treatment: At substrate expansion and isolation joints, comply with resinous flooring manufacturer's written instructions.

B. Integral Cove Base Accessories: Adhesively install precast accessories before applying flooring coats and in accordance with manufacturer's written instructions.

C. Field-Formed Integral Cove Base: Apply cove base mix to wall surfaces before applying flooring coats. Apply in accordance with manufacturer's written instructions and details, including those for taping, mixing, priming, troweling, sanding, and topcoating of cove base. Round internal and external corners.
   1. Integral Cove Base: 4 inches high.

D. Self-Leveling Body Coats: Apply self-leveling slurry body coats in thickness specified for flooring system.
   1. Aggregates: Broadcast aggregates at rate recommended in writing by manufacturer. After resin is cured, remove excess aggregates to provide surface texture indicated.

E. Troweled or Screeded Body Coats: Apply troweled or screeded body coats in thickness specified for flooring system. Hand or power trowel and grout to fill voids. When body coats are cured, remove trowel marks and roughness using method recommended in writing by manufacturer.

F. Grout Coat: Apply grout coat to fill voids in surface of final body coat.

G. Topcoats: Apply topcoats in number indicated for flooring system specified, at spreading rates recommended in writing by manufacturer, and to produce wearing surface specified.

## 3.4 PROTECTION

A. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.

**END OF SECTION**

# SECTION 09 68 13

# TILE CARPETING

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Modular carpet tile.

### 1.2 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.

### 1.3 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. Type, color, and location of edge, transition, and other accessory strips.
   10. Transition details to other flooring materials.

C. Samples: 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. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch- long Samples.

D. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

## 1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.

B. Sample Warranty: For special warranty.

## 1.5 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.

## 1.6 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.

## 1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with the Carpet and Rug Institute's CRI 104.

## 1.8 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.

D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

## 1.9 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 CARPET TILE

A. Fiber Content: 100 percent nylon 6.

B. Applied Treatments:
   1. Soil-Resistance Treatment: Manufacturer's standard treatment.

C. Performance Characteristics:
   1. Appearance Retention Rating: Heavy traffic, 3.0 minimum according to ASTM D7330.
   2. Dimensional Tolerance: Within 1/32 inch of specified size dimensions, as determined by physical measurement.
   3. Electrostatic Propensity: Less than 3.5 kV according to AATCC 134.

## 2.2 INSTALLATION ACCESSORIES

A. 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.

B. Metal Edge/Transition Strips: Extruded aluminum with selected finish of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.

# 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 03 30 00 "Cast-in-Place Concrete" and that surfaces are free of cracks, ridges, depressions, scale, and foreign deposits.

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 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.

C. Maintain dye-lot integrity. Do not mix dye lots in same area.

D. Maintain pile-direction patterns 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. Install pattern parallel to walls and borders.

## 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**

# SECTION 09 69 33

# LOW-PROFILE FIXED HEIGHT ACCESS FLOORING

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section includes low-profile, fixed-height access flooring.

### 1.2 COORDINATION

A. Coordinate location of electrical work in underfloor cavity and wire management channels.

### 1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
   1. Review connections between low-profile, fixed-height access flooring and electrical systems.

### 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 low-profile, fixed-height access flooring.
   2. Include loading capacities and rolling loads data.

B. Shop Drawings: For low-profile, fixed-height access flooring:
   1. Include layout of low-profile, fixed-height access flooring and relationship to adjoining Work based on field-verified dimensions.
   2. Details and sections with descriptive notes indicating materials, finishes, fasteners, typical and special edge conditions, accessories, and understructures.

C. Samples:
   1. Exposed Metal Accessories: Approximately 10 inches in length.
   2. One full-size unit for each component of each type of low-profile, fixed-height access flooring required.
   3. Floor Coverings: Full-size units for each color and texture specified.
   4. Acoustical under sheet.

D. Installation Methods for Finished Flooring: Submit manufacturer's recommendation for adhering carpet tile and LVT flooring to the raised access flooring system. Contractor shall coordinate with finished flooring submittals.

E. Warranty: Provide manufacturer's standard warranty for 20 years.

## 1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data for Installer: An entity who employes installers who have been trained and experienced in installation of the low-profile access flooring system or under supervision of access-flooring manufacturer's authorized representative.

## 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. Low-Profile, Fixed-Height Access-Flooring Components: Two percent of each system component and fastener.

## 1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

# PART 2 PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Low-profile, fixed-height access flooring shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

B. Structural Performance:
   1. Loading Capacity: 250-lbf/sq. ft. live load with the following deflection and permanent set:
      a. Top-Surface Deflection: Maximum 0.15 inch.
      b. Permanent Set: Maximum 0.06 inch.

C. Fire Performance:
   1. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
      a. Flame-Spread Index: 25 or less.
      b. Smoke-Developed Index: 50 or less.

## 2.2 LOW-PROFILE, FIXED-HEIGHT ACCESS FLOORING

A. Low-Profile, Fixed-Height Access Flooring: Manufacturer's standard, modular, steel or polymer components, designed to interconnect and provide channels for installation of wiring; with manufacturer's standard factory-applied finish.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide FreeAxez, LLC; Gridd 70 Reinforced System, with manufacturer's slip sheet, or comparable product by one of the following
      a. ASM Products.
      b. DIRTT Environmental Solutions.
      c. Tate Access Floors, Inc.
   2. Module: Low-profile access flooring with nominal module size of 24 by 24 inches.
   3. Height: Low-profile access flooring with nominal height of 3 inches maximum.

B. Service Outlets and Wiring: Standard UL-listed and -labeled assemblies, for recessed mounting flush with top of floor panels; for power, communication, and signal services; and complying with the following requirements:
   1. Structural Performance: Cover capable of supporting a 1000-lbf concentrated load.
   2. Cover and Box Type: Hinged polycarbonate cover with opening for passage of cables when cover is closed and including frame and steel box or formed-steel plate for mounting electrical receptacles.
   3. Receptacles and Wiring: Equip each service outlet with power receptacles to comply with the following requirements:
      a. Type of Receptacle: Heavy-duty duplex, two-pole, three-wire grounding, 20 A, 125 V, NEMA WD 6, Configuration 5-20R unless otherwise indicated.
      b. Number of Receptacles for Outlet: Two.
      c. Wiring Method: Factory wired for field hardwiring with armored cable, containing three insulated No. 12 AWG solid-copper conductors, terminated with a 6-inch- long pigtail.
      d. Wiring Method: Power-in connectors, built into outlet housing, of type to fit power-in and power-out connectors of branch-circuit cables supplied with building electrical system.

C. Fascia Closures: Where underfloor cavity is not enclosed by abutting walls or other construction, provide metal closure plates with manufacturer's standard finish.

D. Ramps: Manufacturer's standard ramp construction of width and slope indicated, but not steeper than 1:12, of same materials, performance, and construction requirements as low-profile, fixed-height access flooring.

E. Perimeter Support: Manufacturer's standard method for supporting panel edge and forming transition between low-profile, fixed-height access flooring and adjoining floor coverings at same level as low-profile, fixed-height access flooring.

F. Acoustical Under Sheet: Manufacturer's standard Class A rating. Flame spread less than 25; smoke development less than 75.

## 2.3 FABRICATION

A. Fabrication Tolerances:
   1. Size: Plus or minus 0.020 inch of required size.
   2. Flatness: Plus or minus 0.035 inch, measured on a diagonal on top of panel.

# PART 3 EXECUTION

## 3.1 EXAMINATION

A. Examine substrates, with Installer and manufacturer's authorized representative present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
   1. Verify that substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of conditions and deleterious substances that might interfere with attachment of pedestals.

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

## 3.2 PREPARATION

A. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

B. Lay out low-profile access flooring installation to keep the number of cut panels at floor perimeter to a minimum. Avoid using panels cut to less than 6 inches.

C. Complete any necessary subfloor preparation, and vacuum subfloor to remove dust, dirt, and construction debris before beginning installation.

## 3.3 INSTALLATION

A. Install low-profile, fixed-height access flooring and accessories under supervision of low-profile, fixed-height access-flooring manufacturer's authorized representative to produce a rigid, firm installation that complies with performance requirements and is free of instability, rocking, rattles, and squeaks.

B. Install flooring securely in place and properly seated, with panel edges flush. Do not force panels into place.

C. Scribe perimeter panels to provide a close fit with adjoining construction, having no voids greater than 1/8 inch where panels abut vertical surfaces.

D. Secure ramps according to manufacturer's installation instructions.

E. Protection:
   1. Control traffic on low-profile access flooring after installation. Do not allow traffic that exceeds the published floor capacity. Before construction or delivery traffic is permitted travel on the access floor provide minimum 3/4-inch plywood sheathing over partially or fully-completed floors per manufacturer's requirements.
   2. Ensure wheel loads do not exceed the floor capacity.

**END OF SECTION**

# SECTION 09 77 20

# DECORATIVE FIBERGLASS REINFORCED WALL PANELS

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes: Prefinished polyester glass reinforced plastic sheets and adhered to unfinished gypsum wallboard.
   1. PVC trim.

B. Products Not Furnished or Installed under This Section:
   1. Gypsum substrate board.

### 1.2 REFERENCES

A. American Society for Testing and Materials: Standard Specifications (ASTM)
   1. ASTM D 790 - Flexural Strengths (psi)
   2. ASTM D 790 - Flexural Modulus (psi)
   3. ASTM D 638 - Tensile Strengths (psi)
   4. ASTM D 638 - Tensile Modulus (psi)
   5. ASTM D 2583 - Barcol Hardness
   6. ASTM D 256 - Izod Impact Strengths (ft #/in)
   7. ASTM D 696 - Thermal Coefficient of Lineal Expansion (in/in/F)
   8. ASTM D 570 - Water Absorption (%)
   9. ASTM D 792 - Specific Gravity
   10. ASTM D 3359 - Cross-cut Adhesion
   11. ASTM D 3273 - Mold & Mildew
   12. ASTM D 5319 - Standard Specification for Glass-Fiber Reinforced Polyester Wall and Ceiling Panels.
   13. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

### 1.3 SUBMITTALS

A. Product Data: Submit manufacturer's data to indicate compliance with these specifications, including:
   1. Storage, handling and preparation instructions and recommendations.
   2. Installation instructions.

B. Shop Drawings: Submit elevations of each wall showing location of paneling and trim members with respect to all discontinuities in the wall elevation.

C. Selection Samples: Submit manufacturer’s standard color pattern selection samples representing manufacturer's full range of available colors and patterns.

D. Samples for Verification: Submit appropriate section of panel for each finish selected indicating the color, texture, and pattern required.
   1. Submit complete with specified applied finish.
   2. For selected patterns show complete pattern repeat.
   3. Exposed Trim Molding: Provide samples of each type, finish, and color.

E. Manufacturers Safety Data Sheets (SDS) for adhesives, sealants and other pertinent materials prior to their delivery to the site (available as downloads for most Marlite’s products at http://www.marlite.com/tech-details.aspx or by contacting Marlite at info@marlite.com).

## 1.4 QUALITY ASSURANCE

A. Conform to building code requirements for interior finish for smoke and flame spread requirements as tested in accordance with:
   1. ASTM E 84 (Method of test for surface burning characteristics of building Materials)
   2. Wall Required Rating - Class C.

B. Sanitary Standards: System components and finishes to comply with:
   1. United States Department of Agriculture (USDA) / Food Safety & Inspection Services (FSIS) requirements for food preparation facilities, incidental contact.
   2. Food and Drug Administration (FDA) 2013 Food Code 6-101.11.
   3. Canadian Food Inspection Agency (CFIA) requirements.

## 1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver materials factory packaged on strong pallets.

B. Store panels and trim lying flat, under cover and protected from the elements. Allow panels and adhesive to acclimate to room temperature (range of 60 to 75°F) for 48 hours prior to installation.

## 1.6 PROJECT CONDITIONS

A. Environmental Limitations: Building are to be fully enclosed prior to installation with heat (70° or similar room temperature) and ventilation consistent with good working conditions for finish work.

B. During installation and for not less than 48 hours before, maintain an ambient temperature and relative humidity within limits required by type of adhesive used and recommendation of adhesive manufacturer.
   1. Provide ventilation to disperse fumes during application of adhesive as

recommended by the adhesive manufacturer.

## 1.7 WARRANTY

A. Furnish one-year guarantee against defects in material.

# PART 2 PRODUCTS

## 2.1 ACCEPTABLE MANUFACTURER

A. Marlite; 1 Marlite Drive, Dover, OH 44622. 800-377-1221 FAX (330) 343-4668 Email: info@marlite.com www.marlite.com.

B. Product:
   1. Symmetrix™ SmartSeam FRP Panels with Sani-coat Sealer

## 2.2 PANELS

A. Fiberglass reinforced thermosetting polyester resin panel sheets complying with ASTM D 5319.
   1. Finishing: BlueSky™ Advanced Finishing System: Spray-applied Sani-coat Sealer covers entire panel including grooves and features water-based coatings and controlled, low-temperature inline curing.
   2. Dimensions:
      a. Thickness - 0.090” (2.29mm) nominal
      b. Width - 4'-0” (1.22m) nominal
      c. Length - As indicated on the drawings nominal
   3. Tolerance:
      a. Length and Width: +/-1/8” (3.175mm)
      b. Square - Not to exceed 1/8” for 4’ (1.2m) panels, 8’ (2.4m) panels or 5/32” (3.96mm) for 10’ (3.0m) panels

B. Properties: Resistant to rot, corrosion, denting, peeling, and splintering.
   1. Flexural Strength - 0.9 x 104 psi per ASTM D 790.
   2. Flexural Modulus - 6.0 x 106 psi per ASTM D 790.
   3. Tensile Strength - 11.5 x 103 psi per ASTM D 638.
   4. Tensile Modulus - 0.45 x 106 psi per ASTM D 638.
   5. Barcol Hardness (scratch resistance) - 28 per ASTM D 2583.
   6. Izod Impact Strength - 6.0 ft. lbs./in ASTM D 256
   7. Thermal Coefficient of Lineal Expansion - 2.22 x 10-5 in/in/F per ASTM D 696
   8. Water Absorption - 0.15% per ASTM D 570.
   9. Specific Gravity - 1.8 per ASTM D 792.
   10. Cross-cut Adhesion - 0 removed per ASTM D 3359
   11. Mold & Mildew - Pass per ASTM D 3273.
   12. Standard Specification for FRP Wall Panels - per ASTM D 5319

13. Standard Test Method Surface Burning Characteristics of Building Materials - Class C per ASTM E 84.

C. Back Surface: Smooth. Imperfections which do not affect functional properties are not cause for rejection.

D. Front Surface: Smooth. Marlite Symmetrix SmartSeam FRP Panels with Sani-coat Sealer are available in a variety of panel colors, groove colors, finishes, tile patterns, groove directions, tile sizes and panel sizes.

E. Panel Color and Groove Color:
   1. SYM SS100 White Panel and White Grooves
   2. SYM SS105 Black Panel and White Grooves
   3. SYM SS916 White Panel and Black Grooves
   4. SYM SS917 White Panel and Grey Grooves
   5. SYM SS920 Grey Panel and White Grooves

F. Finish Gloss Level:
   1. High Gloss (not available on BlueSky Digital Print Panels)
   2. Satin

G. Tile Pattern, Groove Direction, Tile Size & Panel Size:
   1. Subway Horizontal Direction
      a. 6” x 3” tiles, panel size 4’ x 4’ nominal
      b. 8” x 4” tiles, panel size 4’ x 4’ nominal
      c. 24” x 12” tiles, panel size 5’ x 3’ nominal
   2. Subway Vertical Direction
      a. 3” x 6” tiles, panel size 4’ x 8’ nominal
      b. 4” x 8” tiles, panel size 4’ x 8’ nominal
      c. 12” x 24” tiles, panel size 4’ x 8’ nominal
   3. Square
      a. 4” x 4” tiles, panel size 4’ x 8’ nominal
      b. 8” x 8” tiles, panel size 4’ x 8’ nominal
      c. 16” x 16” tiles, panel size 4’ x 8’ nominal
   4. Rectangle Horizontal Direction
      a. 6” x 3” tiles, panel size 4’ x 8’ nominal
      b. 12” x 6” tiles, panel size 4’ x 8’ nominal
      c. 24” x 12” tiles, panel size 4’ x 8’ nominal
   5. Rectangle Vertical Direction
      a. 3” x 6” tiles, panel size 4’ x 8’ nominal
      b. 6” x 12” tiles, panel size 4’ x 8’ nominal
      c. 8” x 24” tiles, panel size 4’ x 8’ nominal
   6. Linear
      a. 4” tiles, panel size 4’ x 8” nominal
      b. 8” tiles, panel size 4’ x 8’ nominal
      c. 16” tiles, panel size 4’ x 8’ nominal

H. Fire Rating: Class C (III) Fire Rating.

## 2.3 TRIM MOLDING

A. PVC Trim: Thin-wall semi-rigid extruded PVC. Provide as needed.
   1. Color: extruded custom harmonizing color

## 2.4 ACCESSORIES

A. Adhesive: Either of the following construction adhesives complying with ASTM C 557.
   1. Marlite C-551 FRP Adhesive - Water- resistant, non-flammable adhesive. Use over porous subwall only, such as unfinished drywall.
   2. Titebond Advanced Polymer Panel Adhesive - VOC compliant, non-flammable, environmentally safe adhesive. Use over non-porous subwall.
   3. Marlite C-109 Low VOC Cartridge Adhesive required for interlocking SmartSeam Panels.
   4. Marlite MS-250 Clear Silicone Cartridge Sealant for interlocking SmartSeam Panels.

# PART 3 EXECUTION

## 3.1 PREPARATION

A. Examine sub wall to determine that corners are plumb and straight, surfaces are smooth, uniform, clean and free from foreign matter, nails countersunk, joints and cracks filled flush and smooth with the adjoining surface.
   1. Verify that stud spacing does not exceed 24” (61cm) on-center.

B. Repair defects prior to installation.
   1. Level wall surfaces to panel manufacturer’s requirements. Remove protrusions and fill indentations.

## 3.2 INSTALLATION

A. Comply with manufacturer's recommended procedures and installation sequence.

B. Cut panels to meet supports allowing 1/8” (3 mm) clearance for every 8 feet (2.4m) of panel.
   1. Cut and drill with carbide tipped saw blades or drill bits or cut with shears.

C. Apply panels to board substrate, above base, vertically oriented with seams plumb and pattern aligned with adjoining panels.
   1. Install panels with manufacturer's recommended gap for panel field and corner joints.
   2. Adhesive trowel and application method to conform to adhesive manufacturer’s recommendations.
   3. For interlocking SmartSeam Panels (non-continuous vertical joints, i.e. subway

groove configuration), apply Marlite C-109 Low VOC Cartridge adhesive using swirl technique at jagged panel edges.

D. Apply panel moldings to all panel edges using silicone sealant providing for required clearances.
   1. All moldings must provide for a minimum 1/8” (3mm) of panel expansion at joints and edges, to insure proper installation.
   2. Apply sealant to all moldings, channels and joints between the system and different materials to assure watertight installation.

## 3.3 CLEANING

A. Remove excess sealant from panels and moldings. Wipe panel down using a damp cloth and mild soap solution or cleaner.

B. Refer to manufacturer's specific cleaning recommendations Do not use abrasive cleaners.

**END OF SECTION**

# SECTION 09 91 13

# EXTERIOR PAINTING

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Primers.
   2. Finish coatings.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include preparation requirements and application instructions.
   2. Indicate VOC content.

B. Samples: For each type of topcoat product.

C. Samples for Initial Selection: For each type of topcoat product.

D. Samples for Verification: For each type of paint system and each color and gloss of topcoat.
   1. Submit Samples on rigid backing, 8 inches square.
   2. Label each coat of each Sample.
   3. Label each Sample for location and application area.

E. Product List: For each product indicated, include the following:
   1. Cross-reference to paint system and locations of application areas.
   2. Use same designations indicated on Drawings and in the Exterior Painting Schedule.
   3. Include color designations.

### 1.3 CLOSEOUT SUBMITTALS

A. Coating Maintenance Manual: Provide coating maintenance manual including area summary with finish schedule; area detail designating location where each product/color/finish was used; product data pages; material safety data sheets; care and cleaning instructions; touch-up procedures; and color samples of each color and finish used.

## 1.4 MAINTENANCE MATERIAL SUBMITTALS

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

## 1.5 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
   1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 2.
      a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft.
      b. Other Items: Architect will designate items or areas required.
   2. Final approval of color selections will be based on mockups.
      a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
   3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
   4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

## 1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Handling: Deliver products to Project site in undamaged condition in manufacturer's original sealed containers, complete with labels and instructions for handling, storing, unpacking, protecting, and installing. Packaging shall bear the manufacturer’s label with the following information:
   1. Product name and type (description).
   2. Batch date.
   3. Color number.
   4. VOC content.
   5. Environmental handling requirements.
   6. Surface preparation requirements.
   7. Application instructions.

B. 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.

### 1.7 FIELD CONDITIONS

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

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

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Sherwin-Williams Company (The); products specified below or comparable product by one of the following:
   1. Benjamin Moore & Co.
   2. PPG Paints.
   3. Pratt & Lambert.
   4. Valspar Corporation (The).

B. Source Limitations: Obtain each paint product from single source from single manufacturer.
   1. Manufacturer's designations listed on a separate color schedule are for color reference only and do not indicate prior approval.

C. Comparable Products: Comparable products of approved manufacturers will be considered in accordance with Section 01 60 00 "Product Requirements," and the following:
   1. Products are approved by manufacturer in writing for application specified.
   2. Products meet performance and physical characteristics of basis-of-design product including published ratio of solids by volume, plus or minus two percent.

### 2.2 PAINT, GENERAL

A. Material Compatibility:
   1. Provide materials for use within each paint system that are 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, provide products recommended in writing by topcoat manufacturer for use in paint system and on substrate indicated.

## 2.3 PRIMERS

A. Exterior, Alkali-Resistant, Water-Based Primer: Pigmented, water-based primer formulated for use on alkaline surfaces, such as exterior plaster, vertical concrete, and masonry.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Sherwin-Williams Company (The); Loxon Concrete & Masonry Primer Sealer, LX02W50 or comparable product.

B. Water-Based, Rust-Inhibitive Primer: Corrosion-resistant, water-based-emulsion primer formulated for resistance to flash rusting when applied to cleaned, exterior ferrous metals subject to mildly corrosive environments.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Sherwin-Williams Company (The); Pro Industrial Pro-Cryl Universal Primer, B66-310 Series or comparable product.

C. Water-Based, Galvanized-Metal Primer: Corrosion-resistant, pigmented, acrylic primer; formulated for use on cleaned/etched, exterior, galvanized metal to prepare it for subsequent water-based coatings.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Sherwin-Williams Company (The); Pro Industrial Pro-Cryl Universal Primer, B66-310 Series or comparable product.

D. Quick-Drying Aluminum Primer: Corrosion-resistant, solvent-based, alkyd or modified-alkyd primer formulated for quick-drying capabilities and for use on prepared exterior aluminum.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Sherwin-Williams Company (The); Pro Industrial ProCryl Universal Metal Primer or comparable product.

## 2.4 FINISH COATINGS

A. Exterior, High-Build Latex Paint: Water-based, high-build, pigmented, emulsion coating; high-solids content improves filling, uniformity, and film build on concrete masonry surfaces. Formulated for abrasion, mold, microbial, and wind-driven rain resistance and for use on exterior masonry, concrete masonry unit, and concrete surfaces.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Sherwin-Williams Company (The); Loxon XP Waterproofing Masonry Coating Flat LX11 Series or comparable product.
   2. Gloss and Sheen Level: Manufacturer's standard low-gloss finish.
   3. Minimum Solids Content: Manufacturer's standard percentage solids by volume.

B. Exterior Alkyd Enamel, Gloss: Solvent-based, pigmented, alkyd enamel formulated for mold, microbial, and water resistance and for use on exterior, primed, wood and metal surfaces.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Sherwin-Williams Company (The); Pro Industrial Enamel HS Alkyd Gloss B54

Series or comparable product.
2. Gloss Level: Manufacturer's standard gloss finish.
3. Fineness of Grind: Manufacturer's standard.

C. Exterior, Water-Based, Light Industrial Coating, Low Sheen: Corrosion-resistant, water-based, pigmented, emulsion coating formulated for resistance to blocking (sticking of two painted surfaces), water, alkalis, moderate abrasion, and mild chemical exposure and for use on exterior, primed, wood and metal surfaces.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Sherwin-Williams Company (The); Pro Industrial Acrylic Eg-Shel B66-660 Series or comparable product.
2. Gloss and Sheen Level: Manufacturer's standard low-sheen finish.

D. Exterior, Water-Based, Light Industrial Coating, Semigloss: Corrosion-resistant, water-based, pigmented, emulsion coating formulated for resistance to blocking (sticking of two painted surfaces), water, alkalis, moderate abrasion, and mild chemical exposure and for use on exterior, primed, wood and metal surfaces.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Sherwin-Williams Company (The); Pro Industrial Acrylic Semi-Gloss Coating, B66-650 Series or comparable product.
2. Gloss Level: Manufacturer's standard semigloss finish.

E. Exterior, Water-Based, Light Industrial Coating, Gloss: Corrosion-resistant, water-based, pigmented, emulsion coating formulated for resistance to blocking (sticking of two painted surfaces), water, alkalis, moderate abrasion, and mild chemical exposure and for use on exterior, primed, wood and metal surfaces.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Sherwin-Williams Company (The); Pro Industrial Acrylic Gloss Coating, B66-600 Series or comparable product.
2. Gloss Level: Manufacturer's standard gloss finish.

## 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.

### 3.2 PREPARATION

A. Comply with manufacturer's written instructions applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
   1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
   1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems specified in this Section.

D. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer.

E. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

F. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

G. Aluminum Substrates: Remove loose surface oxidation.

## 3.3 INSTALLATION

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

B. Tint undercoats same color as topcoat, but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

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

## 3.4 FIELD QUALITY CONTROL

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

## 3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
   1. Do not clean equipment with free-draining water and prevent solvents, thinners, cleaners, and other contaminants from entering into waterways, sanitary and storm drain systems, and ground.
   2. Dispose of contaminants in accordance with requirements of authorities having jurisdiction.
   3. Allow empty paint cans to dry before disposal.
   4. Collect waste paint by type and deliver to recycling or collection facility.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

## 3.6 EXTERIOR PAINTING SCHEDULE

A. Concrete Masonry Unit Substrates:
   1. High-Build Latex System : Dry film thickness of not less than 10 mils.
      a. Prime Coat: As recommended in writing by topcoat manufacturer.
      b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
      c. Topcoat: Exterior, high-build latex paint.
         1) S-W Loxon XP Waterproofing Masonry Coating Flat LX11 Series.

B. Steel and Iron Substrates:
   1. Water-Based, Light Industrial Coating System :
      a. Prime Coat: Shop primer specified in Section in which substrate is specified.
      b. Intermediate Coat: Matching topcoat.
      c. Topcoat: Exterior, water-based, light industrial coating, semigloss.
         1) S-W Pro Industrial Acrylic Semi-Gloss Coating, B66-650 Series.

C. Galvanized-Metal Substrates:
   1. Water-Based, Light Industrial Coating System :
      a. Prime Coat: Epoxy metal primer.
         1) S-W ProCryl Universal Metal Primer.
      b. Intermediate Coat: Matching topcoat.
      c. Topcoat: Exterior, water-based, light industrial coating, semigloss.
         1) S-W Pro Industrial Acrylic Semi-Gloss Coating, B66-650 Series.

D. Aluminum Substrates:
   1. Latex System :
      a. Prime Coat: Quick-drying aluminum primer.
         1) S-W ProCryl Universal Metal Primer.
      b. Intermediate Coat: Matching topcoat.
      c. Topcoat: Exterior latex paint, semigloss.
         1) S-W A-100 Exterior Latex Flat, A6 Series.
         2) S-W A-100 Exterior Latex Low Sheen, A12 Series.
         3) S-W Solo Acrylic Semi-Gloss, A76 Series.
         4) S-W A-100 Exterior Latex Gloss, A8 Series.
   2. Water-Based, Light Industrial Coating System :
      a. Prime Coat: Quick-drying aluminum primer.
         1) S-W ProCryl Universal Metal Primer.
      b. Intermediate Coat: Matching topcoat.
      c. Topcoat: Exterior, water-based, light industrial coating, semigloss.
         1) S-W Pro Industrial Acrylic Eg-Shel B66-660 Series.
         2) S-W Pro Industrial Acrylic Semi-Gloss Coating, B66-650 Series.
         3) S-W Pro Industrial Acrylic Gloss Coating, B66-600 Series.

**END OF SECTION**

# SECTION 09 91 23

# INTERIOR PAINTING

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Primers.
   2. Water-based finish coatings.
   3. Solvent-based finish coatings.
   4. Floor sealers and paints.
   5. Dry fall coatings.

B. Related Requirements:
   1. Section 05 12 00 "Structural Steel Framing" for shop priming of metal substrates with primers specified in this Section.
   2. Section 09 91 13 "Exterior Painting" for surface preparation and the application of paint systems on exterior substrates.
   3. Section 09 93 00 "Staining and Transparent Finishing" for surface preparation and the application of wood stains and transparent finishes on interior wood substrates.
   4. Section 09 96 00 "High-Performance Coatings" for tile-like coatings.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.
   1. Include preparation requirements and application instructions.
   2. Indicate VOC content.

B. Samples: For each type of topcoat product.

C. Samples for Initial Selection: For each type of topcoat product.

D. Samples for Verification: For each type of paint system and each color and gloss of topcoat.
   1. Submit Samples on rigid backing, 8 inches square.
   2. Label each coat of each Sample.
   3. Label each Sample for location and application area.

E. Product Schedule. For each product indicated, include the following:
   1. Use same designations indicated on Drawings and in the Interior Painting Schedule to cross-reference paint systems specified in this Section.
   2. Indicate VOC content.

## 1.3 CLOSEOUT SUBMITTALS

A. Coating Maintenance Manual: Provide coating maintenance manual including area summary with finish schedule; area detail designating location where each product/color/finish was used; product data pages; material safety data sheets; care and cleaning instructions; touch-up procedures; and color samples of each color and finish used.

## 1.4 MAINTENANCE MATERIAL SUBMITTALS

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

## 1.5 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
   1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
      a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft.
      b. Other Items: Architect will designate items or areas required.
   2. Final approval of color selections will be based on mockups.
      a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
   3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
   4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

## 1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Handling: Deliver products to Project site in undamaged condition in manufacturer's original sealed containers, complete with labels and instructions for handling, storing, unpacking, protecting, and installing. Packaging shall bear the manufacturer’s label with the following information:
   1. Product name and type (description).

2. Batch date.
3. Color number.
4. VOC content.
5. Environmental handling requirements.
6. Surface preparation requirements.
7. Application instructions.

B. 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.

## 1.7 FIELD CONDITIONS

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

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures of less than 5 deg F above the dew point; or to damp or wet surfaces.

# PART 2 PRODUCTS

## 2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Sherwin-Williams Company (The); products indicated below or comparable product by one of the following:
   1. Benjamin Moore & Co.
   2. PPG Paints.
   3. Pratt & Lambert.
   4. Valspar Corporation (The).

B. Source Limitations: Obtain each paint product from single source from single manufacturer.
   1. Manufacturer's designations listed on a separate color schedule are for color reference only and do not indicate prior approval.

C. Comparable Products: Comparable products of approved manufacturers will be considered in accordance with Section 01 60 00 "Product Requirements," and the following:
   1. Products are approved by manufacturer in writing for application specified.
   2. Products meet performance and physical characteristics of basis-of-design product including published ratio of solids by volume, plus or minus two percent.

## 2.2 PAINT, GENERAL

A. Material Compatibility:
   1. Materials for use within each paint system to 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 to be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

B. Emissions Requirements: Field-applied paints and coatings that are inside the weatherproofing system shall comply with either of the following:
   1. Low-Emitting Materials: VOC emissions shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
   2. VOC content shall not exceed limits of authorities having jurisdiction and the following:
      a. Flat Coatings: 50 g/L.
      b. Nonflat Coatings: 100 g/L.
      c. Primers, Sealers, and Undercoats: 100 g/L.
      d. Shellacs, Clear: 730 g/L.
      e. Shellacs, Pigmented: 550 g/L.

## 2.3 PRIMERS

A. Alkali-Resistant, Water-Based Primer: Water-based primer formulated for use on alkaline surfaces, such as plaster, vertical concrete, and masonry.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Sherwin-Williams Company (The); Loxon Concrete & Masonry Primer Sealer, LX02W50 Series or comparable product.

B. Interior, Institutional Low-Odor/VOC Primer Sealer: Water-based primer sealer with low-odor characteristics and a VOC of less than 10 grams per liter for use on new interior plaster, concrete, and gypsum wallboard surfaces that are subsequently to be painted with latex finish coats.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Sherwin-Williams Company (The); ProMar 200 Zero VOC Latex Primer, B28W2600 Series or comparable product.

C. Water-Based Rust-Inhibitive Primer: Corrosion-resistant, water-based-emulsion primer formulated for resistance to flash rusting when applied to cleaned, interior ferrous metals subject to mildly corrosive environments.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Sherwin-Williams Company (The); Pro Industrial Pro-Cryl Universal Primer, B66-310 Series or comparable product.

D. Alkyd Quick-Dry Primer for Metal: Corrosion-resistant, solvent-based, modified-alkyd primer; lead and chromate free; formulated for quick-drying capabilities and for use on cleaned, interior steel surfaces.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Sherwin-Williams Company (The); Kem Bond HS B50WZ1 or comparable product.

E. Water-Based Galvanized-Metal Primer: Corrosion-resistant, acrylic primer; formulated for use on cleaned/etched, exterior, galvanized metal to prepare it for subsequent water-based coatings.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Sherwin-Williams Company (The); Pro-Cryl Universal Metal Primer B66 Series or comparable product.

## 2.4 WATER-BASED FINISH COATS

A. Interior, Latex, Flat: Pigmented, water-based paint for use on primed/sealed interior plaster and gypsum board, and on primed wood and metals.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Sherwin-Williams Company (The); ProMar 200 Zero VOC Latex Flat, B30-2600 Series or comparable product.
   2. Gloss and Sheen Level: Manufacturer's standard flat finish.

B. Interior, Latex, Low Sheen: Pigmented, water-based paint for use on primed/sealed interior plaster and gypsum board, and on primed wood and metals.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Sherwin-Williams Company (The); ProMar 200 Zero VOC Latex Low Sheen Enamel, B24-2600 Series or comparable product.
   2. Gloss and Sheen Level: Manufacturer's standard low-sheen finish.

C. Interior, Latex, Eggshell: Pigmented, water-based paint for use on primed/sealed interior plaster and gypsum board, and on primed wood and metals.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Sherwin-Williams Company (The); ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series or comparable product.
   2. Gloss and Sheen Level: Manufacturer's standard eggshell finish.

D. Interior, Latex, Institutional Low Odor/VOC, Flat: White or colored latex paint with low-odor characteristics and a VOC of less than 10 grams per liter, for use in areas, such as hospitals and other occupied buildings, where the odor and VOC levels of conventional latex products would preclude their use.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Sherwin-Williams Company (The); ProMar 200 Zero VOC Latex Flat, B30-2600 Series or comparable product.

E. Interior, Latex, Institutional Low Odor/VOC, Eggshell: White or colored latex paint with low-odor characteristics and a VOC of less than 10 grams per liter, for use in areas, such as hospitals and other occupied buildings, where the odor and VOC levels of conventional latex products would preclude their use.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Sherwin-Williams Company (The); ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series or comparable product.
   2. Gloss and Sheen Level: Manufacturer's standard eggshell finish.

F. Interior, Water-Based Light-Industrial Coating, Eggshell: Pigmented, water-based emulsion coating for interior primed wood and metal surfaces (e.g., walls, doors, frames, trim, and sash), providing resistance to moderate abrasion and mild chemical exposure and corrosive conditions.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Sherwin-Williams Company (The); Pro Industrial Pre-Catalyzed Waterbased Epoxy, K45-151 Series or comparable product.
   2. Gloss and Sheen Level: Manufacturer's standard eggshell finish.

G. Interior, Water-Based Light-Industrial Coating, Semigloss: Pigmented, water-based emulsion coating for interior primed wood and metal surfaces (e.g., walls, doors, frames, trim, and sash), providing resistance to moderate abrasion and mild chemical exposure and corrosive conditions.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Sherwin-Williams Company (The); Pro Industrial Pre-Catalyzed Waterbased Epoxy, K46-151 Series or comparable product.
   2. Gloss Level: Manufacturer's standard semigloss finish.

## 2.5 FLOOR SEALERS AND PAINTS

A. Water-Based Concrete Floor Sealer: Clear, water-based, acrylic-copolymer-emulsion sealer formulated for oil, gasoline, alkali, and water resistance and for use on concrete traffic surfaces.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Sherwin-Williams Company (The); H&C Clarishield Water-Based Wet-Look Concrete Sealer or comparable product.

## 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. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers. Where acceptability of substrate conditions is in question, apply samples and perform in-situ testing to verify compatibility, adhesion, and film integrity of new paint application.
   1. Report, in writing, conditions that may affect application, appearance, or performance of paint.

B. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

C. Proceed with coating application only after unsatisfactory conditions have been corrected; application of coating indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations applicable to substrates indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
   1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
   1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
   1. Concrete Floors: Remove oil, dust, grease, dirt, and other foreign materials. Comply with SSPC-SP-13/NACE 6 or ICRI 03732.

E. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

F. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

## 3.3 INSTALLATION

A. Apply paints in accordance with manufacturer's written instructions.
   1. Use applicators and techniques suited for paint and substrate indicated.
   2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
   3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
   4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
   5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

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

E. Painting Fire-Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
   1. Paint the following work where exposed in equipment rooms:
      a. Equipment, including panelboards.
      b. Uninsulated metal piping.
      c. Uninsulated plastic piping.
      d. Pipe hangers and supports.
      e. Metal conduit.
      f. Plastic conduit.
      g. Tanks that do not have factory-applied final finishes.
      h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
   2. Paint the following work where exposed in occupied spaces:
      a. Equipment, including panelboards.
      b. Uninsulated metal piping.
      c. Uninsulated plastic piping.
      d. Pipe hangers and supports.
      e. Metal conduit.
      f. Plastic conduit.
      g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
      h. Other items as directed by Architect.
   3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets

and outlets that are visible from occupied spaces.

## 3.4 FIELD QUALITY CONTROL

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

## 3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
   1. Do not clean equipment with free-draining water and prevent solvents, thinners, cleaners, and other contaminants from entering into waterways, sanitary and storm drain systems, and ground.
   2. Dispose of contaminants in accordance with requirements of authorities having jurisdiction.
   3. Allow empty paint cans to dry before disposal.
   4. Collect waste paint by type and deliver to recycling or collection facility.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

## 3.6 INTERIOR PAINTING SCHEDULE

A. Concrete Substrates, Traffic Surfaces:
   1. Water-Based Concrete Floor Sealer System :
      a. First Coat: Matching topcoat.
      b. Topcoat: Water-based concrete floor sealer.

B. Steel Substrates:
   1. Latex System, Alkyd Primer :
      a. Prime Coat: Shop primer specified in Section where substrate is specified.
      b. Intermediate Coat: Matching topcoat.
      c. Topcoat: Interior, latex, semigloss.

2. Institutional Low-Odor/VOC Latex System :
    a. Prime Coat: Water-based rust-inhibitive primer.
    b. Intermediate Coat: Matching topcoat.
    c. Topcoat: Interior, latex, institutional low odor/VOC, semigloss.

C. Gypsum Board Substrates:
1. Latex over Latex Sealer System :
    a. Prime Coat: Interior latex primer sealer.
    b. Intermediate Coat: Matching topcoat.
    c. Topcoat: Interior, latex, flat andeggshell.
2. High-Performance Architectural Latex System :
    a. Prime Coat: Interior latex primer sealer.
    b. Intermediate Coat: Matching topcoat.
    c. Topcoat: Interior, latex, high-performance architectural coating, satin.
3. Water-Based Light-Industrial Coating System :
    a. Prime Coat: Interior latex primer sealer.
    b. Intermediate Coat: Matching topcoat.
    c. Topcoat: Interior, water-based, light-industrial coating, eggshell.

**END OF SECTION**

# SECTION 09 96 00

# HIGH-PERFORMANCE COATINGS

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section includes surface preparation and the application of high-performance coating systems on the following substrates:
   1. Exterior Substrates:
      a. Steel.
      b. Galvanized metal.

B. Related Requirements:
   1. Section 05 12 13 "Architecturally Exposed Structural Steel Framing" for shop priming of structural steel with primers specified in this Section.

### 1.2 DEFINITIONS

A. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

B. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

C. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.
   1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
   2. Indicate VOC content.

B. Samples for Verification: For each type of coating system and each color and gloss of topcoat indicated.
   1. Submit Samples on rigid backing, 8 inches square.
   2. Apply coats on Samples in steps to show each coat required for system.
   3. Label each coat of each Sample.
   4. Label each Sample for location and application area.

## 1.4 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. Coatings: 5 percent, but not less than 1 gal. of each material and color applied.

## 1.5 QUALITY ASSURANCE

A. Mockups: Apply mockups of each coating system indicated to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Architect will select one surface to represent surfaces and conditions for application of each coating system.
      a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft.
      b. Other Items: Architect will designate items or areas required.
   2. Final approval of color selections will be based on mockups.
      a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
   3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
   4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

## 1.6 DELIVERY, STORAGE, AND HANDLING

A. Store materials 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.

## 1.7 FIELD CONDITIONS

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

B. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

C. Do not apply exterior coatings in snow, rain, fog, or mist.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Sherwin-Williams Company (The); Macropoxy 646 Fast Cure Epoxy Mastic, or comparable product by one of the following:
   1. Benjamin Moore & Co.
   2. The Pittsburgh Paints Company.

B. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to products listed in the Exterior High-Performance Coating Schedule or Interior High-Performance Coating Schedule for the coating category indicated.

### 2.2 HIGH-PERFORMANCE COATINGS, GENERAL

A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."

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

C. Colors: As selected by Architect from manufacturer's full range.

### 2.3 SOURCE QUALITY CONTROL

A. Testing of Coating Materials: Owner reserves the right to invoke the following procedure:
   1. Owner will engage the services of a qualified testing agency to sample coating materials. Contractor will be notified in advance and may be present when samples are taken. If coating materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
   2. Testing agency will perform tests for compliance with product requirements.
   3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, the two coatings are incompatible.

## PART 3 EXECUTION

### 3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.

C. Proceed with coating application only after unsatisfactory conditions have been corrected.
   1. Application of coating indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and coating systems indicated.

B. Clean substrates of substances that could impair bond of coatings, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
   1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce coating systems indicated.

C. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer.

D. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

E. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied coatings.

### 3.3 APPLICATION

A. Apply high-performance coatings according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
   1. Use applicators and techniques suited for coating and substrate indicated.
   2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
   3. Coat backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.

4. Do not apply coatings over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of the same material are to be applied. Tint undercoats to match color of finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.

D. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

## 3.4 FIELD QUALITY CONTROL

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

## 3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from coating operation. Correct damage to work of other trades by cleaning, repairing, replacing, and recoating, as approved by Architect, and leave in an undamaged condition.

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

## 3.6 EXTERIOR HIGH-PERFORMANCE COATING SCHEDULE

A. Steel Substrates:
   1. Epoxy System :
      a. Prime Coat: Primer, epoxy, anti-corrosive, for metal.
         1) Sherwin-Williams Protective & Marine Coatings; Zinc Clad IV

b. Intermediate Coat: Epoxy, high build, semi-gloss.
   1) Sherwin-Williams Protective & Marine Coatings; Macropoxy 464.

**END OF SECTION**

# SECTION 10 11 00

# VISUAL DISPLAY UNITS

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Glass markerboards.

### 1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

### 1.3 ACTION SUBMITTALS

A. Product Data:
   1. Glass markerboards.

B. Shop Drawings: For visual display units.
   1. Include plans, elevations, sections, details, and attachment to other work.
   2. Show locations of panel joints.
   3. Show locations and layout of special-purpose graphics.
   4. Include sections of typical trim members.
   5. Include wiring diagrams for power and control wiring.

### 1.4 INFORMATIONAL SUBMITTALS

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

### 1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For visual display units to include in maintenance manuals.

### 1.6 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.

## 1.7 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.

# PART 2 PRODUCTS

## 2.1 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: 50 or less.

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.

## 2.2 GLASS MARKERBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. ASI Visual Display Products.
   2. Claridge Products and Equipment, LLC.
   3. Clarus Glassboards, LLC.
   4. Ghent; a GMi Company.
   5. Peter Pepper Products, Inc.

B. Glass Markerboards: Fabricated of 6-mm tempered or 6-mm tempered-laminated glass with steel backing for use with magnets.
   1. Edge Treatment: Smooth polished edge with eased corners.
   2. Frame: Aluminum trim in profile indicated.
   3. Surface: Matte.
   4. Color: White.

C. Mounting:
   1. Round, stainless steel standoffs, holding glass approximately 1 inch from wall surface; mounted in notches in standoffs at top and bottom edges of markerboard.
   2. Concealed, Z-shaped brackets.

3. Manufacturer's standard adhesive or adhesive-foam tape mounting.

D. Graphics: Provide screen-printed graphics as indicated.

E. Marker Tray: Aluminum, attached with magnet.

F. Size: Refer to Drawings.

## 2.3 MATERIALS

A. Clear Tempered Glass: ASTM C1048, Kind FT, Condition A, Type I, Class 1, Quality Q3, with exposed edges seamed before tempering.

B. Extruded Aluminum: ASTM B221, Alloy 6063.

C. 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 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM/NOMMA AMP 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.

## 2.5 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 roughing-in for electrical power systems to verify actual locations of connections before installation of motorized, sliding visual display units.

C. Examine walls and partitions for proper preparation and backing for visual display units.

D. Examine walls and partitions for suitable framing depth where sliding visual display units will be installed.

E. 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. Prime wall surfaces indicated to receive visual display units and as recommended in writing by primer/sealer manufacturer and visual display unit manufacturer.

E. Prepare recesses for sliding visual display units as required by type and size of unit.

## 3.3 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:
   1. Adhere to wall surfaces with egg-size adhesive gobs at 16 inches o.c., horizontally and vertically.
   2. 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.

C. 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 : 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**

# SECTION 10 14 16

# PLAQUES

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Metal plaques for Building Dedication.

### 1.2 DEFINITIONS

A. Accessible: In accordance with the accessibility standard.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For plaques.
   1. Include fabrication and installation details and attachments to other work.
   2. Show plaque mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
   3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each plaque at least half size.

C. Samples for Initial Selection: For each type of plaque, exposed component, and exposed finish.
   1. Include representative Samples of available typestyles and graphic symbols.

### 1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.

B. Sample Warranty: For special warranty.

### 1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For plaques to include in maintenance manuals.

## 1.6 WARRANTY

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

# PART 2 PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

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

## 2.2 METAL PLAQUES

A. Cast Plaque : Cast-metal plaque with background texture, border, and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
   1. Plaque Material: Cast aluminum.
   2. Plaque Thickness: 0.50 inch.
   3. Finishes:
      a. Integral Metal Finish: As selected by Architect from full range of industry finishes.
      b. Integral Aluminum Finish: Match Architect's sample.
      c. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard, in color as selected by Architect from manufacturer's full range.
      d. Overcoat: Manufacturer's standard baked-on clear coating.
   4. Background Texture: As selected by Architect from manufacturer's full range.
   5. Integrally Cast Border Style: Square single line, polished.
   6. Applied Frame Material, Style, and Finish: As indicated on Drawings.
   7. Mounting: Concealed studs Rosette-head through fasteners Countersunk flathead through fasteners.

## 2.3 MATERIALS

A. Aluminum Castings: ASTM B26/B26M, alloy and temper recommended by plaque manufacturer for casting process used and for type of use and finish indicated.

B. Aluminum Sheet and Plate: ASTM B209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

C. Aluminum Extrusions: ASTM B221, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

## 2.4 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of plaques, noncorrosive and compatible with each material joined, and complying with the following:
   1. Use concealed fasteners and anchors unless indicated to be exposed.
   2. For exterior exposure, furnish stainless steel devices unless otherwise indicated.
   3. Plaque Mounting Fasteners:
      a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of plaque, screwed into back of plaque, or screwed into tapped lugs cast integrally into back of plaque unless otherwise indicated.

B. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch thick, with adhesive on both sides.

C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

## 2.5 FABRICATION

A. General: Provide manufacturer's standard plaques according to requirements indicated.
   1. Preassemble plaques in the shop to greatest extent possible. Disassemble plaques only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
   2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
   3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
   4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
   5. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match plaque finish.
   6. Castings: Fabricate castings free of warp, cracks, blowholes, pits, scale, sand holes, and other defects that impair appearance or strength. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks before finishing.

B. Surface-Engraved Graphics: Machine-engrave characters and other graphic devices into indicated plaque surface to produce precisely formed copy, incised to uniform depth.
   1. Engraved Metal: Fill engraved graphics with manufacturer's standard baked enamel.

C. Brackets: Fabricate brackets, fittings, and hardware for bracket-mounted plaques to suit plaque construction and mounting conditions indicated. Modify manufacturer's standard brackets as required.
   1. Stainless Steel Brackets: Factory finish brackets to match plaque background finish unless otherwise indicated.

## 2.6 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.

D. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

## 2.7 ALUMINUM FINISHES

A. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

## 2.8 STAINLESS STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
   1. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
   2. Directional Satin Finish: No. 4.
   3. Dull Satin Finish: No. 6.
   4. Reflective, Directional Polish: No. 7.
   5. Mirrorlike Reflective, Nondirectional Polish: No. 8.

## 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.

B. Verify that plaque-support surfaces are within tolerances to accommodate plaques without gaps or irregularities between backs of plaques and support surfaces unless otherwise indicated.

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

### 3.2 INSTALLATION OF METAL PLAQUES

A. General: Install plaques using mounting methods indicated and according to manufacturer's written instructions.
   1. Install plaques level, plumb, true to line, and at locations and heights indicated, with plaque surfaces free of distortion and other defects in appearance.
   2. Install plaques so they do not protrude or obstruct according to the accessibility standard.
   3. Before installation, verify that plaque surfaces are clean and free of materials or debris that would impair installation.
   4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

B. Mounting Methods:
   1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of plaque. Remove loose debris from hole and substrate surface.
      a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place plaque in position and push until flush to surface, embedding studs in holes. Temporarily support plaque in position until adhesive fully sets.
      b. Thin or Hollow Surfaces: Place plaque in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.
   2. Through Fasteners: Drill holes in substrate using predrilled holes in plaque as template. Countersink holes in plaque if required. Place plaque in position and flush to surface. Install through fasteners and tighten.
   3. Brackets: Remove loose debris from substrate surface and install bracket supports in position, so that plaque is correctly located and aligned.
   4. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of plaque and of suitable quantity to support weight of plaque after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as plaque is applied and to prevent visibility of cured adhesive at plaque edges.

Place plaque in position, and push to engage adhesive. Temporarily support plaque in position until adhesive fully sets.

5. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of plaque and of suitable quantity to support weight of plaque without slippage. Keep strips away from edges to prevent visibility at plaque edges. Place plaque in position, and push to engage tape adhesive.
6. Shim-Plate Mounting: Provide 1/8-inch- thick, concealed aluminum shim plates with predrilled and countersunk holes, at locations indicated, and where other direct mounting methods are impractical. Attach plate with fasteners and anchors suitable for secure attachment to substrate. Attach plaques to plate using method specified above.

## 3.3 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed plaques and plaques that do not comply with specified requirements. Replace plaques with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as plaques are installed.

C. On completion of installation, clean exposed surfaces of plaques according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain plaques in a clean condition during construction and protect from damage until acceptance by Owner.

**END OF SECTION**

# SECTION 10 14 19

# DIMENSIONAL LETTER SIGNAGE

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Dimensional characters.
      a. Cutout dimensional characters.

### 1.2 COORDINATION

A. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For signs.
   1. Include fabrication and installation details and attachments to other work.
   2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
   3. Show message list, typestyles, graphic elements, and layout for each sign at least half size.

C. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.
   1. Include representative Samples of available typestyles and graphic symbols.

D. Delegated Design Submittal: For laser cut letters and logos.
   1. Include structural analysis calculations for signs indicated to comply with design loads; signed and sealed by the qualified professional engineer responsible for their preparation.

### 1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.

B. Sample Warranty: For special warranty.

## 1.5 CLOSEOUT SUBMITTALS

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

## 1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

## 1.7 FIELD CONDITIONS

A. Field Measurements: Verify locations of electrical service embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

## 1.8 WARRANTY

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

# PART 2 PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design sign structure and anchorage of dimensional character sign type(s) according to structural performance requirements.

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.

## 2.2 DIMENSIONAL CHARACTERS

A. Cutout Characters : Characters with uniform faces; square-cut, smooth, eased edges; precisely formed lines and profiles; and as follows:
   1. Character Material: Sheet aluminum.
   2. Character Height: As indicated on Drawings.
   3. Thickness: Manufacturer's standard for size of character.
   4. Finishes:

a. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

5. Mounting: Projecting studs.

## 2.3 DIMENSIONAL CHARACTER MATERIALS

A. Aluminum Sheet and Plate: ASTM B209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

B. Aluminum Extrusions: ASTM B221, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

C. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

## 2.4 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following:
   1. Use concealed fasteners and anchors unless indicated to be exposed.
   2. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, installed in predrilled holes.
   3. For exterior exposure, furnish stainless steel or hot-dip galvanized devices unless otherwise indicated.

B. Projecting Studs: Threaded studs with sleeve spacer, welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material, unless otherwise indicated.

## 2.5 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
   1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
   2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
   3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.

4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
5. Internally brace dimensional characters for stability, to meet structural performance loading without oil-canning or other surface deformation, and for securing fasteners.

## 2.6 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.

D. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

# 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.

B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.

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

## 3.2 INSTALLATION OF DIMENSIONAL CHARACTERS

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
   1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
   2. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
   3. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of

bituminous paint.

B. Mounting Methods:
   1. Projecting Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
      a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place spacers on studs, place sign in position, and push until spacers are pinched between sign and substrate, embedding the stud ends in holes. Temporarily support sign in position until adhesive fully sets.
      b. Thin or Hollow Surfaces: Place spacers on studs, place sign in position with spacers pinched between sign and substrate, and install washers and nuts on stud ends projecting through opposite side of surface, and tighten.

## 3.3 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed characters and signs that do not comply with specified requirements. Replace characters with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

**END OF SECTION**

# SECTION 10 14 23.16

# ROOM-IDENTIFICATION PANEL SIGNAGE

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section includes room-identification signs that are directly attached to the building.

### 1.2 DEFINITIONS

A. Accessible: In accordance with the accessibility standard.

### 1.3 COORDINATION

A. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other installers.

### 1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For room-identification signs.
   1. Include fabrication and installation details and attachments to other work.
   2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
   3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.

C. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.
   1. Include representative Samples of available typestyles and graphic symbols.

D. Product Schedule: For room-identification signs. Use same designations indicated on Drawings or specified.

### 1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.

B. Sample Warranty: For special warranty.

## 1.6 CLOSEOUT SUBMITTALS

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

## 1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

## 1.8 FIELD CONDITIONS

A. Field Measurements: Verify locations of anchorage devices embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

## 1.9 WARRANTY

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

# PART 2 PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

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

## 2.2 ROOM-IDENTIFICATION SIGNS

A. Room-Identification Sign : Sign system with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
   1. Sign-Panel Perimeter: Finish edges smooth.
   2. Mounting: Surface mounted to wall with two-face tape or hook-and-loop tape.
   3. Text and Typeface: Accessible raised characters and Braille and typeface as selected by Architect from manufacturer's full range. Finish raised characters to contrast with background color, and finish Braille to match background color.

## 2.3 SIGN MATERIALS

A. Acrylic Sheet: ASTM D 4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).

B. Vinyl Film: UV-resistant vinyl film with pressure-sensitive, permanent adhesive; die cut to form characters or images as indicated on Drawings.

C. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

## 2.4 ACCESSORIES

A. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch thick, with adhesive on both sides.

B. Hook-and-Loop Tape: Manufacturer's standard two-part tape consisting of hooked part on sign back and looped side on mounting surface.

## 2.5 FABRICATION

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

B. Subsurface-Applied Graphics: Apply graphics to back face of clear face-sheet material to produce precisely formed image. Image shall be free of rough edges.

C. Subsurface-Etched Graphics: Reverse etch back face of clear face-sheet material. Fill resulting copy with manufacturer's standard enamel. Apply opaque manufacturer's standard background color coating over enamel-filled copy.

## 2.6 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

# PART 3 EXECUTION

## 3.1 INSTALLATION

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
   1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
   2. Install signs so they do not protrude or obstruct according to the accessibility standard.
   3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.

B. Accessibility: Install signs in locations on walls and according to the accessibility standard.

C. Mounting Methods:
   1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
      a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
      b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.
   2. Through Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.
   3. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.
   4. Two-Face Tape: Clean bond-breaking materials from substrate surface and

remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.

5. Hook-and-Loop Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply sign component of two-part tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage; push to engage tape adhesive. Keep tape strips 0.250 inch away from edges to prevent visibility at sign edges when sign is initially installed or reinstalled. Apply substrate component of tape to substrate in locations aligning with tape on back of sign; push and rub well to fully engage tape adhesive to substrate.
6. Magnetic Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position.

## 3.2 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

**END OF SECTION**

# SECTION 10 14 26

# POST AND PANEL/PYLON SIGNAGE

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Internally illuminated post-and-panel signs.

### 1.2 DEFINITIONS

A. Illuminated: Illuminated by lighting source integrally constructed as part of the sign unit.

### 1.3 COORDINATION

A. Furnish templates and tolerance information for placement of sign-anchorage devices embedded in permanent construction by other installers.

B. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

### 1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For signage.
   1. Include fabrication and installation details and attachments to other work.
   2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
   3. Show message list, typestyles, graphic elements, and layout for each sign at least half size.
   4. Show locations of electrical service connections.
   5. Include diagrams for power, signal, and control wiring.

C. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.
   1. Include representative Samples of available typestyles and graphic symbols.

D. Samples for Verification: For each type of sign assembly, showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:
   1. Variable Component Materials: 8-inch Sample of each base material, character or graphic element, in each exposed color and finish not included in other Samples.
   2. Exposed Accessories: Full-size Sample of each accessory type.
   3. Full-size Samples, if approved, will be returned to Contractor for use in Project.

E. Delegated-Design Submittal: For signs indicated in "Performance Requirements" Article.
   1. Include structural analysis calculations for signs indicated to comply with design loads; signed and sealed by the qualified professional engineer responsible for their preparation.

## 1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.

B. Evaluation Reports: For post-installed anchors and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

C. Sample Warranty: For special warranty.

## 1.6 CLOSEOUT SUBMITTALS

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

## 1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

## 1.8 FIELD CONDITIONS

A. Field Measurements: Verify locations of anchorage devices and electrical service embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

## 1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Deterioration of finishes beyond normal weathering.

b. Deterioration of embedded graphic image.
c. Separation or delamination of sheet materials and components.

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

## PART 2 PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design sign structure and anchorage of post-and-panel sign type(s) according to structural performance requirements.

B. Structural Performance: Signs and supporting elements shall withstand the effects of gravity and other loads within limits and under conditions indicated.
1. Uniform Wind Load: As indicated on Drawings.
2. Concentrated Horizontal Load: As indicated on Drawings.
3. Other Design Load: As indicated on Drawings.
4. Uniform and concentrated loads need not be assumed to act concurrently.

C. Thermal Movements: For exterior signs, allow for thermal movements from ambient and surface temperature changes.
1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

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

### 2.2 POST-AND-PANEL SIGNS

A. Post-and-Panel Sign : Sign of hollow-box configuration; with smooth, uniform surfaces and support assembly; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
1. Illuminated Sign: Backlighted construction with fiber-optic or LED lighting including transformers, insulators, and other accessories for operability, with provision for servicing and concealing connections to building electrical system. Use tight or sealed joint construction to prevent unintentional light leakage. Space lamps apart from each other and away from sign surfaces as needed to illuminate evenly.
a. Power: As indicated on electrical Drawings.
b. Weeps: Provide weep holes to drain water at lowest part of exterior signs. Equip weeps with permanent baffles to block light leakage without inhibiting drainage.
2. Solid-Sheet Sign Panels, Returns, and Back : metal composite material sheet with finish specified in "Sign-Panel-Face Finish and Applied Graphics" Subparagraph and as follows:
a. Thickness: Manufacturer's standard for size of sign.

b. Surface-Applied Graphics: Applied baked enamel or powder coat.
c. Etched and Filled Graphics: Sign face etched or routed to receive enamel-paint infill.
d. Inset, Cutout Characters: Sign face routed to receive push-through acrylic graphics flush with the sign panel.

3. Hollow-Box Sign Frame: Entire perimeter framed with formed-aluminum sheet or extruded-aluminum, hollow-box-type frame with vertical edges attached to supports with aluminum fittings. Close top and bottom edges of panels with manufacturer's standard welded seams or extrusions.
   a. Hollow-Box Depth: Same depth as posts.
   b. Profile: Square.
   c. Corner Condition in Elevation: Mitered.
   d. Finish and Color: Match Architect's sample.
4. Sign-Frame Mounting: As indicated on Drawings.
5. Sign-Panel-Face Finish and Applied Graphics:
   a. Painted Finish and Graphics: Manufacturer's standard, factory-applied exterior-grade sign paint, in color matching Architect's sample.
   b. Overcoat: Manufacturer's standard baked-on clear coating.
6. Text and Typeface: typeface as selected by Architect from manufacturer's full range.

## 2.3 MATERIALS

A. Metal Composite Material: Refer to Section 07 42 13.23 - Metal Composit Material Wall Panels for materials for this signage. Sign shall match the panels applied to the building walls.

B. Steel Materials:
   1. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, G90 coating, either commercial or forming steel.
   2. Steel Sheet: Uncoated, cold-rolled, ASTM A 1008/A 1008M, commercial steel, Type B, exposed or electrolytic zinc-coated, ASTM A 879/A 879M, Coating Designation 08Z, with steel sheet substrate according to ASTM A 1008/A 1008M, commercial steel, exposed.
   3. Steel Members Fabricated from Plate or Bar Stock: ASTM A 529/A 529M or ASTM A 572/A 572M, 42,000-psi minimum yield strength.
   4. Steel Tubing or Pipe: ASTM A 500/A 500M, Grade B.
   5. Bolts for Steel Framing: ASTM A 307 or ASTM F 3125/F 3125M, Grade A325 as necessary for design loads and connection details.
   6. For steel exposed to view on completion, provide materials having flat, smooth surfaces without blemishes. Do not use materials whose surfaces exhibit pitting, seam marks, roller marks, rolled trade names, or roughness.

C. Acrylic Sheet: ASTM D 4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).

D. Fiberglass Sheet: Multiple laminations of glass-fiber-reinforced polyester resin with UV-light stable, colorfast, nonfading, weather- and stain-resistant, colored polyester

gel coat, and with manufacturer's standard finish.

E. Polycarbonate Sheet: ASTM C 1349, Appendix X1, Type II (coated, mar-resistant, UV-stabilized polycarbonate), with coating on both sides.

F. Vinyl Film: UV-resistant vinyl film of nominal thickness indicated, with pressure-sensitive, permanent adhesive on back; die cut to form characters or images as indicated on Drawings and suitable for exterior applications.

G. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

## 2.4 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following unless otherwise indicated:
   1. Use concealed fasteners and anchors unless indicated to be exposed.
   2. Exposed Metal-Fastener Components, General:
      a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.
   3. Inserts: Furnish inserts to be set by other installers into concrete or masonry work.

B. 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. as appropriate for the substrate.
   1. Uses: Securing signs with imposed loads to structure.
   2. Type: Torque-controlled, expansion anchor or adhesive anchor.
   3. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

C. Power-Actuated Anchors: Fastener systems 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 AC70.

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

E. Anchoring Materials:
   1. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
   2. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

a. Water-Resistant Product: At exterior locations, provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

## 2.5 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
   1. Preassemble signs in the shop to greatest extent possible. Disassemble signs only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation, in locations concealed from view after final assembly.
   2. Mill joints to tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
   3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed joints of flux, and dress exposed and contact surfaces.
   4. Conceal fasteners and anchors unless indicated to be exposed; locate exposed fasteners where they will be inconspicuous.
   5. Internally brace signs for stability, to meet structural performance loading without oil-canning or other surface deformation, and for securing fasteners.

B. Sign Message Panels: Construct sign-panel surfaces to be smooth and to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch measured diagonally from corner to corner.
   1. Coordinate dimensions and attachment methods to produce message panels with closely fitting joints. Align edges and surfaces with one another in the relationship indicated.
   2. Increase panel thickness or reinforce with concealed stiffeners or backing materials as needed to produce surfaces without distortion, buckles, warp, or other surface deformations.
   3. Continuously weld joints and seams unless other methods are indicated; grind, fill, and dress welds to produce smooth, flush, exposed surfaces with welds invisible after final finishing.

C. Post Fabrication: Fabricate posts designed for structural performance indicated and of lengths required for installation method indicated for each sign.
   1. Steel Posts: Fabricate from minimum 0.120-inch- thick, steel tubing unless otherwise indicated. Include post caps, fillers, spacers, junction boxes, access panels, reinforcement where required for loading conditions, and related accessories required for complete installation.
      a. Hot-dip galvanize post assemblies after fabrication according to ASTM A 123/A 123M.
   2. Direct Burial: Fabricate posts 36 inches longer than height of sign to permit direct burial or embedment in concrete foundations or concrete-filled postholes.
   3. Baseplates: Fabricate posts with baseplates welded to bottom of posts. Drill

holes in baseplate for anchor-bolt connection.
   a. Provide drilled-in-place anchor bolts of size required for connecting posts to concrete foundations.
4. Sleeves: Fabricate posts 12 inches longer than height of sign to permit embedment in sleeves cast in concrete foundations or concrete-filled postholes. Provide sleeves by manufacturer, sized to receive outside diameter of posts. Size sleeves for direct embedment in concrete foundations or concrete-filled postholes and to prevent sign movement, but not less than 24 inches for embedment.
5. Reverse Sleeves: Provide inserts by sign manufacturer, sized for close fit inside posts. Size inserts for direct embedment in concrete foundations and to attach sign posts securely and prevent sign movement, but of a height not less than one-third of post height plus 36 inches for embedment.
   a. Provide through bolts to fasten posts to inserts.

## 2.6 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.

## 2.7 STEEL FINISHES

A. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, and prepare for coating according to coating manufacturer's written instructions.
   1. For Baked-Enamel or Powder-Coat Finish: After cleaning, apply a conversion coating compatible with the organic coating to be applied over it.

B. Factory Prime Finish: After surface preparation and pretreatment, apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer.

C. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of 2 mils.

# 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. Verify that sign-support surfaces are within tolerances to accommodate signs.

C. Verify that anchorage devices embedded in permanent construction are correctly sized and located to accommodate signs.

D. Verify that electrical service is correctly sized and located to accommodate signs.

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

## 3.2 INSTALLATION

A. General: Install signs using installation methods indicated and according to manufacturer's written instructions.
   1. Install signs level, plumb, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
   2. Install signs so they do not protrude or obstruct according to the accessibility standard.
   3. Before installation, verify that sign components are clean and free of materials or debris that would impair installation.
   4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

## 3.3 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

**END OF SECTION**

# SECTION 10 21 13.17

# PHENOLIC-CORE TOILET COMPARTMENTS

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Phenolic-core toilet compartments.

### 1.2 COORDINATION

A. Coordinate requirements for overhead supports, blocking, reinforcing, and other supports concealed within wall and ceiling to ensure that toilet compartments can be supported and installed as indicated.

### 1.3 ACTION SUBMITTALS

A. Product Data.
   1. Phenolic-core toilet compartments.
      a. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for toilet compartments.

B. Shop Drawings:
   1. Include plans, elevations, sections, details, and attachment details.
   2. Show locations of cutouts for compartment-mounted toilet accessories.
   3. Show locations of centerlines of toilet fixtures.
   4. Show locations of floor drains.
   5. Show ceiling grid, ceiling-mounted items, and overhead support or bracing locations.

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

### 1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For toilet compartments.

### 1.5 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings,

and other construction contiguous with toilet compartments by field measurements, and coordinate before fabrication.

## PART 2 PRODUCTS

### 2.1 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.

B. Structural Performance: Where grab bars are mounted on toilet compartments, design panels to comply with the following requirements:
   1. Panels are able to withstand a concentrated load on grab bar of at least 250 lbf applied at any direction and at any point, without deformation of panel.

C. Regulatory Requirements: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1 for toilet compartments designated as accessible.

### 2.2 PHENOLIC-CORE TOILET COMPARTMENTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. ASI Global Partitions.
   2. Bobrick Washroom Equipment, Inc.
   3. Bradley Corporation.
   4. Partition Systems International of South Carolina (PSISC); Columbia Systems International of South Carolina LLC.
   5. Scranton Products.

B. Toilet-Enclosure Style: Overhead braced,Floor anchored, privacy type.

C. Urinal-Screen Style: Wall hung Floor anchored Overhead braced.

D. Door, Panel, and Pilaster Construction: Solid phenolic-core material with melamine facing on both sides fused to substrate during manufacture (not separately laminated), and with eased and polished edges. Provide minimum 3/4-inch- thick doors and pilasters and minimum 1/2-inch- thick panels. Provide with no-sightline system consisting of door and pilaster lapped edges on strike side of door and door and pilaster lapped edges on hinge side of door (unless continuous hinge is used).

E. Urinal-Screen Construction: Matching panel construction.

F. Pilaster Shoes: Formed from stainless steel sheet, not less than 0.031-inch nominal

thickness and 3 inches high, finished to match hardware.

G. Pilaster Sleeves (Caps): Formed from stainless steel sheet, not less than 0.031-inch nominal thickness and 3 inches high, finished to match hardware.

H. Urinal-Screen Post: Manufacturer's standard post design of monolithic phenolic-core urinal screen cutout at bottom to form a post; with shoe matching that on the pilaster.

I. Brackets (Fittings):
   1. Stirrup Type: Ear or U-brackets, stainless steel.

J. Phenolic Compartment Finish: One color in each room.
   1. Through-Color Phenolic: Manufacturer's standard solid through-color.
      a. Color: As selected by Architect from manufacturer's full range.

## 2.3 HARDWARE AND ACCESSORIES

A. Door Hardware and Accessories, Heavy Duty: Manufacturer's heavy-duty institutional operating hardware and accessories.
   1. Hinges: Manufacturer's minimum 0.062-inch- thick, stainless steel surface-mounted, paired, self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees, allowing emergency access by lifting door. Mount with through bolts.
   2. Latch and Keeper: Manufacturer's heavy-duty, surface-mounted, cast stainless steel latch unit designed to resist damage due to slamming, with combination rubber-faced door strike and keeper, and with provision for emergency access. Provide units that comply with regulatory requirements for accessibility at toilet enclosures designated as accessible. Mount with through bolts.
   3. Coat Hook: Manufacturer's heavy-duty, combination cast stainless steel hook and rubber-tipped bumper, sized to prevent inswinging door from hitting compartment-mounted accessories. Mount with through bolts.
   4. Door Bumper: Manufacturer's heavy-duty, rubber-tipped, cast stainless steel bumper at outswinging doors. Mount with through bolts.
   5. Occupancy Indicators: Indicators showing occupancy of individual compartment. Provide ADA compliant at all locations.

B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.

C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized-steel, or other rust-resistant, protective-coated steel compatible with related materials.

## 2.4 MATERIALS

A. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304, stretcher-leveled standard of flatness.

B. Stainless Steel Castings: ASTM A743/A743M.

## 2.5 FABRICATION

A. Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.

B. Overhead-Braced Units: Manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters and walls to suit floor and wall conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.

C. Floor-Anchored Units: Manufacturer's standard corrosion-resistant anchoring assemblies at pilasters and walls, with leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.

D. Door Size and Swings: Unless otherwise indicated, provide 24-inch- wide, inswinging doors for standard toilet enclosures and 36-inch- wide, outswinging doors with a minimum 32-inch- wide, clear opening for toilet enclosures designated as accessible.

# PART 3 EXECUTION

## 3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for fastening, support, alignment, operating clearances, and other conditions affecting performance of the Work.
   1. Confirm location and adequacy of blocking and supports required for installation.

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

## 3.2 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
   1. Maximum Clearances:
      a. Pilasters and Panels or Screens: 1/2 inch.
      b. Panels or Screens and Walls: 1 inch.

B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set

pilasters with anchors penetrating not less than 1-3/4 inches into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels, and adjust so tops of doors are parallel with overhead brace when doors are in closed position.

C. Floor-Anchored Units: Set pilasters with anchors penetrating not less than 2 inches into structural floor unless otherwise indicated in manufacturer's written instructions. Level, plumb, and tighten pilasters. Hang doors and adjust so tops of doors are level with tops of pilasters when doors are in closed position.

D. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

## 3.3 ADJUSTING

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

**END OF SECTION**

# SECTION 10 22 39

# FOLDING PANEL PARTITIONS

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Manually operated, paired panel operable partitions.

### 1.2 DEFINITIONS

A. NIC: Noise Isolation Class.

B. NRC: Noise Reduction Coefficient.

C. STC: Sound Transmission Class.

### 1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

### 1.4 ACTION SUBMITTALS

A. Product Data:
   1. Operable acoustical panel partitions.

B. Shop Drawings: For operable panel partitions.
   1. Include plans, elevations, sections, attachment details, and numbered panel installation sequence.
   2. Indicate stacking and operating clearances. Indicate location and installation requirements for hardware and track, blocking, and direction of travel.
   3. Include diagrams for power, signal, and control wiring.

C. Samples for Initial Selection: For each type of exposed material, finish, covering, or facing.
   1. Include Samples of accessories involving color selection.

D. Delegated Design Submittals: For operable panel partitions.
   1. Include design calculations for seismic restraints that brace tracks to structure above.

## 1.5 INFORMATIONAL SUBMITTALS

A. 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. Partition track, track supports and bracing, switches, turning space, and storage layout.
   2. Suspended ceiling components.
   3. Structural members to which suspension systems will be attached.
   4. Size and location of initial access modules for acoustical tile.
   5. Items penetrating finished ceiling including the following:
      a. Lighting fixtures.
      b. HVAC ductwork, outlets, and inlets.
      c. Speakers.
      d. Sprinklers.
      e. Smoke detectors.
      f. Access panels.

B. Qualification Data: For Installer.

C. Seismic Qualification Certificates: For operable panel partitions, tracks, accessories, and components, from manufacturer. Include seismic capacity of partition assemblies to remain in vertical position during a seismic event and the following:
   1. Basis for Certification: Indicate whether certification is based on analysis, testing, or experience data, in accordance with ASCE/SEI 7.
   2. Detailed description of partition anchorage devices on which the certification is based and their installation requirements.

D. Product Certificates: For each type of operable panel partition.
   1. Include approval letter signed by manufacturer acknowledging Owner-furnished panel facing material complies with requirements.

E. Product Test Reports: For each operable panel partition, for tests performed by a qualified testing agency.

F. Sample Warranty: For manufacturer's special warranty.

## 1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For operable panel partitions to include in maintenance manuals.
   1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:
      a. Panel finish facings and finishes for exposed trim and accessories. Include precautions for cleaning materials and methods that could be detrimental to finishes and performance.
      b. Seals, hardware, track, track switches, carriers, and other operating components.

c. Electric operator and controls.

## 1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same production run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Panel Finish-Facing Material: Furnish full width in quantity to cover both sides of two panels when installed.

## 1.8 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is certified in writing by the operable partition manufacturer, as qualified to install the manufacturer's partition systems for work similar in material, design, and extent to that indicated for this Project.

B. Acoustical Performance: Test operable partitions in an independent acoustical laboratory in accordance with ASTM E90 test procedure and classified in accordance with ASTM E413 to attain no less than the STC rating specified. Provide a complete and unedited written test report by the testing laboratory upon request.

C. Preparation of the opening shall conform to the criteria set forth per ASTM E557 Standard Practice for Architectural Application and Installation of Operable Partitions.

## 1.9 DELIVERY, STORAGE, AND HANDLING

A. Protectively package and sequence panels in order for installation. Clearly mark packages and panels with numbering system used on Shop Drawings. Do not use permanent markings on panels.

## 1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of operable panel partitions that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Faulty operation of operable panel partitions.
      b. Deterioration of metals, metal finishes, and other materials beyond normal use.
   2. Warranty Period: Five years from date of Substantial Completion.

## PART 2 PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design seismic bracing of tracks to structure above.

B. Seismic Performance: Operable panel partitions are to withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7.
   1. The term "withstand" means "the partition panels will remain in place without separation of any parts when subjected to the seismic forces specified."

C. Acoustical Performance: Provide operable panel partitions tested by a qualified testing agency for the following acoustical properties in accordance with test methods indicated:
   1. Sound-Transmission Requirements: Operable panel partition assembly tested for laboratory sound-transmission loss performance in accordance with ASTM E90, determined by ASTM E413, and rated for not less than the STC indicated.

D. Fire-Test-Response Characteristics: Provide panels with finishes complying with one of the following as determined by testing identical products by a testing and inspecting agency acceptable to authorities having jurisdiction:
   1. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
      a. Flame-Spread Index: 25 or less.
      b. Smoke-Developed Index: 450 or less.

### 2.2 OPERABLE ACOUSTICAL PANEL PARTITIONS

A. Operable Acoustical Panel Partitions : Partition system, including panels, seals, finish facing, suspension system, operators, and accessories.
   1. Basis-of-Design: Modernfold, Inc.; Acousti-Seal Premier - Paired Panel Series 932.
   2. Other Manufacturers: Subject to compliance with requirements, other manufacturers include the following:
      a. KWIK-WALL Company.
      b. Moderco Inc.

B. Panel Operation: Manually operated, paired panels.

C. Panel Construction: As required to support panel from suspension components and with reinforcement for hardware attachment. Fabricate panels with tight hairline joints and concealed fasteners. Fabricate panels so finished in-place partition is rigid; level; plumb; aligned, with tight joints and uniform appearance; and free of bow, warp, twist, deformation, and surface and finish irregularities.

D. Dimensions: Fabricate operable acoustical panel partitions to form an assembled system of dimensions indicated and verified by field measurements.
   1. Panel Width: Equal widths.

E. STC: Not less than 52.

F. Panel Thickness: As shown on Drawings from manufacturer's standard dimension selection.

G. Panel Closure: Manufacturer's standard unless otherwise indicated.

H. Hardware: Manufacturer's standard as required to operate operable panel partition and accessories; with decorative, protective finish.
   1. Hinges: Manufacturer's standard.

I. Finish Facing: Fabric wall covering.

## 2.3 SEALS

A. Description: Seals that produce operable panel partitions complying with performance requirements and the following:
   1. Manufacturer's standard seals unless otherwise indicated.
   2. Seals made from materials and in profiles that minimize sound leakage.
   3. Seals fitting tight at contact surfaces and sealing continuously between adjacent panels and between operable panel partition perimeter and adjacent surfaces, when operable panel partition is extended and closed.

B. Vertical Interlocking Sound Seals between panels: Roll-formed steel astragals, with reversible tongue and groove configuration in each panel edge for universal panel operation. Rigid plastic or aluminum astragals or astragals in only one panel edge are not acceptable.

C. Horizontal Top Seals: Continuous contact extruded vinyl bulb shape with pairs of non-contacting vinyl fingers to prevent distortion without the need for mechanically operated parts.

D. Horizontal Bottom Seals:
   1. Automatic operable seals providing nominal 2-inch (51 mm) operating clearance with an operating range of +1/2-inch (13mm) to –1-1/2 inch (38 mm) which automatically drop as panels are positioned, without the need for tools or cranks.

## 2.4 PANEL FINISH FACINGS

A. Description: Finish facings for panels that comply with indicated fire-test-response characteristics and that are factory applied to operable panel partitions with appropriate backing, using mildew-resistant nonstaining adhesive as recommended by facing manufacturer's written instructions.
   1. Apply one-piece, seamless facings free of air bubbles, wrinkles, blisters, and other defects, with edges tightly butted, and with invisible seams complying with Shop Drawings for location, and with no gaps or overlaps. Horizontal butted edges and seams are not permitted. Tightly secure and conceal raw and selvage edges of facing for finished appearance.
   2. Match facing pattern 72 inches above finished floor.

B. Fabric Wall Covering: Manufacturer's standard fabric, from same dye lot, treated to resist stains.
   1. Color/Pattern: As selected by Architect from manufacturer's full range.

C. Trimless Edges: Fabricate exposed panel edges so finish facing wraps uninterrupted around panel, covering edge and resulting in an installed partition with facing visible on vertical panel edges, without trim, for minimal sightlines at panel-to-panel joints.

## 2.5 SUSPENSION SYSTEMS

A. Tracks: Steel or aluminum mounted directly to overhead structural support, designed for operation, size, and weight of operable panel partition indicated. Size track to support partition operation and storage without damage to suspension system, operable panel partitions, or adjacent construction. Limit track deflection to no more than 0.10 inch between bracket supports. Provide a continuous system of track sections and accessories to accommodate configuration and layout indicated for partition operation and storage.
   1. Panel Guide: Aluminum guide on both sides of the track to facilitate straightening of the panels; finished with factory-applied, decorative, protective finish.
   2. Head Closure Trim: As required for acoustical performance; primed for field finish.

B. Carriers: Trolley system as required for configuration type, size, and weight of partition and for easy operation; with ball-bearing wheels.
   1. Multidirectional Carriers: Capable of negotiating intersections without track switches.

C. Track Intersections, Switches, and Accessories: As required for operation, storage, track configuration, and layout indicated for operable panel partitions, and compatible with partition assembly specified. Fabricate track intersections and switches from steel or aluminum.

D. Aluminum Finish: Mill finish or manufacturer's standard, factory-applied, decorative finish unless otherwise indicated.

E. Steel Finish: Manufacturer's standard, factory-applied, corrosion-resistant, protective coating unless otherwise indicated.

## 2.6 ACCESSORIES

A. Storage Pocket Door: Full height at end of partition runs to conceal stacked partition; of same materials, finish, construction, thickness, and acoustical qualities as panels; complete with operating hardware and acoustical seals at soffit, floor, and jambs. Hinges in finish to match other exposed hardware.
   1. Manufacturer's standard method to secure storage pocket door in closed position.

# PART 3 EXECUTION

## 3.1 EXAMINATION

A. Examine flooring, floor levelness, structural support, and opening, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of operable panel partitions.

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

## 3.2 INSTALLATION OF OPERABLE PANEL PARTITIONS

A. Install operable panel partitions and accessories after other finishing operations, including painting, have been completed in area of partition installation.

B. Install panels in numbered sequence indicated on Shop Drawings.

C. Broken, cracked, chipped, deformed, or unmatched panels are not acceptable.

D. Broken, cracked, deformed, or unmatched gasketing or gasketing with gaps at butted ends is not acceptable.

## 3.3 ADJUSTING

A. Adjust operable panel partitions, hardware, and other moving parts to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust storage pocket doors to operate smoothly and easily, without binding or warping.

C. Verify that safety devices are properly functioning.

## 3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain operable panel partitions.

**END OF SECTION**

# SECTION 10 26 00

# WALL AND DOOR PROTECTION

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Corner guards.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes.
   2. Include fire ratings of units recessed in fire-rated walls and listings for door-protection items attached to fire-rated doors.

B. Samples for Initial Selection: For each type of impact-resistant wall-protection unit indicated, in each color and texture specified.

### 1.3 DELIVERY, STORAGE, AND HANDLING

A. Store wall and door protection in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

### 1.4 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of wall- and door-protection units that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures including detachment of components from each other or from the substrates, delamination, and permanent deformation beyond normal use.
      b. Deterioration of metals, metal finishes, plastics, and other materials beyond normal use.
   2. Warranty Period: Five years from date of Substantial Completion.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

A. Source Limitations: Obtain wall- and door-protection products from single source from single manufacturer.

### 2.2 PERFORMANCE REQUIREMENTS

A. Surface Burning Characteristics: Comply with ASTM E 84 or UL 723; 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 CORNER GUARDS

A. Surface-Mounted, Metal Corner Guards : Fabricated as one piece from formed or extruded metal with formed edges; with 90- or 135-degree turn to match wall condition.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Balco; a CSW Industrials Company.
      b. Construction Specialties, Inc.
      c. inpro Corporation.
      d. JL Industries; Activar Construction Products Group, Inc.
      e. Koroseal Interior Products, LLC.
   2. Material: Stainless-steel sheet, Type 304.
      a. Thickness: Minimum 0.0625 inch.
      b. Finish: Directional satin, No. 4.
   3. Wing Size: Nominal 2-1/2 by 2-1/2 inches.
   4. Corner Radius: 1/8 inch.
   5. Mounting: Flat-head, countersunk screws through factory-drilled mounting holes.

### 2.4 MATERIALS

A. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.

B. Adhesive: As recommended by protection product manufacturer.

### 2.5 FABRICATION

A. Fabricate wall and door protection according to requirements indicated for design,

performance, dimensions, and member sizes, including thicknesses of components.

B. Factory Assembly: Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.

C. Quality: Fabricate components with uniformly tight seams and joints and with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

D. Wood Handrails: Miter corners and ends of wood handrails for returns.

## 2.6 FINISHES

A. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

# PART 3 EXECUTION

## 3.1 EXAMINATION

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

B. Examine walls to which wall and door protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.
   1. For wall and door protection attached with adhesive, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

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

## 3.2 PREPARATION

A. Complete finishing operations, including painting, before installing wall and door protection.

B. Before installation, clean substrate to remove dust, debris, and loose particles.

## 3.3 INSTALLATION

A. Installation Quality: Install wall and door protection according to manufacturer's written instructions, level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.

B. Mounting Heights: Install wall and door protection in locations and at mounting heights indicated on Drawings.

## 3.4 CLEANING

A. Immediately after completion of installation, clean plastic covers and accessories using a standard ammonia-based household cleaning agent.

**END OF SECTION**

# SECTION 10 28 00

# TOILET, BATH, AND LAUNDRY ACCESSORIES

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Public-use washroom accessories.
   2. Public-use shower room accessories.

### 1.2 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.

### 1.3 ACTION SUBMITTALS

A. Product Data:
   1. Public-use washroom accessories.

B. Product Data Submittals: For each product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
   2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
   3. Include electrical characteristics.

C. Samples: For each exposed product and for each finish specified, full size.
   1. Approved full-size Samples will be returned and may be used in the Work.

### 1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For manufacturer's special warranties.

## 1.5 CLOSEOUT SUBMITTALS

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

## 1.6 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.

B. Manufacturer's Special Warranty for Hand Dryers: Manufacturer agrees to repair or replace hand dryers that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Two years from date of Substantial Completion.

# PART 2 PRODUCTS

## 2.1 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.

## 2.2 PUBLIC-USE WASHROOM ACCESSORIES

A. Source Limitations: Obtain public-use washroom accessories from single source from single manufacturer.

B. Toilet Tissue (Roll) Dispenser :
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ASI-American Specialties, Inc.
      b. Bobrick Washroom Equipment, Inc.
      c. Bradley Corporation.
   2. Description: Roll-in-reserve dispenser with hinged front secured with tumbler lockset.
   3. Mounting: Surface mounted.
   4. Operation: Noncontrol delivery with standard spindle.
   5. Capacity: Designed for 4-1/2- or 5-inch- diameter tissue rolls.
   6. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

C. Paper Towel (Roll) Dispenser :
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ASI-American Specialties, Inc.
      b. Bobrick Washroom Equipment, Inc.
      c. Bradley Corporation.
   2. Description: Pull-towel-actuated mechanism that permits controlled delivery of paper rolls in preset lengths.
   3. Mounting: Surface mounted.
   4. Minimum Capacity: 8-inch- wide, 800-foot- long roll.
   5. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
   6. Lockset: Tumbler type.

D. High-Speed Air Hand Dryer :
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ASI-American Specialties, Inc.
      b. Bobrick Washroom Equipment, Inc.
      c. Bradley Corporation.
      d. Dyson Inc.
      e. Excel Dryer Inc.
   2. Description: High-speed, unheated-air hand dryer for rapid hand drying.
   3. Mounting: Surface mounted.
      a. Protrusion Limit: Installed unit protrudes maximum 4 inches from wall surface.
   4. Operation: Infrared-sensor activated with timed power cutoff switch.
      a. Average Dry Time: 12 seconds.
      b. Automatic Shutoff: At 60 seconds.
   5. Maximum Sound Level: 69 dB.
   6. Cover Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

E. Soap Dispenser :
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ASI-American Specialties, Inc.
      b. Bobrick Washroom Equipment, Inc.
      c. Bradley Corporation.
   2. Description: Designed for manual operation and dispensing soap in liquid or lotion form.
   3. Mounting: Vertically oriented, surface mounted.
   4. Materials: Stainless Steel.
   5. Lockset: Tumbler type.
   6. Refill Indicator: Window type.

F. Grab Bar :
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ASI-American Specialties, Inc.

b. Bobrick Washroom Equipment, Inc.
c. Bradley Corporation.
2. Mounting: Flanges with concealed fasteners.
3. Material: Stainless steel, 0.05 inch thick.
a. Finish: Smooth, ASTM A480/A480M No. 4 finish (satin).
4. OD: 1-1/4 inches.
5. Configuration and Length: As indicated on Drawings.

G. Sanitary-Napkin Disposal Unit :
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. ASI-American Specialties, Inc.
b. Bobrick Washroom Equipment, Inc.
c. Bradley Corporation.
2. Mounting: Surface mounted.
3. Door or Cover: Self-closing, disposal-opening cover.
4. Receptacle: Removable.
5. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

H. Mirror Unit :
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. ASI-American Specialties, Inc.
b. Bobrick Washroom Equipment, Inc.
c. Bradley Corporation.
2. Frame: Stainless steel channel.
a. Corners: Manufacturer's standard.
3. Size: As indicated on Drawings.
4. Hangers: Manufacturer's standard rigid, tamper and theft resistant.

I. Hook :
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. ASI-American Specialties, Inc.
b. Bobrick Washroom Equipment, Inc.
c. Bradley Corporation.
2. Description: Single-prong unit.
3. Mounting: Concealed.
4. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

## 2.3 PUBLIC-USE SHOWER ROOM ACCESSORIES

A. Source Limitations: Obtain each type of public-use shower room accessory from single source from single manufacturer.

B. Folding Shower Seat :
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ASI-American Specialties, Inc.
b. Bobrick Washroom Equipment, Inc.
c. Bradley Corporation.

2. Configuration: L-shaped seat, designed for wheelchair access.
3. Seat: Phenolic or polymeric composite of slat-type or one-piece construction in color as selected by Architect.
4. Mounting Mechanism: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

## 2.4 CHILDCARE ACCESSORIES

A. Source Limitations: Obtain childcare accessories from single source from single manufacturer.

B. Diaper-Changing Station :
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. ASI-American Specialties, Inc.
b. Bradley Corporation.
c. Koala Kare Products; Bobrick Washroom Equipment, Inc.
2. Description: Horizontal unit that opens by folding down from stored position and with child-protection strap.
a. Engineered to support minimum of 250 lb static load when opened.
3. Mounting: Surface mounted, with unit projecting not more than 4 inches from wall when closed.
4. Operation: By pneumatic shock-absorbing mechanism.
5. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin), with replaceable insulated polystyrene tray liner and rounded plastic corners.
6. Liner Dispenser: Provide built-in dispenser for disposable sanitary liners.

## 2.5 CUSTODIAL ACCESSORIES

A. Source Limitations: Obtain custodial accessories from single source from single manufacturer.

B. Custodial Mop and Broom Holder :
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. ASI-American Specialties, Inc.
b. Bobrick Washroom Equipment, Inc.
c. Bradley Corporation.
2. Description: Unit with shelf, hooks, holders, and rod suspended beneath shelf.
3. Length: 36 inches.
4. Hooks: Four.
5. Mop/Broom Holders: Three, spring-loaded, rubber hat, cam type.
6. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
a. Shelf: Not less than nominal 0.05-inch- thick stainless steel.
b. Rod: Approximately 1/4-inch- diameter stainless steel.

## 2.6 MATERIALS

A. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.031-inch- minimum nominal thickness unless otherwise indicated.

B. Steel Sheet: ASTM A1008/A1008M, Designation CS (cold rolled, commercial steel), 0.036-inch- minimum nominal thickness.

C. Galvanized-Steel Sheet: ASTM A653/A653M, with G60 hot-dip zinc coating.

D. Galvanized-Steel Mounting Devices: ASTM A153/A153M, hot-dip galvanized after fabrication.

E. 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.

F. Chrome Plating: ASTM B456, Service Condition Number SC 2 (moderate service).

G. Mirrors: ASTM C1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

## 2.7 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

# PART 3 EXECUTION

## 3.1 INSTALLATION

A. Install accessories in accordance with 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.

C. Shower Seats: 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 in accordance with manufacturer's written instructions.

**END OF SECTION**

# SECTION 10 44 13

# FIRE PROTECTION CABINETS

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Fire-protection cabinets for the following:
      a. Portable fire extinguisher.

### 1.2 PREINSTALLATION CONFERENCE

A. Preinstallation Conference: Conduct conference at Project site.
   1. Review methods and procedures related to fire-protection cabinets, including, but not limited to, the following:
      a. Schedules and coordination requirements.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing recessed-, semirecessed-, or surface-mounting method and relationships of box and trim to surrounding construction.
   2. Show location of knockouts for hose valves.

B. Shop Drawings: For fire-protection cabinets.
   1. Include plans, elevations, sections, details, and attachments to other work.

C. Samples: For each type of exposed finish required.

### 1.4 COORDINATION

A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

A. Source Limitations: Obtain fire-protection cabinets, accessories, and fire extinguishers from single source from single manufacturer.

### 2.2 PERFORMANCE REQUIREMENTS

A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E814 for fire-resistance rating of walls where they are installed.

### 2.3 FIRE-PROTECTION CABINET

A. Cabinet Type: Suitable for fire extinguisher.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. JL Industries; Activar Construction Products Group, Inc.
      b. Larsen's Manufacturing Company.
      c. Nystrom, Inc.

B. Cabinet Construction: One-hour fire rated.
   1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.043-inch- thick cold-rolled steel sheet lined with minimum 5/8-inch- thick fire-barrier material. Provide factory-drilled mounting holes.

C. Cabinet Material: Cold-rolled steel sheet.
   1. Shelf: Same metal and finish as cabinet.

D. Recessed Cabinet:
   1. Trimless with Concealed Flange: Surface of surrounding wall finishes flush with exterior finished surface of cabinet frame and door, without overlapping trim attached to cabinet. Provide recessed flange, of same material as box, attached to box, to act as drywall bead.

E. Semirecessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend).
   1. Square-Edge Trim: 1-1/4- to 1-1/2-inch backbend depth.

F. Cabinet Trim Material: Steel sheet Same material and finish as door.

G. Door Material: Steel sheet.

H. Door Style: Vertical duo panel with frame.

I. Door Glazing: Tempered float glass (clear).

J. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
   1. Provide manufacturer's standard.
   2. Provide concealed hinge, permitting door to open 180 degrees.

K. Accessories:
   1. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated.
      a. Identify fire extinguisher in fire-protection cabinet with the words " FIRE EXTINGUISHER."
         1) Location: Applied to location indicated on Drawings.
         2) Application Process: Silk-screened.
         3) Lettering Color: Red.
         4) Orientation: As indicated on Drawings.

L. Materials:
   1. Cold-Rolled Steel: ASTM A1008/A1008M, Commercial Steel (CS), Type B.
      a. Finish: Baked enamel, TGIC polyester powder coat, HAA polyester powder coat, epoxy powder coat, or polyester/epoxy hybrid powder coat, complying with AAMA 2603.
      b. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
      c. Color: As selected by Architect from manufacturer's full range.
   2. Tempered Float Glass: ASTM C1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

## 2.4 FABRICATION

A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
   1. Weld joints and grind smooth.
   2. Miter corners and grind smooth.
   3. Provide factory-drilled mounting holes.
   4. Prepare doors and frames to receive locks.
   5. Install door locks at factory.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles.
   1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
   2. Fabricate door frames of one-piece construction with edges flanged.
   3. Miter and weld perimeter door frames and grind smooth.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

## 2.5 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable, temporary protective covering before shipping.

C. Finish fire-protection cabinets after assembly.

D. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

# PART 3 EXECUTION

## 3.1 EXAMINATION

A. Examine roughing-in for hose and cabinets to verify actual locations of piping connections before cabinet installation.

B. Examine walls and partitions for suitable framing depth and blocking where recessed and semirecessed cabinets will be installed.

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

## 3.2 PREPARATION

A. Prepare recesses for recessed and semirecessed fire-protection cabinets as required by type and size of cabinet and trim style.

## 3.3 INSTALLATION

A. General: Install fire-protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.
   1. Fire-Protection Cabinet Mounting Height: 42 inches above finished floor to top of fire extinguisher.

B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.
   1. Unless otherwise indicated, provide recessed fire-protection cabinets. If wall thickness is inadequate for recessed cabinets, provide semirecessed fire-protection cabinets.
   2. Provide inside latch and lock for break-glass panels.
   3. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.
   4. Fire-Rated Cabinets:

a. Install cabinet with not more than 1/16-inch tolerance between pipe OD and knockout OD. Center pipe within knockout.
b. Seal through penetrations with firestopping sealant as specified in Section 07 84 13 "Penetration Firestopping."

## 3.4 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet and mounting bracket manufacturers.

E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

**END OF SECTION**

# SECTION 10 44 16

# FIRE EXTINGUISHERS

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section includes portable, hand-carried fire extinguishers.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.

### 1.3 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

### 1.4 CLOSEOUT SUBMITTALS

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

### 1.5 COORDINATION

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

### 1.6 WARRANTY

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

## PART 2 PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
   1. Provide fire extinguishers approved, listed, and labeled by FM Global.

### 2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Guardian Fire Equipment, Inc.
      b. JL Industries; Activar Construction Products Group, Inc.
      c. Kidde; Carrier Global Corporation.
      d. Larsen's Manufacturing Company.
      e. Nystrom, Inc.
   2. Source Limitations: Obtain fire extinguishers, fire-protection cabinets, and accessories, from single source from single manufacturer.

B. Multipurpose Dry-Chemical Type in Steel Container : UL-rated 3-A:40-B:C, 5-lband 4-A:60-B:C, 10-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

## PART 3 EXECUTION

### 3.1 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.
   1. Remove and replace damaged, defective, or undercharged fire extinguishers.

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

## 3.2 INSTALLATION

A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.

B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.
   1. Mounting Height: Top of fire extinguisher to be at 42 inches above finished floor.

**END OF SECTION**

# SECTION 10 51 13

# METAL LOCKERS

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Welded corridor lockers.

### 1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

### 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 each type of metal locker.

B. Shop Drawings: For metal lockers.
   1. Include plans, elevations, sections, and attachment details.
   2. Show locker trim and accessories.
   3. Include locker identification system and numbering sequence.

C. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available.

### 1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Sample Warranty: For special warranty.

### 1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals.

## 1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver metal lockers until spaces to receive them are clean, dry, and ready for their installation.

## 1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of recessed openings by field measurements before fabrication.

## 1.8 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that metal lockers can be supported and installed as indicated.

## 1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of metal lockers that fail in materials or workmanship, excluding finish, within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures.
      b. Faulty operation of latches and other door hardware.
   2. Damage from deliberate destruction and vandalism is excluded.
   3. Warranty Period for Knocked-Down Metal Lockers: Two years from date of Substantial Completion.
   4. Warranty Period for Welded Metal Lockers: Lifetime from date of Substantial Completion.

# PART 2 PRODUCTS

## 2.1 MANUFACTURERS

A. Source Limitations: Obtain metal lockers and accessories from single source from single locker manufacturer.
   1. Obtain locks from single lock manufacturer.

## 2.2 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: For lockers indicated to be accessible, comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.

## 2.3 WELDED CORRIDOR LOCKERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. ASI Storage Solutions.
   2. Lyon LLC.
   3. Penco Products, Inc.
   4. Republic Storage Systems, LLC.

B. Doors: One piece; fabricated from 0.075-inch nominal-thickness steel sheet; formed into channel shape with double bend at vertical edges and with right-angle single bend at horizontal edges.
   1. Reinforcement: Manufacturer's standard reinforcing angles, channels, or stiffeners for doors more than 15 inches wide; welded to inner face of doors.
   2. Door Style: Unperforated panel.

C. Body: Assembled by welding body components together. Fabricate from unperforated steel sheet with thicknesses as follows:
   1. Tops, Bottoms, and Sides: 0.060-inch nominal thickness.
   2. Backs: 0.048-inch nominal thickness.
   3. Shelves: 0.060-inch nominal thickness, with double bend at front and single bend at sides and back.

D. Frames: Channel formed; fabricated from 0.060-inch nominal-thickness steel sheet; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral, full-height door strikes on vertical main frames.
   1. Cross Frames between Tiers: Channel formed and fabricated from same material as main frames; welded to vertical main frames.

E. Hinges: Welded to door and attached to door frame with no fewer than two factory-installed rivets per hinge that are completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees.
   1. Hinges: Manufacturer's standard, steel, continuous or knuckle type.

F. Recessed Door Handle and Latch: Stainless steel cup with integral door pull, recessed so locking device does not protrude beyond door face; pry and vandal resistant.
   1. Multipoint Latching: Finger-lift latch control designed for use with built-in combination locks or padlocks; positive automatic latching and prelocking.
      a. Latch Hooks: Equip doors 48 inches and higher with three latch hooks and doors less than 48 inches high with two latch hooks; fabricated from 0.120-inch nominal-thickness steel sheet; welded to full-height door strikes; with resilient silencer on each latch hook.
      b. Latching Mechanism: Manufacturer's standard, rattle-free latching mechanism and moving components isolated to prevent metal-to-metal contact, and incorporating a prelocking device that allows locker door to be locked while door is open and then closed without unlocking or damaging lock or latching mechanism.

G. Door Handle and Latch for Lockers: Stainless steel strike plate with integral pull; with steel padlock loop that projects through metal locker door.

H. Locks: [Combination padlocks], [Built-in combination locks], [Cylinder locks], [Built-in, card-operated locks], [Digital keypad locks], and [Built-in, coin-operated locks].

I. Identification Plates: Manufacturer's standard, etched, embossed, or stamped aluminum plates, with numbers and letters at least 3/8 inch high.

J. Hooks: Manufacturer's standard ball-pointed, aluminum or steel; zinc plated.

K. Continuous Zee Base: Fabricated from, manufacturer's standard thickness, but not less than 0.060-inch nominal-thickness steel sheet.
   1. Height: 4 inches.

L. Continuous Sloping Tops: Fabricated from 0.048-inch nominal-thickness steel sheet, with a pitch of approximately 20 degrees.
   1. Closures: Vertical -end type.

M. Recess Trim: Fabricated from 0.048-inch nominal-thickness steel sheet.

N. Filler Panels: Fabricated from 0.048-inch nominal-thickness steel sheet.

O. Boxed End Panels: Fabricated from 0.048-inch nominal-thickness steel sheet.

P. Finished End Panels: Fabricated from 0.024-inch nominal-thickness steel sheet to cover unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.

Q. Materials:
   1. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B, suitable for exposed applications.
   2. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with A60 zinc-iron, alloy (galvannealed) coating designation.

R. Finish: Baked enamel or powder coat.
   1. Color: As selected by Architect from manufacturer's full range.

## 2.4 LOCKS

A. Combination Padlock: Provided by Owner.

B. Built-in Combination Lock: Key-controlled, three-number dialing combination locks; capable of at least five combination changes made automatically with a control key.
   1. Bolt Operation: Manually locking deadbolt or automatically locking spring bolt.

C. Cylinder Lock: Built-in, flush, cam lock with five-pin tumbler keyway, keyed separately and master keyed. Furnish two change keys for each lock and [two] master keys.
   1. Key Type: [Flat], [Grooved], and [, with minimum 2- by 2.68-inch key head for

accessible lockers].
2. Bolt Operation: [Manually locking deadbolt] or [automatically locking spring bolt].

D. Built-in, Card-Operated Lock: Self-contained units mounted on interior of door with replaceable lock cylinders keyed separately and master keyed. Mount instruction decals on both door faces. Furnish one change card key for each lock and one master card key.
1. Bolt Operation: [Manually locking deadbolt] or [automatically locking spring bolt].

E. Digital Keypad Lock: Battery-powered electronic keypad with reprogrammable manager and owner codes that override access. Three consecutive incorrect code entries will disable lock for three minutes.
1. Designed for permanently assigned access via entry of user's four-digit code.
2. Designed for shared or temporary access by multiple users, with user-defined code to lock and unlock. Provide LED indicator to show when lock is in use.

## 2.5 FABRICATION

A. Fabricate metal lockers square, rigid, without warp, and with metal faces flat and free of dents or distortion. Make exposed metal edges safe to touch and free of sharp edges and burrs.
1. Form body panels, doors, shelves, and accessories from one-piece steel sheet unless otherwise indicated.
2. Provide fasteners, filler plates, supports, clips, and closures as required for complete installation.

B. Fabricate each metal locker with an individual door and frame; individual top, bottom, and back; and common intermediate uprights separating compartments.

C. Equipment: Provide each locker with an identification plate and the following equipment:
1. Single-Tier Units: Shelf, one double-prong ceiling hook, and two single-prong wall hooks.
2. Double-Tier Units: One double-prong ceiling hook and two single-prong wall hooks.

D. Welded Construction: Factory preassemble metal lockers by welding all joints, seams, and connections; with no bolts, nuts, screws, or rivets used in assembly of main locker groups. Factory weld main locker groups into one-piece structures. Grind exposed welds smooth and flush.

E. Accessible Lockers: Fabricate as follows:
1. Locate bottom shelf no lower than 15 inches above the floor.
2. Where hooks, coat rods, or additional shelves are provided, locate no higher than 48 inches above the floor.

F. Continuous Zee Base: Fabricated in lengths as long as practical to enclose base and base ends; finished to match lockers.

G. Continuous Sloping Tops: Fabricated in lengths as long as practical, without visible fasteners at splice locations; finished to match lockers.
   1. Sloping-top corner fillers, mitered.

H. Individual Sloping Tops: Fabricated in width to fit one locker frame in lieu of flat locker tops; with integral back; finished to match lockers. Provide wedge-shaped divider panels between lockers.

I. Recess Trim: Fabricated with minimum 2-1/2-inch face width and in lengths as long as practical; finished to match lockers.

J. Filler Panels: Fabricated in an unequal leg angle shape; finished to match lockers. Provide slip-joint filler angle formed to receive filler panel.

K. Boxed End Panels: Fabricated with 1-inch- wide edge dimension, and designed for concealing fasteners and holes at exposed ends of nonrecessed metal lockers; finished to match lockers.
   1. Provide one-piece panels for double-row (back-to-back) locker ends.

L. Finished End Panels: Fabricated to conceal unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.
   1. Provide one-piece panels for double-row (back-to-back) locker ends.

M. Center Dividers: Full-depth, vertical partitions between bottom and shelf; finished to match lockers.

## 2.6 ACCESSORIES

A. Fasteners: Zinc- or nickel-plated steel, slotless-type, exposed bolt heads; with self-locking nuts or lock washers for nuts on moving parts.

B. Anchors: Material, type, and size required for secure anchorage to each substrate.
   1. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls, and elsewhere as indicated, for corrosion resistance.
   2. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

# PART 3 EXECUTION

## 3.1 EXAMINATION

A. Examine walls and floors or support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

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

## 3.2 INSTALLATION

A. Install lockers level, plumb, and true; shim as required, using concealed shims.
   1. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than 36 inches o.c. Using concealed fasteners, install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion.
   2. Anchor single rows of metal lockers to walls near top and bottom of lockers.
   3. Anchor back-to-back metal lockers to floor.

B. Welded Lockers: Connect groups together with manufacturer's standard fasteners, with no exposed fasteners on face frames.

C. Equipment:
   1. Attach hooks with at least two fasteners.
   2. Attach door locks on doors using security-type fasteners.
   3. Identification Plates: Identify metal lockers with identification indicated on Drawings.
      a. Attach plates to each locker door, near top, centered, with at least two aluminum rivets.
      b. Attach plates to upper shelf of each open-front metal locker, centered, with a least two aluminum rivets.

D. Trim: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.
   1. Attach recess trim to recessed metal lockers with concealed clips.
   2. Attach filler panels with concealed fasteners. Locate filler panels where indicated on Drawings.
   3. Attach sloping-top units to metal lockers, with closures at exposed ends.
   4. Attach boxed end panels using concealed fasteners to conceal exposed ends of nonrecessed metal lockers.
   5. Attach finished end panels using fasteners only at perimeter to conceal exposed ends of nonrecessed metal lockers.

E. Movable Benches: Place benches in locations indicated on Drawings.

## 3.3 ADJUSTING

A. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding. Verify that integral locking devices operate properly.

## 3.4 PROTECTION

A. Protect metal lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.

B. Touch up marred finishes, or replace metal lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

**END OF SECTION**

# SECTION 10 71 13

# EXTERIOR SUN CONTROL DEVICES

## PART 1 GENERAL

### 1.1 SECTION INCLUDES

A. Extruded aluminum stationary exterior sun control devices.

### 1.2 REFERENCE DOCUMENTS

A. AAMA 2604 - High Performance Organic Coatings on Architectural Extrusions and Panels.

B. AAMA 2605 - High Performance Organic Coatings on Architectural Extrusions and Panels.

C. ASCE 7 - Minimum Design Loads for Buildings and Other Structures

D. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

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

F. ASTM D822 - Standard Practice for Filtered Open-Flame Carbon-Arc Exposure of Paint and Related Coatings.

G. ASTM D4214 - Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films.

H. ASTM D2244 - Standard Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.

I. ASTM E330 - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights, and Curtain Walls by Uniform Static Air Pressure Difference.

## 1.3 PERFORMANCE REQUIRMENTS

A. Provide sun control devices which have been manufactured, fabricated and installed to withstand loads from ASCE - 7, or local requirements of Authority Having Jurisdiction.

B. Sun control devices shall be designed to perform under conditions herein or required by site conditions with no permanent damage to or deforming of the sunshade blades or assembly, noise or metal fatigue caused by sunshade blade rattle or flutter, or permanent damage to fasteners or anchors.

## 1.4 SUBMITTALS

A. Product Data: For each product to be used, including:
   1. Manufacturer’s product data including performance data.
   2. Installation Instructions
   3. Maintenance and Operations Manuals
   4. Health Product Declarations (HPDs) and Declare Labels

B. Shop Drawings
   1. Submit project specific shop drawings indication materials, construction, dimensions, accessories, and installation details.

C. Delegated Design Submittal: For sun control devices indicated to comply with structural and seismic performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. Samples
   1. Submit color chip samples for units with factory-applied paint.

## 1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications:
   1. The manufacturer shall have implemented the management of quality objectives, continual improvement, and monitoring of customer satisfaction to assure that customer needs and expectations are met.

## 1.6 DELIVERY, STORAGE & HANDLING

A. Delivery: Deliver materials to site in manufacturer’s original, unopened containers and packaging, with labels clearly indicating manufacturer and material

B. Storage: Store materials in a dry area indoors, protected from damage and in accordance with manufacturer’s instructions.

C. Handling: Protect materials and finishes during handling and installation to prevent

damage

D. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

## 1.7 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by the manufacturer for optimum results. Do not install products under environment conditions outside the manufacturer's absolute limits.

B. Field Measurements: Verify actual measurements of openings by field measurements before fabrication. Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.

## 1.8 WARRANTY

A. Manufacturer shall provide a standard limited warranty for sun control systems for a period of 1 year from date of Final Acceptance, When notified in writing from the Owner of a manufacturing defect, manufacturer shall promptly correct deficiencies without cost to the owner.

B. Manufacturer shall provide 20 year limited warranty for fluoropolymer-based finish on aluminum substrates
   1. Finish coating shall not peel, blister, chip, crack, or check.
   2. Chalking, fading, or erosion of finish when measured by the following tests:
      a. Finish coating shall not chalk in excess of 8 numerical ratings when measured in accordance with ASTM D4214.
      b. Finish coating shall not change color or fade in excess of 5 NBS units as determined by ASTM D2244 and ASTM D822
      c. Finish coating shall not erode at a rate in excess of.01 mils/year confirmed by Florida test samples.

# PART 2 PRODUCTS

## 2.1 PREFORMANCE REQUIREMENTS

A. Delegated Design: Design sun control devices, including comprehensive engineering analysis by a qualified professional engineer, using structural and seismic performance requirements and design criteria indicated.

B. Structural Performance: Sun control devices shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of components, noise or metal fatigue caused by sunshade-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures are considered to act normal to the face of the building.
   1. Wind Loads: Refer to Structural Drawings.

C. Seismic Performance:
   1. As indicated on Drawings.
   2. Sun shades, including attachments to other construction, withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7.

## 2.2 SUN CONTROL DEVICES

A. Basis-of-Design: In accordance with requirements of this Section, provide sun control devices by Architectural Louvers, Cincinnati, Ohio; 6-inch deep airfoil blade.

B. Other Available Manufacturers - subject to compliance with requirements stated within.
   1. Construction Specialties (CS).
   2. Industrial Louvers Inc. (ILI).

## 2.3 MATERIAL

A. Blades and fascia shall be fabricated from a minimum 0.081-inch wall thickness extruded aluminum. Blades shall be of design as indicated on drawings.

B. Outrigger material shall be fabricated from a minimum.250 (1/4”) wall thickness plate aluminum.

C. Mounting brackets shall be fabricated from a minimum.375 (3/8”) wall thickness.

D. Aluminum Extrusions: ASTM B221, Alloy 6063-T6

E. Fully mechanically fastened construction

## 2.4 FINISHES (FACTORY)

A. General: Comply with NAAMM “Metal Finishes Manual” for finish designations and application recommendations, except as otherwise indicated. Apply finishes in factory. Protect finishes on exposed surfaces prior to shipment. Remove scratches and blemishes from exposed surfaces that will be visible after completing finishing process. Provide color as indicated or, if not otherwise indicated, as selected by architect.

B. Fluorocarbon Two Coat Finish
   1. Coating shall conform to AAMA 2605.

2. Sun Control Devices to be finished with a minimum 1.0 mil (0.025 mm) thick full strength 70% resin, 2 coat Fluoropolymer system.
3. All aluminum shall be thoroughly cleaned, etched, and given a chrome-free conversion pretreatment before application of coating. Coating shall be ILFI LBC Red List Free.

## PART 3 EXECUTION

### 3.1 EXAMINATION

A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance.

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

### 3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using methods recommended by the manufacturer for achieving the best results for the substrate under the project conditions.

### 3.3 INSTALLATION

A. Install sun control devices at locations as indicated on the drawings and in accordance with the manufacturer’s instructions.

### 3.4 CLEANING

A. Clean sun control device surface in accordance with manufacturer’s instructions.

B. Touch-up paint, repair or replace damaged products before Substantial Completion.

**END OF SECTION**

# SECTION 10 73 16.13

# METAL CANOPY

## PART 1 GENERAL

### 1.1 SUMMARY

A. Work in this section includes furnishing and installation of manufactured wall-supported canopies.

B. Related Items and Considerations
   1. Flashing of various designs may be required. Generic flashing supplied by Mapes. Specialty flashing to be supplied by installer.
   2. Determine wall construction, make-up and thickness.
   3. Ensure adequate wall condition to carry canopy loads where required.
   4. Consider water drainage away from canopy where necessary.
   5. Any necessary removal or relocation of existing structures, obstructions or materials.

### 1.2 FIELD MEASUREMENTS

A. Confirm dimensions prior to preparation of shop drawings when possible.

B. If requested, supply manufacturer s standard literature and specifications for canopies.

C. Submit shop drawings showing structural component locations/positions, material dimensions and details of construction and assembly.

### 1.3 PERFORMANCE REQUIREMENTS

A. Canopy shall conform to local building codes.

B. PE Stamped calculations are required and must be signed and sealed by an engineer licensed within the state canopy is installed.

### 1.4 DELIVER, STORAGE, AND HANDLING

A. Deliver and store all canopy components in protected areas.

## PART 2 PRODUCTS

### 2.1 MANUFACTURER

A. Basis of Design; Mapes Canopies.

B. Other acceptable manufacturers.
   1. Avadeck
   2. Peach Protective Covers
   3. Tennessee Valley Metals

### 2.2 CANOPY TYPES

A. Cantilevered. Basis of Design; Mapes Cantilever, 2 ¾” deck, 8” J fascia, super lumideck fastening. Extruded aluminum (T6 - 6063), Fascia:.125”, Decking:.078”, Deflection rating L/180.
   1. Model: SuperShade Cantilever.

### 2.3 MATERIALS

A. Sun shading elements shall consist of extruded aluminum louver blades, minimum 0.110-inch thickness.

B. Intermediate framing members shall be extruded aluminum, alloy 6063-T6, in profile and thickness provided by manufacturer.

C. Cantilever support brackets shall be design engineered per project application.

D. Cantilever support brackets shall have standard available finishes; selected by Architect.

E. Fascia shall be custom: Match sizes shown on Drawings.

### 2.4 FINISHES

A. Finish type shall be 2-Coat Kynar Finish.

### 2.5 FABRICATION

A. All Mapes SuperShade sunshades are shipped in preassembled sections for ease of installation.

B. All connections shall be mechanically assembled utilizing 3/16 fasteners with a minimum shear stress of 350 lbs. Pre-welded or factory-welded connections are not acceptable.

C. Louver blades shall be all extruded aluminum set on a nominal 45 degree back slant.

## PART 3 EXECUTION

### 3.1 INSPECTION

A. Confirm that surrounding area is ready for the canopy installation.

B. Installer shall confirm dimensions and elevations to be as shown on drawings provided by Mapes Industries.

C. Erection shall be performed by an approved installer and scheduled after all concrete, masonry and roofing in the area is completed

### 3.2 INSTALLATION

A. Installation shall be in strict accordance with manufacturer's shop drawings. Particular attention should be given to protecting the finish during handling and erection.

B. After installation, entire system shall be left in a clean condition.

**END OF SECTION**

# SECTION 10 73 26

# WALKWAY COVERINGS

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section includes design, fabrication and installation of complete welded, extruded aluminum protective cover system.

### 1.2 REFERENCES

A. Use current editions unless indicated otherwise.

B. The Aluminum Association
   1. Aluminum Design Manual

C. American Society of Civil Engineers (ASCE) / Structural Engineering Institute (SEI)
   1. ASCE/SEI 7, Minimum Design Loads for Buildings and Other Structures

### 1.3 ACTION SUBMITTALS

A. Submit manufacturer's product data, specifications and installation instructions for building components and accessories.

B. Shop Drawings (Delegated-Design Submittal)
   1. Submit shop drawings indicating all necessary plan dimensions, elevations and details.
   2. Include engineering calculations to supplement the general design stating that the protective cover system design complies with the wind requirements of ASCE 7, the stability criteria of applicable building code, and all other governing criteria.
   3. Engineering calculations and shop drawings shall bear the seal of a professional engineer licensed in the State of Texas.

### 1.4 QUALITY ASSURANCE

A. Walkway Cover shall be produced and installed by a listed manufacturer with at least five years experience in the design and fabrication of extruded aluminum walkway cover systems.

B. Components shall be assembled in shop to greatest extent possible to minimize field assembly.

## 1.5 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Protect materials from exposure to moisture. Do not deliver until after wet work is complete and dry.

C. Store materials in a dry, warm, ventilated weathertight location.

## 1.6 WARRANTY

A. Provide written warranty against defects in material and workmanship for the work of this Section for a period of one year from the Date of Substantial Completion.

B. Refer to Section 01 77 00, Closeout Procedures, for Warranty form.

# PART 2 PRODUCTS

## 2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by Mapes Canopies, Inc.; Post Supported Walkway Canopies. Available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. Dittmer Architectural Aluminum
   2. Peachtree Protective Covers, Inc.
   3. Perfection Architectural Systems, Inc.

B. Source Limitations: Obtain aluminum windows from single source from single manufacturer.

## 2.2 MATERIALS

A. Walkway cover shall be all welded extruded aluminum system complete with internal drainage.

B. Provide expansion joints as necessary to accommodate temperature changes of 120° F.

C. Aluminum Members
   1. All sections shall be extruded aluminum 6063 alloy, heat treated to T-6 temper.
   2. All sections shall be sized by a professional engineer licensed in the State of Texas to comply with live load and wind load requirements of the project, but shall not be less than the dimensions indicated on the drawings.
   3. Deck
      a. Extruded aluminum, self-flashing, interlocking sections with welded endplate

water dams where sections terminate at other than drainage channels

4. Fascia
   a. Extruded aluminum fascia sections as shown on drawings and as required to complete the installation resulting in a neat finished appearance.

D. Flashing: Aluminum sheet, thickness as recommended by manufacturer for specific condition, but not less than.040 inch

E. Fasteners: Fasteners shall be aluminum, 18-8 stainless steel or, 300 series stainless steel.

F. Grout: Grout shall be 2000 psi compressive strength, 1 part Portland cement and 3 parts masonry sand. Add water to produce pouring consistency.

G. Foam Block-Outs: Rigid foam blocks sized as required for column embedment depth and shape.

## 2.3 FABRICATION

A. Bent Construction
   1. Beams and columns shall be factory welded with neatly mitered corners into one-piece rigid bents. Field welding is not permitted.
   2. All welds shall be smooth and uniform using an inert gas shielded arc. Suitable edge preparation shall be performed to assure 100% penetration.
   3. Grind welds only where interfering with adjoining structure to allow for flush connection.
   4. Rigid mechanical joints shall be used only when shipping limitations prohibit the shipment of fully welded bents.

B. Deck Construction
   1. Deck shall be manufactured of extruded modules that interlock in a self-flashing manner.
   2. Interlocking joints shall be positively fastened at 8 inch centers creating a monolithic structural unit capable of developing the full strength of the sections.
   3. Fastenings must have minimum shear strength of 350 pounds each.
   4. Deck shall be assembled with sufficient camber to offset dead load deflection.

# PART 3 EXECUTION

## 3.1 EXAMINATION

A. Erection shall be performed after all concrete, masonry, and roofing work in the vicinity is complete and cleaned.

B. Examine footings in which bents will be set. Verify footing locations and elevations comply with shop drawings.

C. Examine building surfaces to which canopy will connect.

D. Coordinate with responsible trade to perform corrective work on unsatisfactory footings or surfaces.

## 3.2 ERECTION

A. Erect protective covers in accordance with manufacturer's installation instructions.

B. Furnish column sleeves (foam blockouts) or anchor bolts (if required) for installation by General Contractor.

C. Erect all components true to line, level and plumb.

D. Aluminum columns embedded in concrete shall be protected by clear acrylic.

E. Fill downspout columns with grout to the discharge level to prevent standing water.

F. Install weep holes at non-draining columns at top of concrete to remove condensation.

## 3.3 CLEANING

A. Clean surfaces soiled by work promptly after installation as recommended by manufacturer.

B. Remove surplus materials and debris from the site.

## 3.4 PROTECTION

A. Protect finished aluminum surfaces from damage due to subsequent construction operations.

**END OF SECTION**

# SECTION 10 75 16

# GROUND-SET FLAGPOLES

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section includes ground-set flagpoles made from aluminum I with pole mounted LED light kit.

B. Owner-Furnished Material: Flags.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, operating characteristics, fittings, accessories, and finishes for flagpoles.

B. Shop Drawings: For each flagpole.
   1. Include the following
      a. Plans, elevations, and attachment details. Show general arrangement, jointing, fittings, accessories, grounding, anchoring, and support.
      b. Section, and details of foundation system.

C. Samples for Verification: For each type of exposed finish, in manufacturer's standard sizes.

D. Delegated Design Submittals: For flagpoles.

### 1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For flagpoles to include in operation and maintenance manuals.

### 1.4 DELIVERY, STORAGE, AND HANDLING

A. Spiral wrap flagpoles with heavy paper and enclose in a hard fiber tube or other protective container.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

A. Source Limitations: Obtain flagpoles as complete units, including fittings, accessories, bases, and anchorage devices, and pole-mounted LED light kit from single source from single manufacturer.

### 2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design flagpole assemblies.

B. Seismic Performance: Flagpole assemblies to withstand the effects of earthquake motions determined according to ASCE/SEI 7.

C. Structural Performance: Flagpole assemblies, including anchorages and supports, to withstand design loads indicated within limits and under conditions indicated.
   1. Wind Loads: Determine according to NAAMM FP 1001. Basic wind speed for Project location is identified on Drawings.
   2. Base flagpole design on nylon or cotton flags of maximum standard size suitable for use with flagpole or flag size indicated, whichever is more stringent.

### 2.3 ALUMINUM FLAGPOLES

A. Aluminum Flagpoles: Cone -tapered flagpoles fabricated from seamless extruded tubing complying with ASTM B241/B241M, Alloy 6063, with a minimum wall thickness of 3/16 inch.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. American Flagpole.
      b. Concord American Flagpole.
      c. Eder Flag Manufacturing Company, Inc.
      d. Ewing Flagpole Co., Inc.; Ewing Group Company.
      e. US Flag & Flagpole Supply, LLC.

B. Exposed Height: 30 feet.

C. Construct flagpoles in one piece if possible. If more than one piece is necessary, comply with the following:
   1. Fabricate shop and field joints without using fasteners, screw collars, or lead calking.
   2. Provide flush hairline joints using self-aligning, snug-fitting, internal sleeves.

D. Metal Foundation Tube: Manufacturer's standard corrugated-steel foundation tube, 0.060-inch wall thickness with 3/16-inch steel bottom plate and support plate; 3/4-inch- diameter, steel ground spike; and steel centering wedges welded together. Galvanize foundation tube after assembly. Furnish loose hardwood wedges at top of foundation tube for plumbing pole.
   1. Flashing Collar: Same material and finish as flagpole.

E. Sleeve for Aluminum Flagpole: PVC pipe foundation sleeve, made to fit flagpole, for casting into concrete foundation.
   1. Flashing Collar: Same material and finish as flagpole.

F. Cast-Metal Shoe Base: Made from aluminum with same finish and color as flagpoles for anchor-bolt mounting; furnish with anchor bolts.
   1. Furnish ground spike.

G. LED Light Kit: Provide manufacturer's kit to fit securely on pole as follows:
   1. Three pole-mounted lights per pole.
   2. Aluminum finish matching flag pole.
   3. Dusk to dawn photo sensors.
   4. Fully concealed wiring.

## 2.4 FITTINGS

A. Internal Halyard, Winch System: Manually operated winch with control stop device and removable handle, stainless steel cable halyard, and concealed revolving truck assembly with plastic-coated counterweight and sling. Furnish flush access door secured with cylinder lock. Finish truck assembly to match flagpole.
   1. Halyard Flag Snaps: Stainless steel swivel snap hooks with neoprene or vinyl covers. Furnish two per halyard.
   2. Plastic Halyard Flag Clips for Internal Halyard, Winch System: Made from injection-molded, UV-stabilized, acetal resin (Delrin). Clips attach to flag and have two eyes for inserting both runs of halyards. Furnish two per halyard.

## 2.5 MISCELLANEOUS MATERIALS

A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M.

B. Drainage Material: Crushed stone, or crushed or uncrushed gravel; coarse aggregate.

C. Sand: ASTM C33/C33M, fine aggregate.

D. Elastomeric Joint Sealant: Single-component neutral-curing silicone joint sealant complying with requirements in Section 07 92 00 "Joint Sealants."

## 2.6 ALUMINUM FINISHES

A. Natural Satin Finish: AA-M32, fine, directional, medium satin polish; buff complying with AA-M20; seal aluminum surfaces with clear, hard-coat wax.

B. Clear Anodic Finish: AAMA 611, AA-M12C22A41.

C. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44.
   1. Color: As selected by Architect from manufacturer's full range.
   2. 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. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
   1. Color and Gloss: As selected by Architect from manufacturer's full range.

# PART 3 EXECUTION

## 3.1 PREPARATION

A. Prepare uncoated metal flagpoles that are set in foundation tubes by painting below-grade portions with a heavy coat of bituminous paint.

B. Foundation Excavation: Excavate to neat clean lines in undisturbed soil. Remove loose soil and foreign matter from excavation and moisten earth before placing concrete. Place and compact drainage material at excavation bottom.

C. Provide forms where required due to unstable soil conditions and for perimeter of flagpole base at grade. Secure and brace forms to prevent displacement during concreting.

D. Foundation Tube: Place foundation tube, center, and brace to prevent displacement during concreting. Place concrete. Plumb and level foundation tube and allow concrete to cure.

E. Sleeves: Locate and secure sleeves in forms by bracing to reinforcement and forms.

F. Anchor Bolts: Locate and secure anchor bolts in forms with templates and by tying to reinforcement.

G. Place concrete, as specified in Section 03 30 00 "Cast-in-Place Concrete." Compact concrete in place by using vibrators. Moist-cure exposed concrete for no fewer than seven days or use nonstaining curing compound.

H. Trowel exposed concrete surfaces to a smooth, dense finish, free of trowel marks, and uniform in texture and appearance. Provide positive slope for water runoff to perimeter of concrete base.

## 3.2 FLAGPOLE INSTALLATION

A. General: Install flagpoles where indicated and according to Shop Drawings and manufacturer's written instructions.

B. Coordinate electrical requirements with manufacturer and electrical sub-contractor.

C. Foundation Tube: Place flagpole in tube, seated on bottom plate between steel centering wedges, and install hardwood wedges to secure flagpole in place. Place and compact sand in foundation tube and remove hardwood wedges. Seal top of foundation tube with a 2-inch layer of elastomeric joint sealant and cover with flashing collar.

D. Baseplate: Cast anchor bolts in concrete foundation. Install baseplate on washers placed over leveling nuts on anchor bolts and adjust until flagpole is plumb. After flagpole is plumb, tighten retaining nuts and fill space under baseplate solidly with nonshrink, nonmetallic grout. Finish exposed grout surfaces smooth and slope 45 degrees away from edges of baseplate.

**END OF SECTION**

# SECTION 10 82 13

# EXTERIOR GRILLES AND SCREENS

## PART 1 GENERAL

### 1.1 SUMMARY

A. Furnish screenwall/vision barrier, structural supports and attachment brackets as shown on the drawings, as specified, and as needed for a complete and proper installation.

B. The screenwall/vision barrier to be furnished include the following:
   1. Fixed extruded screenwall/vision barrier.

### 1.2 REFERENCES

A. The Aluminum Association Incorporated
   1. Aluminum Standards and Data
   2. Specifications and Guidelines for Aluminum Structures

B. American Society of Civil Engineers
   1. Minimum Design Loads for Buildings and Other Structures

C. American Society for Testing and Materials
   1. ASTM B209
   2. ASTM B211
   3. ASTM B221
   4. ASTM E90-90

D. Architectural Aluminum Manufacturers Association
   1. AAMA 800 Voluntary Specifications and Test Methods for Sealants
   2. AAMA 605.2 Voluntary Specification for High Performance Organic Coatings on Aluminum Extrusions and Panels.
   3. AAMA TIR Metal Curtain Wall Fasteners
   4. AAMA 2605-98 Superior Performing Organic Coatings on Aluminum Extrusions and Panels

E. Canadian Standards Association
   1. CAN3-S157-M83 Strength Design in Aluminum
   2. S136 94 Cold Formed Steel Structural Members

## 1.3 SUBMITTALS

A. Product Data
   1. Material types and thickness.

B. Shop Drawings
   1. Include elevations, sections, and specific details for each louver.
   2. Show anchorage details and connections for all component parts.
   3. Include signed and sealed structural calculations.

C. Samples:
   1. Submit color chips for approval.

## 1.4 QUALITY ASSURANCE

A. Single subcontract responsibility: Subcontract the work to a single firm that has had not less than six years' experience in the design and manufacturing of work similar to that shown and required.

B. Structural Requirements: Design all materials to withstand wind and snow loads as required by the applicable building code. Maximum allowable deflection for the louver structural members to be l/180 or 0.75 inch, whichever is less. Maximum allowable deflection for the louver blades to be l/120 or 0.50 inch across the weak axis, whichever is less.

C. Professional Engineer Requirements: Drawings and structural calculations to be signed and sealed by a professional engineer licensed to practice in the state where the project is located.

D. Warranty: Provide written warranty to the owner that all products will be free of defective materials or workmanship for a period of one year from date of installation.

## 1.5 DELIVERY, STORAGE, AND HANDLING

A. Delivery: At the time of delivery all materials shall be visually inspected for damage. Any damaged boxes, crates, louver sections, etc. shall be noted on the receiving ticket and immediately reported to the shipping company and the material manufacturer.

B. Storage:
   1. Material may be stored flat on end or on its side.
   2. Material may be stored either indoors or outdoors.
   3. If stored outdoors the material must be raised sufficiently off the ground to prevent it being flooded.
   4. If stored outdoors the material must be covered with a weatherproof flame-resistant sheeting or tarpaulin.

C. Handling:
   1. Material shall be handled in accordance with sound material handling practices and in such a way as to minimize racking.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

A. Basis of Design - manufactured by Construction Specialties subject to compliance with requirements listed. The grilles and related materials herein specified and indicated on the drawings shall be manufactured by: Construction Specialties, 3 Werner Way, Lebanon, NJ 08833. Tel: 800.233.8493. Email: cet@c-sgroup.com. No substitutions.

B. Drawings and specifications are based on manufacturer’s literature from Construction Specialties, Inc. drawings and specifications unless otherwise indicated. Other manufacturers must be approved equal by Architect/Owner.

### 2.2 MATERIALS

A. Aluminum Extrusions: ASTM B211, Alloy 6063-T5, 6063-T6 or 6061-T6.

B. Aluminum Sheet: ASTM B3209, Alloy 1100, 3003 or 5005.

### 2.3 FABRICATION, GENERAL

A. Provide CS screenwall models, structural supports and accessories as specified and/or shown on the drawings. Materials, sizes, depths, arrangements, and material thickness to be as indicated or as required for optimal performance with respect to strength; durability; and uniform appearance.

B. Screenwall to be mechanically assembled using stainless steel or aluminum fasteners.

C. Include supports, anchorage, and accessories required for complete assembly.

### 2.4 SCREENWALL/VISION BARRIER MODEL

A. CS Aluminum Screen, Vert-A-Cade 301 as manufactured by Construction Specialties, Inc. Blades to be fabricated from extruded aluminum sections in 6063-T52 alloy and spaced approximately 6 3/4" on center. Blades to be nominal 4" deep and mechanically secured to continuous extruded aluminum supports. Aluminum supports fixed directly to horizontal steel supports (not by CS) or to spandrel beams with extruded aluminum clip angles. All fasteners to be stainless steel or aluminum. Material shipped knocked down for field assembly by the installer. Support braces

and mounting clips to painted standard Kynar to coat black.

## 2.5 FINISHES

A. General: Comply with NAAMM "Metal Finishes Manual" for finish designations and application recommendations, except as otherwise indicated. Apply finishes in factory. Protect finishes on exposed surfaces prior to shipment. Remove scratches and blemishes from exposed surfaces that will be visible after completing finishing process. Provide color as indicated or, if not otherwise indicated, as selected by architect.

B. 100% Fluoropolymer Resin Powder Coat System complying with AAMA-2605-5 standards for gloss and color retention. Finish thickness to be 1.5 to 3.0 mils.
   1. Finish to allow zero VOCs to be emitted into facility of application or at job site.
   2. Finish to adhere to a 4H Hardness rating.
   3. Furnish manufacturer's twenty (20) year warranty for finish for gloss and color retention

C. Three Coat Fluorocarbon Coating
   1. Sunshades to be finished with a minimum 1.4 mil (0.035mm) thick full strength 70% resin, 3 coat Fluoropolymer system.
   2. All aluminum shall be thoroughly cleaned, etched, and given a chromated conversion pre-treatment before application of the Kynar/Hylar coating. The coating shall consist of a primer, a high Metallic color coat and a clear PVF2 topcoat. It shall receive a bake cycle of 17 minutes at 450°F. All finishing procedures shall be one continuous operation in the plant of the manufacturer.
   3. Manufacturer to furnish an extended 20 limited warranty for the Kynar/Hylar coating. This limited warranty shall begin on the date of material shipment.

# PART 3 EXECUTION

## 3.1 EXAMINATION

A. Examine openings to receive the work. Do not proceed until any unsatisfactory conditions have been corrected.

## 3.2 INSTALLATION

A. Comply with manufacturer's instructions and recommendations for installation of the work.

B. Verify dimensions of supporting structure at the site by accurate field measurements so that the work will be accurately designed, fabricated, and fitted to the structure.

C. Anchor sunshades to the building substructure as indicated on architectural drawings.

D. Erection Tolerances:
   1. Maximum variation from plane or location shown on the approved shop drawings: 1/8" per 12 feet of length, but not exceeding 1/2" in any total building length or portion thereof (non-cumulative).
   2. Maximum offset from true alignment between two members abutting end to end, edge-to-edge in line or separated by less than 3": 1/16" (shop or field joints). This limiting condition shall prevail under both load and no-load conditions.

E. Cut and trim component parts during erection only with the approval of the manufacturer or fabricator, and in accordance with his recommendations. Restore finish completely. Remove and replace members where cutting and trimming has impaired the strength or appearance of the assembly.

F. Do not erect warped, bowed, deformed, or otherwise damaged or defaced members. Remove and replace any members damaged in the erection process as directed.

G. Set units level, plumb and true to line, with uniform joints.

## 3.3 PROTECTION

A. Protect installed materials to prevent damage by other trades. Use materials that may be easily removed without leaving residue or permanent stains.

## 3.4 ADJUSTING AND CLEANING

A. Immediately clean exposed surfaces of the louvers to remove fingerprints and dirt accumulation during the installation process. Do not let soiling remain until the final cleaning.

B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to the material finishes. Thoroughly rinse surfaces and dry.

C. Restore louvers and accessory components damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by the Architect, remove damaged materials, and replace with new materials.
   1. Touch up minor abrasions in finishes with a compatible air-dried coating that matches the color and gloss of the factory applied coating.

**END OF SECTION**

# SECTION 11 30 13

# RESIDENTIAL APPLIANCES

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Cooking appliances.
   2. Refrigeration appliances.
   3. Cleaning appliances.

### 1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

### 1.3 ACTION SUBMITTALS

A. Product Data:
   1. Cooking appliances.
   2. Refrigeration appliances.
   3. Cleaning appliances.

### 1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranties: For manufacturers' special warranties.

### 1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each residential appliance to include in operation and maintenance manuals.

### 1.6 WARRANTY

A. Special Warranties: Manufacturer agrees to repair or replace residential appliances or components that fail in materials or workmanship within specified warranty period.

B. Microwave Oven: Limited warranty, including parts and labor for first year and parts thereafter, for on-site service.
   1. Warranty Period: Two years from date of Substantial Completion.

C. Refrigerator/Freezer, Freezer, and Icemaker, Sealed System: Limited warranty, including parts and labor for first year and parts thereafter, for on-site service on the product.
   1. Warranty Period : Two years from date of Substantial Completion.

D. Dishwasher: Limited warranty, including parts and labor for first year and parts thereafter, for on-site service on the product.
   1. Warranty Period : Two years from date of Substantial Completion.

## PART 2 PRODUCTS

### 2.1 SOURCE LIMITATIONS

A. Obtain residential appliances from single source and each type of residential appliance from single manufacturer.

### 2.2 PERFORMANCE REQUIREMENTS

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

B. Accessibility: Where residential appliances are indicated to comply with accessibility requirements, comply with applicable provisions in the DOJ's 2010 ADA Standards for Accessible Design and ICC A117.1.

### 2.3 COOKING APPLIANCES

A. Microwave Oven :
   1. Type: Conventional.
   2. Capacity: 2.0 cu. ft.
   3. Oven Door: Door with observation window and pull handle.
   4. Microwave Power Rating: Manufacturer's standard.
   5. Controls: Digital panel controls and timer display.
   6. Material: Stainless steel.

### 2.4 REFRIGERATION APPLIANCES

A. Refrigerator/Freezer : Two-door refrigerator/freezer with freezer on bottom and complying with AHAM HRF-1.
   1. Type: Freestanding.
   2. Appliance Color/Finish: Stainless steel.

B. Icemaker :
   1. Type: Undercounter.
   2. Ice Capacity:

a. Production: 30 lb per day.
b. Storage: 25 lb.

3. Appliance Color/Finish: Stainless steel.

## 2.5 CLEANING APPLIANCES

A. Dishwasher : Complying with AHAM DW-1.
1. Type: Built-in undercounter.
2. Sound Level: Maximum 42 dB.
3. Tub and Door Liner: Stainless steel with sealed detergent and automatic rinsing-aid dispensers.
4. Rack System: Nylon -coated sliding dish racks, with removable cutlery basket.
5. Controls: Touch-pad controls with four wash cycles and hot-air and heat-off drying cycle options.
6. Appliance Color/Finish: Stainless steel.

## 2.6 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

# PART 3 EXECUTION

## 3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, power connections, and other conditions affecting installation and performance of residential appliances.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before appliance installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

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

## 3.2 INSTALLATION

A. Install appliances according to manufacturer's written instructions.

B. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and that rough openings are completely concealed.

C. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.

**END OF SECTION**

# SECTION 11 40 00

# FOODSERVICE EQUIPMENT

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Fabricated equipment.
   2. Food waste machines.
   3. Cooking equipment.
   4. Self-contained refrigeration equipment.
   5. Warewashing equipment.
   6. Serving equipment.
   7. Stainless steel sheet wall panels for cooking areas.

B. Owner-Furnished Equipment: Where indicated, Owner will furnish equipment for installation by Contractor.

### 1.2 COORDINATION

A. Coordinate foodservice equipment layout and installation with other work, including layout and installation of lighting fixtures, HVAC equipment, and fire-suppression system components.

B. Coordinate locations and requirements of utility service connections.

C. Coordinate sizes, locations, and requirements of the following:
   1. Overhead equipment supports.
   2. Equipment bases.
   3. Floor depressions.
   4. Insulated floors.
   5. Floor areas with positive slopes to drains.
   6. Floor sinks and drains serving foodservice equipment.
   7. Roof curbs, equipment supports, and penetrations.

### 1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

## 1.4 ACTION SUBMITTALS

A. Product Data
   1. Fabricated equipment.
   2. Cooking equipment.
   3. Self-contained refrigeration equipment.

B. Include the following:
   1. Manufacturer's model number.
   2. Accessories and components that will be included for Project.
   3. Clearance requirements for access and maintenance.
   4. Utility service connections for water, drainage, power, and fuel; include roughing-in dimensions.

C. Shop Drawings: For fabricated equipment. Include plans, elevations, sections, roughing-in dimensions, fabrication details, utility service requirements, and attachments to other work.

D. Samples for Initial Selection: For units with factory-applied color finishes.

E. Samples for Verification: For each factory-applied color finish required, in manufacturer's standard sizes.

## 1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: For foodservice facilities.
   1. Indicate locations of foodservice equipment and connections to utilities.
   2. Key equipment using same designations as indicated on Drawings.
   3. Include plans and elevations; clearance requirements for equipment access and maintenance; details of equipment supports; and utility service characteristics.
   4. Include details of seismic bracing for equipment.

B. Sample Warranty: For special warranty.

## 1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For foodservice equipment to include in emergency, operation, and maintenance manuals.
   1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:
      a. Product Schedule: For each foodservice equipment item, include the following:
         1) Designation indicated on Drawings.
         2) Manufacturer's name and model number.
         3) List of factory-authorized service agencies including addresses and telephone numbers.

## 1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of construction contiguous with foodservice equipment by field measurements before fabrication. Indicate measurements on Coordination Drawings.

## 1.8 WARRANTY

A. Refrigeration Compressor Warranty: Manufacturer agrees to repair or replace compressors that fail in materials or workmanship within specified warranty period.
   1. Failure includes, but is not limited to, inability to maintain set temperature.
   2. Warranty Period: Five years from date of Substantial Completion.

# PART 2 PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

A. NSF Standards: Provide equipment that bears NSF Certification Mark or UL Classification Mark certifying compliance with applicable NSF standards.

B. UL Certification: Provide electric and fuel-burning equipment and components that are evaluated by UL for fire, electric shock, and casualty hazards according to applicable safety standards, and that are UL certified for compliance and labeled for intended use.

C. Steam Equipment: Provide steam-generating and direct-steam heating equipment that is fabricated and labeled to comply with 2013 ASME Boiler and Pressure Vessel Code.

D. Regulatory Requirements: Install equipment to comply with the following:
   1. ASHRAE 15, "Safety Code for Mechanical Refrigeration."
   2. NFPA 54, "National Fuel Gas Code."
   3. NFPA 70, "National Electrical Code."
   4. NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operations."

E. Seismic Restraints: Comply with SMACNA's "Kitchen Ventilation Systems and Food Service Equipment Fabrication and Installation Guidelines," Appendix A, "Seismic Restraint Details," unless otherwise indicated.

## 2.2 FABRICATED EQUIPMENT

A. List will be provided.

## 2.3 FOOD WASTE MACHINES

A. List will be provided.

## 2.4 COOKING EQUIPMENT

A. List will be provided.

## 2.5 SELF-CONTAINED REFRIGERATION EQUIPMENT

A. List will be provided.

## 2.6 WAREWASHING EQUIPMENT

A. List will be provided.

## 2.7 SERVING EQUIPMENT

A. List will be provided.

## 2.8 MISCELLANEOUS MATERIALS

A. Installation Accessories, General: NSF certified for end-use application indicated.

B. Elastomeric Joint Sealant: ASTM C920; silicone. Type S (single component), Grade NS (nonsag), Class 25, Use NT (nontraffic) related to exposure, and Use M, G, A, or O as applicable to joint substrates indicated.
   1. Public Health and Safety Requirements:
      a. Sealant is certified for compliance with NSF standards for end-use application indicated.
      b. Washed and cured sealant complies with the FDA's regulations for use in areas that come in contact with food.
   2. Cylindrical Sealant Backing: ASTM C1330, Type C, closed-cell polyethylene, in diameter greater than joint width.

## 2.9 FINISHES

A. Stainless Steel Finishes:
   1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
   2. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
      a. Run grain of directional finishes with long dimension of each piece.
      b. When polishing is completed, passivate and rinse surfaces. Remove

embedded foreign matter and leave surfaces chemically clean.

B. Powder-Coat Finishes: Immediately after cleaning and pretreating, electrostatically apply manufacturer's standard, baked-polymer, thermosetting powder finish. Comply with resin manufacturer's written instructions for application, baking, and minimum dry film thickness.

## PART 3 EXECUTION

### 3.1 INSTALLATION

A. Install foodservice equipment level and plumb, according to manufacturer's written instructions.
   1. Connect equipment to utilities.
   2. Provide cutouts in equipment, neatly formed, where required to run service lines through equipment to make final connections.

B. Complete equipment assembly where field assembly is required.
   1. Provide closed butt and contact joints that do not require a filler.
   2. Grind field welds on stainless steel equipment until smooth and polish to match adjacent finish.

C. Install equipment with access and maintenance clearances that comply with manufacturer's written installation instructions and with requirements of authorities having jurisdiction.

D. Install cabinets and similar equipment on bases in a bed of sealant.

E. Install closure-trim strips and similar items requiring fasteners in a bed of sealant.

F. Install joint sealant in joints between equipment and abutting surfaces with continuous joint backing unless otherwise indicated. Produce airtight, watertight, vermin-proof, sanitary joints.

### 3.2 CLEANING AND PROTECTING

A. After completing installation of equipment, repair damaged finishes.

B. Clean and adjust equipment as required to produce ready-for-use condition.

C. Protect equipment from damage during remainder of the construction period.

### 3.3 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain foodservice equipment.

**END OF SECTION**

# SECTION 12 24 13

# ROLLER WINDOW SHADES

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Manually operated, single-roller shades.

### 1.2 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.
   1. Motor-Operated Shades: Include details of installation and diagrams for power, signal, and control wiring.

C. Samples: For each exposed product and for each color and texture specified, 10 inches long.

### 1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For roller shades to include in maintenance manuals.

### 1.4 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.

## 1.5 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.

# PART 2 PRODUCTS

## 2.1 SOURCE LIMITATIONS

A. Obtain roller shades from single source from single manufacturer.

## 2.2 MANUALLY OPERATED, SINGLE-ROLLER SHADES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Hunter Douglas Architectural Window Coverings.
   2. Levolor Inc.
   3. MechoShade Systems, LLC.
   4. Springs Window Fashions; SWFcontract.

B. 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: Manufacturer's standard.
      a. Loop Length: Full length of roller shade.
      b. Limit Stops: Provide upper and lower ball stops.
      c. Chain-Retainer Type: Clip, jamb mount.

C. 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.

D. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.

E. Shadebands:
   1. Shadeband Material: Light-filtering fabric.

F. Installation Accessories:
   1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.
      a. Shape: L-shaped.
      b. Height: Manufacturer's standard height required to conceal roller and shadeband assembly when shade is fully open, but not less than 4 inches.

## 2.3 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: Woven fabric, stain and fade resistant.
   1. Source: Roller shade manufacturer.
   2. Type: [Woven PVC-coated fiberglass and PVC-coated polyester].
   3. Weave: Mesh.
   4. Openness Factor: 3 percent.
   5. Color: As selected by Architect from manufacturer's full range.

## 2.4 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.

C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible, except as follows:
   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.

## 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. 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.

### 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.

**END OF SECTION**

# SECTION 12 36 61.16

# SOLID SURFACING COUNTERTOPS

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Solid surface material countertops.
   2. Solid surface material backsplashes.
   3. Solid surface material end splashes.

### 1.2 ACTION SUBMITTALS

A. Product Data: For countertop materials.

B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.
   1. Show locations and details of joints.
   2. Show direction of directional pattern, if any.

C. Samples for Verification: For the following products:
   1. Countertop material, 6 inches square.

### 1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

### 1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For solid surface material countertops to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

### 1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project, and whose products have a record of successful in-service performance.

B. Installer Qualifications: Fabricator of countertops.

## 1.6 FIELD CONDITIONS

A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

## 1.7 COORDINATION

A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

# PART 2 PRODUCTS

## 2.1 SOLID SURFACE COUNTERTOP MATERIALS

A. Solid Surface Material: Homogeneous-filled plastic resin complying with ISFA 2-01.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Avonite Surfaces; a Brand of Aristech Surfaces LLC.
      b. DuPont; DuPont de Nemours, Inc.
      c. Formica Corporation.
      d. LG Hausys, Ltd.
      e. Wilsonart LLC.
   2. Type: Provide Standard type unless Special Purpose type is indicated.
   3. Colors and Patterns: As selected by Architect from manufacturer's full range.

## 2.2 FABRICATION

A. Fabricate countertops according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WI's "Architectural Woodwork Standards."
   1. Grade: Custom.

B. Countertops:
   1. 1/2-inch- thick, solid surface material with front edge built up with same material.

C. Backsplashes: 1/2-inch- thick, solid surface material.

D. Fabricate tops with shop-applied edges unless otherwise indicated. Comply with solid surface material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
   1. Install integral sink bowls in countertops in the shop.

E. Joints:
   1. Fabricate countertops without joints.
   2. Fabricate countertops in sections for joining in field, with joints at locations indicated on Shop Drawings.
      a. Joint Locations: Not within 18 inches of a sink or cooktop and not where a countertop section less than 36 inches long would result, unless

unavoidable.

F. Cutouts and Holes:
   1. Counter-Mounted Cooktops: Prepare countertops in shop for field cutting openings for cooktops. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.

## 2.3 INSTALLATION MATERIALS

A. Adhesive: Product recommended by solid surface material manufacturer.

B. Sealant for Countertops: Comply with applicable requirements in Section 07 92 00 "Joint Sealants."

# PART 3 EXECUTION

## 3.1 EXAMINATION

A. Examine substrates to receive solid surface material countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.

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

## 3.2 INSTALLATION

A. Install countertops level to a tolerance of 1/8 inch in 8 feet, 1/4 inch maximum. Do not exceed 1/64-inch difference between planes of adjacent units.

B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Predrill holes for screws as recommended by manufacturer. 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. 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.

D. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.

E. 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.

F. 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 particleboard subtops by saturating with varnish.

G. Apply sealant to gaps at walls; comply with Section 07 92 00 "Joint Sealants."

**END OF SECTION**

# SECTION 12 36 61.19

# QUARTZ AGGLOMERATE COUNTERTOPS

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Quartz agglomerate countertops.
   2. Quartz agglomerate backsplashes.
   3. Quartz agglomerate end splashes.

### 1.2 ACTION SUBMITTALS

A. Product Data: For countertop materials.

B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.
   1. Show locations and details of joints.
   2. Show direction of directional pattern, if any.

C. Samples for Verification: For the following products:
   1. Countertop material, 6 inches square.

### 1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

### 1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For quartz agglomerate countertops to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

### 1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project, and whose products have a record of successful in-service performance.

B. Installer Qualifications: Fabricator of countertops.

### 1.6 FIELD CONDITIONS

A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

### 1.7 COORDINATION

A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

## PART 2 PRODUCTS

### 2.1 QUARTZ AGGLOMERATE COUNTERTOP MATERIALS

A. Quartz Agglomerate: Solid sheets consisting of quartz aggregates bound together with a matrix of polymers, resins, and pigment and complying with ISFA 3-01.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Cambria.
      b. DuPont; DuPont de Nemours, Inc.
      c. LG Hausys, Ltd.
      d. TechniStone; Wilsonart LLC.
      e. Wilsonart LLC.
   2. Colors and Patterns: As selected by Architect from manufacturer's full range.

### 2.2 FABRICATION

A. Fabricate countertops according to quartz agglomerate manufacturer's written instructions and the AWI/AWMAC/WI's "Architectural Woodwork Standards."
   1. Grade: Custom.

B. Configuration:
   1. Front:.
   2. Backsplash:.
   3. End Splash: Matching backsplash.

C. Countertops: 1/2-inch- thick, quartz agglomerate with front edge built up with same material.

D. Backsplashes: 1/2-inch- thick, quartz agglomerate.

E. Fabricate tops with shop-applied edges and backsplashes unless otherwise indicated. Comply with quartz agglomerate manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
   1. Fabricate with loose backsplashes for field assembly.

F. Joints:
   1. Fabricate countertops without joints.
   2. Fabricate countertops in sections for joining in field.
      a. Joint Locations: Not within 18 inches of a sink or cooktop and not where a countertop section less than 36 inches long would result, unless unavoidable.
      b. Joint Type, Bonded: 1/32 inch or less in width.

G. Cutouts and Holes:
   1. Counter-Mounted Cooktops: Prepare countertops in shop for field cutting openings for cooktops. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.

## 2.3 INSTALLATION MATERIALS

A. Adhesive: Product recommended by quartz agglomerate manufacturer.

B. Sealant for Countertops: Comply with applicable requirements in Section 07 92 00 "Joint Sealants."

# PART 3 EXECUTION

## 3.1 EXAMINATION

A. Examine substrates to receive quartz agglomerate countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.

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

## 3.2 INSTALLATION

A. Install countertops level to a tolerance of 1/8 inch in 8 feet, 1/4 inch maximum. Do not exceed 1/64-inch difference between planes of adjacent units.

B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Predrill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with quartz agglomerate manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

C. Secure countertops to subtops with adhesive according to quartz agglomerate manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with quartz agglomerate manufacturer's written instructions. Carefully dress joints smooth, remove surface

scratches, and clean entire surface.

D. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.

E. 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.

F. 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 particleboard subtops by saturating with varnish.

G. Apply sealant to gaps at walls; comply with Section 07 92 00 "Joint Sealants."

**END OF SECTION**

# SECTION 14 21 23.16

# MACHINE ROOM-LESS ELECTRIC TRACTION PASSENGER ELEVATORS

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Machine-room-less electric traction elevators.

### 1.2 DEFINITIONS

A. Definitions in ASME A17.1/CSA B44 apply to work of this Section.

B. Service Elevator: A passenger elevator that is also used to carry freight.

### 1.3 ACTION SUBMITTALS

A. Product Data Submittals: For each product.
   1. Include capacities, sizes, performances, operations, safety features, finishes, and similar information.
   2. Include Product Data for car enclosures, hoistway entrances, and operation, control, and signal systems.

B. Shop Drawings:
   1. Include plans, elevations, sections, and large-scale details indicating service at each landing, coordination with building structure, relationships with other construction, and locations of equipment.
   2. Include large-scale layout of car-control station and standby power operation control panel.
   3. Indicate maximum dynamic and static loads imposed on building structure at points of support, and maximum and average power demands.

C. Samples for Verification: For exposed car, hoistway door and frame, and signal equipment finishes; 3-inch- square Samples of sheet materials; and 4-inch lengths of running trim members.

### 1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Seismic Qualification Certificates: For elevator equipment, accessories, and components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway and pit layout and dimensions, as indicated on Drawings, and electrical service including standby power generator, as shown and specified, are adequate for elevator system being provided.

D. Sample Warranty: For special warranty.

## 1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.
   1. Submit manufacturer's or Installer's standard operation and maintenance manual, in accordance with ASME A17.1/CSA B44 including diagnostic and repair information available to manufacturer's and Installer's maintenance personnel.

B. Continuing Maintenance Proposal:
   1. Submit a continuing maintenance proposal from Installer to Owner, in the form of a standard one-year maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.
   2. Submit a continuing maintenance proposal from Installer to Owner with terms, conditions, and obligations as set forth in, and in same form as, a "Draft of Elevator Maintenance Agreement" at end of this Section, starting on date initial maintenance service is concluded.

## 1.6 QUALITY ASSURANCE

A. Installer Qualifications: Elevator manufacturer or an authorized representative who is trained and approved by manufacturer.

## 1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle materials, components, and equipment in manufacturer's protective packaging. Store materials, components, and equipment off of ground, under cover, and in a dry location.

## 1.8 COORDINATION

A. Coordinate installation of inserts, sleeves, block outs, elevator equipment with integral anchors, and other items that are embedded in concrete or masonry for elevator equipment. Furnish templates, inserts, sleeves, elevator equipment with integral anchors, and installation instructions and deliver to Project site in time for installation.

B. Coordinate locations and dimensions of work specified in other Sections that relates to electric traction elevators including pit ladders; sumps and floor drains in pits; entrance subsills; electrical service; and electrical outlets, lights, and switches in hoistways and pits.

## 1.9 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair, restore, or replace elevator work that fails in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.
   2. Warranty Period: one (1) year(s) from date of Substantial Completion.

# PART 2 PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with ASME A17.1/CSA B44.

B. Accessibility Requirements: Comply with requirements for accessible elevators in the United States Access Board's ADA-ABA Accessibility Guidelines and with ICC A117.1.

C. Seismic Performance: Elevator system shall withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7 and shall comply with elevator seismic requirements in ASME A17.1/CSA B44.
   1. The term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified and the system will be fully operational after the seismic event."
   2. Project Seismic Design Category: C.
   3. Elevator Component Importance Factor: 1.5.
   4. Provide earthquake equipment required by ASME A17.1/CSA B44.
   5. Provide seismic switch required by ASCE/SEI 7.

## 2.2 ELEVATORS

A. Elevator System, General: Manufacturer's standard elevator systems. Unless otherwise indicated, manufacturer's standard components shall be used, as included in standard elevator systems and as required for complete system.

B. Elevator Description:
   1. Group Number:.
      a. Group 1: Elevators 1 and 2.
      b. Group 2: Elevator 3.
   2. Emergency Elevator Number(s): Elevator 3.
   3. Service Elevator Number(s): Elevators 1 and 2.
   4. Rated Load:.
      a. Elevators 1 and 2: 2,100 lbs.
      b. Elevator 3: 3,500 lbs.
   5. Freight Loading Class for Service Elevator(s): Class A.
   6. Rated Speed: 150 fpm.
   7. Operation System: Group automatic operation.
   8. Auxiliary Operations:
      a. Standby power operation.
      b. Earthquake Emergency Operation: Comply with requirements in ASME A17.1/CSA B44.
   9. Security Features: [Card-reader operation], [Keypad operation], and [Car-to-lobby feature].
   10. Car Enclosures:
      a. Inside Width: Not less than 70 inches from side wall to side wall.
      b. Inside Depth: Not less than 53 inches from back wall to front wall (return panels).
      c. Inside Height: Not less than 93 inches to underside of ceiling.
      d. Front Walls (Return Panels): Satin stainless steel, ASTM A480/A480M, No. 4 finish.
      e. Car Fixtures: Satin stainless steel, ASTM A480/A480M, No. 4 finish.
      f. Side and Rear Wall Panels: Plastic laminate.
      g. Reveals: Satin stainless steel, ASTM A480/A480M, No. 4 finish.
      h. Door Faces (Interior): Satin stainless steel, ASTM A480/A480M, No. 4 finish.
      i. Door Sills: Aluminum.
      j. Ceiling: Satin stainless steel, ASTM A480/A480M, No. 4 finish.
      k. Handrails: 1/2 by 2 inches rectangular satin stainless steel, at sides and rear of car.
      l. Floor recessed and prepared to flooring specified in Section 09 6 23 - Resinous Matrix Terrazzo Flooring.
   11. Hoistway Entrances:
      a. Width: 90 inches.
      b. Height: 84 inches.
      c. Type: Single-speed center opening.
      d. Frames: Satin stainless steel, ASTM A480/A480M, No. 4 finish.
      e. Doors and Transoms: Satin stainless steel, ASTM A480/A480M, No. 4 finish.
      f. Sills: Aluminum.

12. Hall Fixtures: Satin stainless steel, ASTM A480/A480M, No. 4 finish.
13. Additional Requirements:
    a. Provide inspection certificate in each car, mounted under acrylic cover with frame made from satin stainless steel, ASTM A480/A480M, No. 4 finish.
    b. Provide hooks for protective pads in service car and one complete set(s) of full-height protective pads.

## 2.3 MACHINE ROOM-LESS ELECTRIC TRACTION ELEVATORS

A. HYPERLINK "http://www.specagent.com/LookUp/?ulid=15517&mf=04&src=wd" Basis-of-Design Product: Subject to compliance with requirements, provide Schindler Elevator Corp; 3300 MRL, Traction, or comparable product by one of the following:
   1. Otis Worldwide Corporation.
   2. ThyssenKrupp Elevator.

B. Source Limitations: Obtain elevators from single manufacturer.
   1. Major elevator components, including driving machines, controllers, signal fixtures, door operators, car frames, cars, and entrances, shall be manufactured by single manufacturer.

## 2.4 TRACTION SYSTEMS

A. Elevator Machines: Permanent magnet, variable-voltage, variable-frequency, ac-type hoisting machines and solid-state power converters.
   1. Provide regenerative or nonregenerative system.
   2. Limit total harmonic distortion of regenerated power to 5 percent in accordance with IEEE 519.
   3. Provide means for absorbing regenerated power when elevator system is operating on standby power.
   4. Provide line filters or chokes to prevent electrical peaks or spikes from feeding back into building power system.

B. Fluid for Hydraulic Buffers: Fire-resistant fluid.

C. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work. Device installation is specified in another Section.

D. Machine Beams: Provide steel framing to support elevator hoisting machine and deflector sheaves from the building structure. Comply with Section 05 50 00 "Metal Fabrications" for materials and fabrication.

E. Car Frame and Platform: Bolted- or welded-steel units.

F. Guides: Roller guides or polymer-coated, nonlubricated sliding guides. Provide guides at top and bottom of car and counterweight frames.

## 2.5 OPERATION SYSTEMS

A. Provide manufacturer's standard microprocessor operation systems as required to provide type of operation indicated.

B. Group Automatic Operation with Demand-Based Dispatching: Provide reprogrammable group automatic system that assigns cars to hall calls based on a dispatching program designed to minimize passenger wait time. System automatically adjusts to demand changes for different traffic conditions including heavy incoming, heavy two-way, heavy outgoing, and light off-hours as variations of normal two-way traffic.

C. Auxiliary Operations:
   1. Group Standby Power Operation:
      a. On activation of standby power, cars are returned to a designated floor and parked with doors open. One car is returned at a time, with priority given to loaded cars. If a car cannot be returned after two attempts, it is removed from the system. When all cars have been returned or removed from the system, one car is automatically placed in service. If car selected for service cannot operate within 60 seconds, the system removes car from service and places another car in service. Cars can be manually put in service on standby power, either for return operation or for regular operation, by switches in control panel located at main lobby. Manual operation causes automatic operation to cease.
      b. On activation of standby power, cars are returned, one at a time, to a designated floor and parked with doors open. If a car cannot be returned, it is removed from the system. When all cars have been returned or removed from the system, one car can be put in service on standby power by a selector switch in control panel located at main lobby.
   2. Automatic Dispatching of Loaded Car: When car load exceeds 80 percent of rated capacity, doors begin closing.
   3. Loaded-Car Bypass: When car load exceeds 80 percent of rated capacity, car responds only to car calls, not to hall calls.
   4. Distributed Parking: When cars are not required for response to calls, they are parked with doors closed and distributed in predetermined zones throughout the building. One zone to include the main floor and adjacent floors; remaining floors to be divided into approximately equal zones.

D. Security features may not affect emergency firefighters' service.
   1. Card-Reader Operation: System uses card readers at car-control stations and hall push-button stations to authorize calls. Security system determines which landings and at what times calls require authorization by card reader. Provide required conductors in traveling cable and panel in machine room for interconnecting card readers, other security access system equipment, and elevator controllers. Allow space for card reader in car.
      a. Security access system equipment is specified in Section 28 15 00 "Access Control Hardware Devices."
   2. Keyswitch Operation: Push buttons are activated and deactivated by security

keyswitches at car-control stations and hall push-button stations. Key is removable position.

3. Keypad Operation: Allows each landing to be restricted or unrestricted. When a restricted landing button is pressed, a "Restricted Floor" lamp lights and remains lit until landing access code has been entered into a keypad or predetermined time has elapsed. Car calls for restricted landings do not register until landing access code is entered into keypad within predetermined time after landing button is pressed.
    a. Access codes are programmed at each car operating panel using a security keyswitch. Keypad operation can be activated and deactivated by security keyswitch at main landing.
4. Car-to-Lobby Feature: Feature, activated by keyswitch at main lobby, that causes all cars in a group to return immediately to lobby and open doors for inspection. On deactivation by keyswitch, calls registered before keyswitch activation are completed and normal operation is resumed.

## 2.6 DOOR REOPENING DEVICES

A. Infrared Array: Provide door reopening device with uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more light beams causes doors to stop and reopen.

B. Nudging Feature: After car doors are prevented from closing for predetermined adjustable time, through activating door reopening device, a loud buzzer sounds and doors begins to close at reduced kinetic energy.

## 2.7 CAR ENCLOSURES

A. Provide enameled or powder-coated steel car enclosures to receive removable wall panels, with removable car roof, access doors, power door operators, and ventilation.
    1. Provide standard railings complying with ASME A17.1/CSA B44 on car tops where required by ASME A17.1/CSA B44.
    2. See "Elevator Car Allowances" Paragraph in "Allowances" Article for items to be provided under the Elevator Car Allowance. Provide items not included in the Elevator Car Allowance as needed for finished car including materials and finishes specified below.

B. Materials and Finishes: Manufacturer's standards, but not less than the following:
    1. Subfloor:
        a. Exterior, underlayment grade plywood, not less than 5/8-inch nominal thickness.
        b. Exterior, C-C Plugged grade plywood, not less than 7/8-inch nominal thickness.
    2. Floor Finish:
        a. Refer to Section 09 66 23 - Resinous Matrix Terrazzo Flooring.
    3. Stainless Steel Wall Panels: Flush, formed-metal construction; fabricated from stainless steel sheet.

4. Fabricate car with recesses and cutouts for signal equipment.
5. Fabricate car door frame integrally with front wall of car.
6. Stainless Steel Doors: Flush, hollow-metal construction; fabricated from stainless steel sheet.
7. Sight Guards: Provide sight guards on car doors.
8. Sills: Extruded or machined metal, with grooved surface, 1/4 inch thick.
9. Luminous Ceiling: LED light fixtures and ceiling panels of translucent acrylic or other permanent rigid plastic.
10. Light Fixture Efficiency: Not less than 35 lumens/W.
11. Ventilation Fan Efficiency: Not less than 3.0 cfm/W.

## 2.8 HOISTWAY ENTRANCES

A. Hoistway Entrance Assemblies: Manufacturer's standard horizontal-sliding, door-and-frame hoistway entrances complete with track systems, hardware, sills, and accessories. Frame size and profile to accommodate hoistway wall construction.
   1. Where gypsum board wall construction is indicated, frames to be self-supporting with reinforced head sections.

B. Fire-Rated Hoistway Entrance Assemblies: Door and frame assemblies to comply with NFPA 80 and be listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction based on testing at as close-to-neutral pressure as possible in accordance with NFPA 252 or UL 10B.
   1. Fire-Protection Rating: 1-1/2 hours.

C. Materials and Fabrication: Manufacturer's standards, but not less than the following:
   1. Steel Subframes: Formed from cold- or hot-rolled steel sheet, with factory-applied enamel or powder-coat finish or rust-resistant primer. Fabricate to receive applied finish as indicated.
   2. Stainless Steel Frames: Formed from stainless steel sheet.
   3. Star of Life Symbol: Identify emergency elevators with star of life symbol, not less than 3 inches high, on both jambs of hoistway door frames.
   4. Stainless Steel Doors and Transoms: Flush, hollow-metal construction; fabricated from stainless steel sheet.
   5. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M.

## 2.9 SIGNAL EQUIPMENT

A. Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Provide vandal-resistant buttons and lighted elements illuminated with LEDs.

B. Car-Control Stations: Provide manufacturer's standard recessed car-control stations. Mount in return panel adjacent to car door unless otherwise indicated.
   1. Mark buttons and switches for required use or function. Use both tactile symbols and Braille.
   2. Provide "No Smoking" sign matching car-control station, either integral with car-control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.

C. Swing-Return Car-Control Stations: Provide car-control stations mounted on rear of hinged return panel adjacent to car door and with buttons, switches, controls, and indicator lights projecting through return panel but substantially flush with face of return panel.
   1. Mark buttons and switches for function. Use both tactile symbols and Braille.
   2. Provide "No Smoking" sign matching car-control station, either integral with car-control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.

D. Emergency Communication System: Two-way voice communication system, with visible signal, which dials preprogrammed number of monitoring station and does not require handset use. System is contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply.

E. Car Position Indicator: Provide illuminated, digital-type car position indicator, located above car door or above car-control station. Also, provide audible signal to indicate to passengers that car is either stopping at or passing each of the floors served. Include travel direction arrows if not provided in car-control station.

F. Hall Push-Button Stations: Provide one hall push-button station at each landing for each single elevator or group of elevators, but not less than one station for each four elevators in a group.
   1. Provide units with flat faceplate for mounting with body of unit recessed in wall.
   2. Equip units with buttons for calling elevator and for indicating desired direction of travel.
      a. Provide for connecting units to building security access system so a card reader can be used to register calls.
   3. Provide telephone jack in each unit for firefighters' two-way telephone communication service specified in Section 28 46 21.11 "Addressable Fire-Alarm Systems."

G. Hall Lanterns: Units with illuminated arrows; but provide single arrow at terminal landings. Provide one of the following:
   1. Manufacturer's standard wall-mounted units, for mounting above entrance frames.
   2. Units with flat faceplate for mounting with body of unit recessed in wall and with illuminated elements projecting from faceplate for ease of angular viewing.
   3. Units mounted in both jambs of entrance frame for each elevator.
   4. Units mounted in both car door jambs; may be used only for single elevators or for two-car groups.

H. Hall Annunciator: With each hall lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.
   1. At manufacturer's option, audible signals may be placed on cars.

I. Standby Power Elevator Selector Switches: Provide switches, as required by ASME A17.1/CSA B44, where indicated. Adjacent to switches, provide illuminated signal that indicates when normal power supply has failed.

J. Fire-Command-Center Annunciator Panel: Provide panel containing illuminated position indicators for each elevator, clearly labeled with elevator designation; include illuminated signal that indicates when elevator is operational and when it is at the designated emergency return level with doors open. Provide standby power elevator selector switch(es), as required by ASME A17.1/CSA B44, adjacent to position indicators. Provide illuminated signal that indicates when normal power supply has failed.

K. Emergency Pictorial Signs: Fabricate from materials matching hall push-button stations, with text and graphics as required by authorities having jurisdiction, indicating that in case of fire, elevators are out of service and exits should be used instead. Provide one sign at each hall push-button station unless otherwise indicated.

## 2.10 FINISH MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, commercial steel, Type B, exposed, matte finish.

B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, commercial steel, Type B, pickled.

C. Stainless Steel Sheet: ASTM A240/A240M, Type 304.

D. Stainless Steel Bars: ASTM A276/A276M, Type 304.

E. Stainless Steel Tubing: ASTM A554, Grade MT 304.

F. Aluminum Extrusions: ASTM B221, Alloy 6063.

G. Plastic Laminate: High-pressure type complying with ISO 4586-3, Type HGS for flat applications.

# PART 3 EXECUTION

## 3.1 EXAMINATION

A. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Examine hoistways, hoistway openings, and pits as constructed; verify critical

dimensions; and examine supporting structure and other conditions under which elevator work is to be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

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

## 3.2 INSTALLATION OF MACHINE ROOM-LESS ELECTRIC TRACTION ELEVATORS

A. Comply with manufacturer's written instructions.

B. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualifications of welding operators.

C. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts to minimize vibration transmission to structure and structure-borne noise due to elevator system.

D. Lubricate operating parts of systems, including ropes, as recommended by manufacturers.

E. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay final adjustment of sills and doors until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.

F. Leveling Tolerance: 1/8 inch, up or down, regardless of load and travel direction.

G. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.

H. Locate hall signal equipment for elevators as follows unless otherwise indicated:
   1. For groups of elevators, locate hall push-button stations between two elevators at center of group or at location most convenient for approaching passengers.
   2. Place hall lanterns either above or beside each hoistway entrance.
   3. Mount hall lanterns at a minimum of 72 inches above finished floor.

## 3.3 FIELD QUALITY CONTROL

A. Acceptance Testing: On completion of elevator installation and before permitting elevator use (either temporary or permanent), perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by governing regulations and agencies.

B. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times that tests are to be performed on elevators.

## 3.4 PROTECTION

A. Temporary Use: Limit temporary use for construction purposes to one elevator. Comply with the following requirements for elevator used for construction purposes:
   1. Provide car with temporary enclosure, either within finished car or in place of finished car, to protect finishes from damage.
   2. Provide strippable protective film on entrance and car doors and frames.
   3. Provide padded wood bumpers on entrance door frames covering jambs and frame faces.
   4. Provide other protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
   5. Do not load elevators beyond their rated weight capacity.
   6. Engage elevator Installer to provide full maintenance service. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleanup, and adjustment as necessary for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
   7. Engage elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

## 3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate, adjust, and maintain elevator(s).

B. Check operation of each elevator with Owner's personnel present before date of Substantial Completion and again not more than one month before end of warranty period. Determine that operation systems and devices are functioning properly.

## 3.6 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service to include 12 months' full maintenance by skilled employees of elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation at rated speed and capacity. Parts and supplies to be manufacturer's authorized replacement parts and supplies.
   1. Perform maintenance during normal working hours.
   2. Perform emergency callback service during normal working hours with response time of two hours or less.
   3. Include 24-hour-per-day, 7-day-per-week emergency callback service with response time of two hours or less.

**END OF SECTION**

# SECTION 210517 - SLEEVES AND SLEEVE SEALS FOR FIRE-SUPPRESSION PIPING

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. Section Includes:

1. Sleeves.
2. Stack-sleeve fittings.
3. Sleeve-seal systems.
4. Sleeve-seal fittings.
5. Grout.
6. Silicone sealants.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

### 1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

## PART 2 - PRODUCTS

### 2.1 SLEEVES

A. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop.

B. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, with plain ends and integral welded waterstop collar.

C. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

D. PVC Pipe Sleeves: ASTM D 1785, Schedule 40.

E. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

F. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

## 2.2 STACK-SLEEVE FITTINGS

A. Description: Manufactured, cast-iron sleeve with integral clamping flange for use in waterproof floors and roofs. Include clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

## 2.3 SLEEVE-SEAL SYSTEMS

A. Description:

1. Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
2. Designed to form a hydrostatic seal of 20 psig minimum.
3. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size.
4. Pressure Plates: Carbon steel, Composite plastic, Stainless steel, Stainless steel, Type 316.
5. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, ASTM B 633, Stainless steel, Stainless steel, Type 316, of length required to secure pressure plates to sealing elements.

## 2.4 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall.

B. Plastic or rubber waterstop collar with center opening to match piping OD.

## 2.5 GROUT

A. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

## 2.6 SILICONE SEALANTS

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

B. Silicone, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade P, Class 25, Uses T and NT. Grade P Pourable (self-leveling) formulation is for opening in floors and other horizontal surfaces that are not fire rated.

C. Silicone Foam: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

# PART 3 - EXECUTION

## 3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
2. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

3. Using grout or silicone sealant, seal space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint.

E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

## 3.2 STACK-SLEEVE-FITTING INSTALLATION

A. Install stack-sleeve fittings in new slabs as slabs are constructed.

1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
5. Use silicone sealant to seal around the outside of stack-sleeve fittings.

B. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of floors at pipe penetrations. Seal pipe penetrations with fire- or smoke-stop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

## 3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Use grout or silicone sealant, to seal the space around outside of sleeve-seal fittings.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.

B. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.6 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:

a. Piping Smaller Than NPS 6: Cast-iron pipe sleeves or Steel pipe sleeves or Sleeve-seal fittings.
b. Piping NPS 6 and Larger: Cast-iron pipe sleeves, Steel pipe sleeves or Sleeve-seal fittings.

2. Exterior Concrete Walls below Grade:

a. Piping Smaller Than NPS 6: Cast-iron pipe sleeves with sleeve-seal system, Steel pipe sleeves with sleeve-seal system, or Sleeve-seal fittings.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

b. Piping NPS 6 and Larger: Cast-iron pipe sleeves with sleeve-seal system or Steel pipe sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs-on-Grade:

    a. Piping Smaller Than NPS 6: Cast-iron pipe sleeves with sleeve-seal system or Steel pipe sleeves with sleeve-seal system or Sleeve-seal fittings.

        1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

    b. Piping NPS 6 and Larger: Cast-iron pipe sleeves with sleeve-seal system or Steel pipe sleeves with sleeve-seal system or Sleeve-seal fittings.

        1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

4. Concrete Slabs above Grade:

    a. Piping Smaller Than NPS 6: Steel pipe sleeves, PVC pipe sleeves, Stack-sleeve fittings, Sleeve-seal fittings, Molded-PE or -PP sleeves Molded-PVC sleeves.
    b. Piping NPS 6 and Larger: Steel pipe sleeves, PVC pipe sleeves, Stack-sleeve fittings.

5. Interior Partitions:

    a. Piping Smaller Than NPS 6: Steel pipe sleeves or PVC pipe sleeves.
    b. Piping NPS 6 and Larger: Galvanized-steel sheet sleeves.

END OF SECTION 210517

# SECTION 210518 - ESCUTCHEONS FOR FIRE-SUPPRESSION PIPING

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. Section Includes:

1. Escutcheons.
2. Floor plates.

### 1.3 DEFINITIONS

A. Existing Piping to Remain: Existing piping that is not to be removed and that is not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

### 1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

### 2.2 ESCUTCHEONS

A. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.

B. One-Piece, Stainless-Steel Type: With polished stainless-steel finish.

C. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.

D. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped steel with polished, chrome-plated finish and spring-clip fasteners.

E. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.

F. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed hinge; and spring-clip fasteners.

## 2.3 FLOOR PLATES

A. Split Floor Plates: Steel with concealed hinge.

# PART 3 - EXECUTION

## 3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. Escutcheons for New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.
b. Chrome-Plated Piping: One-piece steel, cast brass or split-plate steel with polished, chrome-plated finish.
c. Insulated Piping: One-piece steel with polished, chrome-plated finish.
d. Insulated Piping: One-piece stainless steel with polished stainless-steel finish.
e. Insulated Piping: One-piece cast brass with polished, chrome-plated finish.
f. Insulated Piping: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
g. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish.
h. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece stainless steel with polished stainless-steel finish.
i. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece cast brass with polished, chrome-plated finish.
j. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
k. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish.
l. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece stainless steel with polished stainless-steel finish.

m. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece cast brass with polished, chrome-plated finish.
n. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece stamped steel with polished, chrome-plated finish.
o. Bare Piping in Unfinished Service Spaces: One-piece steel with polished, chrome-plated finish.
p. Bare Piping in Unfinished Service Spaces: One-piece cast brass with polished, chrome-plated finish.
q. Bare Piping in Unfinished Service Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge or split-plate, stamped steel with exposed-rivet hinge with polished, chrome-plated finish.
r. Bare Piping in Equipment Rooms: One-piece steel with polished, chrome-plated finish.
s. Bare Piping in Equipment Rooms: One-piece cast brass with polished, chrome-plated finish.
t. Bare Piping in Equipment Rooms: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. New Piping: One-piece, floor plate.
2. Existing Piping: Split floor plate.

## 3.2 FIELD QUALITY CONTROL

A. Using new materials, replace broken and damaged escutcheons and floor plates.

END OF SECTION 210518

# SECTION 210523 - GENERAL-DUTY VALVES FOR FIRE PROTECTION PIPING

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. Section Includes:

1. Two-piece ball valves with indicators.
2. Bronze butterfly valves with indicators.
3. Iron butterfly valves with indicators.
4. Check valves.
5. Bronze OS&Y gate valves.
6. Iron OS&Y gate valves.
7. NRS gate valves.
8. Indicator posts.
9. Trim and drain valves.

### 1.3 DEFINITIONS

A. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

B. NRS: Nonrising stem.

C. OS&Y: Outside screw and yoke.

D. SBR: Styrene-butadiene rubber.

### 1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.

### 1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, and weld ends.
3. Set valves open to minimize exposure of functional surfaces.

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 operating handles or stems as lifting or rigging points.

D. Protect flanges and specialties from moisture and dirt.

## PART 2 - PRODUCTS

### 2.1 GENERAL REQUIREMENTS FOR VALVES

A. UL Listed: Valves shall be listed in UL's "Online Certifications Directory" under the headings listed below and shall bear UL mark:

1. Main Level: HAMV - Fire Main Equipment.

a. Level 1: HCBZ - Indicator Posts, Gate Valve.
b. Level 1: HLOT - Valves.

1) Level 3: HLUG - Ball Valves, System Control.
2) Level 3: HLXS - Butterfly Valves.
3) Level 3: HMER - Check Valves.
4) Level 3: HMRZ - Gate Valves.

2. Main Level: VDGT - Sprinkler System & Water Spray System Devices.

a. Level 1: VQGU - Valves, Trim and Drain.

B. FM Global Approved: Valves shall be listed in its "Approval Guide," under the headings listed below:

1. Automated Sprinkler Systems:

a. Indicator posts.
b. Valves.

1) Gate valves.
2) Check valves.

a) Single check valves.

3) Miscellaneous valves.

C. Source Limitations for Valves: Obtain valves for each valve type from single manufacturer.

D. ASME Compliance:

1. ASME B16.1 for flanges on iron valves.
2. ASME B1.20.1 for threads for threaded-end valves.
3. ASME B31.9 for building services piping valves.

E. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.

F. NFPA Compliance: Comply with NFPA 24 for valves.

G. Valve Pressure Ratings: Not less than the minimum pressure rating indicated or higher as required by system pressures.

H. Valve Sizes: Same as upstream piping unless otherwise indicated.

I. Valve Actuator Types:

1. Worm-gear actuator with handwheel for quarter-turn valves, except for trim and drain valves.
2. Handwheel: For other than quarter-turn trim and drain valves.
3. Handlever: For quarter-turn trim and drain valves NPS 2 and smaller.

## 2.2 TWO-PIECE BALL VALVES WITH INDICATORS

A. Description:

1. UL 1091, except with ball instead of disc and FM Global standard for indicating valves (butterfly or ball type), Class Number 1112.
2. Minimum Pressure Rating: 175 psig.
3. Body Design: Two piece.
4. Body Material: Forged brass or bronze.
5. Port Size: Full or standard.
6. Seats: PTFE.
7. Stem: Bronze or stainless steel.
8. Ball: Chrome-plated brass.
9. Actuator: Worm gear or traveling nut.
10. Supervisory Switch: Internal or external.
11. End Connections for Valves NPS 1 through NPS 2: Threaded ends.
12. End Connections for Valves NPS 2-1/2: Grooved ends.

## 2.3 BRONZE BUTTERFLY VALVES WITH INDICATORS

A. Description:

1. Standard: UL 1091 and FM Global standard for indicating valves, (butterfly or ball type), Class Number 1112.
2. Minimum: Pressure rating: 175 psig.
3. Body Material: Bronze.
4. Seat Material: EPDM.
5. Stem Material: Bronze or stainless steel.
6. Disc: Bronze or Stainless steel.
7. Actuator: Worm gear or traveling nut.
8. Supervisory Switch: Internal or external.
9. Ends Connections for Valves NPS 1 through NPS 2: Threaded ends.
10. Ends Connections for Valves NPS 2-1/2: Grooved ends.

## 2.4 IRON BUTTERFLY VALVES WITH INDICATORS

A. Description:

1. Standard: UL 1091 and FM Global standard for indicating valves, (butterfly or ball type), Class Number 112.
2. Minimum Pressure Rating: 175 psig.
3. Body Material: Cast or ductile iron.
4. Seat Material: EPDM.
5. Stem: Stainless steel.
6. Disc: Ductile iron.
7. Actuator: Worm gear or traveling nut.
8. Supervisory Switch: Internal or external.
9. Body Design: Lug or wafer or Grooved-end connections.

## 2.5 CHECK VALVES

A. Description:

1. Standard: UL 312 and FM Global standard for swing check valves, Class Number 1210.
2. Minimum Pressure Rating: 175 psig.
3. Type: Single swing check.
4. Body Material: Cast iron, ductile iron, or bronze.
5. Clapper: Bronze, ductile iron, or stainless steel.
6. Clapper Seat: Brass, bronze, or stainless steel.
7. Hinge Shaft: Bronze or stainless steel.
8. Hinge Spring: Stainless steel.
9. End Connections: Flanged, grooved, or threaded.

## 2.6 BRONZE OS&Y GATE VALVES

A. Description:

1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
2. Minimum Pressure Rating: 175 psig.
3. Body and Bonnet Material: Bronze or brass.
4. Wedge: One-piece bronze or brass.
5. Wedge Seat: Bronze.
6. Stem: Bronze or brass.
7. Packing: Non-asbestos PTFE.
8. Supervisory Switch: External.
9. End Connections: Threaded.

## 2.7 IRON OS&Y GATE VALVES

A. Description:

1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
2. Minimum Pressure Rating: 175 psig.
3. Body and Bonnet Material: Cast or ductile iron.
4. Wedge: Cast or ductile iron, or bronze.
5. Wedge Seat: Cast or ductile iron, or bronze.
6. Stem: Brass or bronze.
7. Packing: Non-asbestos PTFE.
8. Supervisory Switch: External.
9. End Connections: Flanged or Grooved or Threaded.

## 2.8 NRS GATE VALVES

A. Description:

1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
2. Minimum Pressure Rating: 175 psig.
3. Body and Bonnet Material: Cast or ductile iron.
4. Wedge: Cast or ductile iron.
5. Wedge Seat: Cast or ductile iron, or bronze.
6. Stem: Brass or bronze.
7. Packing: Non-asbestos PTFE.
8. Supervisory Switch: External.
9. End Connections: Flanged or Grooved or Threaded.

2.9 TRIM AND DRAIN VALVES

A. Ball Valves:
1. Description:

a. Pressure Rating: 175 psig.
b. Body Design: Two piece.
c. Body Material: Forged brass or bronze.
d. Port size: Full or standard.
e. Seats: PTFE.
f. Stem: Bronze or stainless steel.
g. Ball: Chrome-plated brass.
h. Actuator: Handlever.
i. End Connections for Valves NPS 1 through NPS 2-1/2: Threaded ends.
j. End Connections for Valves NPS 1-1/4 and NPS 2-1/2: Grooved ends.

B. Angle Valves:
1. Description:

a. Pressure Rating: 175 psig.
b. Body Material: Brass or bronze.
c. Ends: Threaded.
d. Stem: Bronze.
e. Disc: Bronze.
f. Packing: Asbestos free.
g. Handwheel: Malleable iron, bronze, or aluminum.

C. Globe Valves:
1. Description:

a. Pressure Rating: 175 psig.
b. Body Material: Bronze with integral seat and screw-in bonnet.
c. Ends: Threaded.
d. Stem: Bronze.
e. Disc Holder and Nut: Bronze.
f. Disc Seat: Nitrile.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron, bronze, or aluminum.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

## 3.2 GENERAL REQUIREMENTS FOR VALVE INSTALLATION

A. Comply with requirements in the following Sections for specific valve installation requirements and applications:

1. Section 211100 "Facility Fire-Suppression Water-Service Piping" for application of valves in fire-suppression water-service piping outside the building.
2. Section 211200 "Fire-Suppression Standpipes" for application of valves in fire-suppression standpipes.
3. Section 211313 "Wet-Pipe Sprinkler Systems" for application of valves in wet-pipe, fire-suppression sprinkler systems.
4. Section 211316 "Dry-Pipe Sprinkler Systems" for application of valves in dry-pipe, fire-suppression sprinkler systems.
5. Section 211339 "Foam-Water Systems" for application of valves in AFFF piping.

B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Install valves having threaded connections with unions at each piece of equipment arranged to allow easy access, service, maintenance, and equipment removal without system shutdown. Provide separate support where necessary.

E. Install valves in horizontal piping with stem at or above the pipe center.

F. Install valves in position to allow full stem movement.

G. Install valve tags. Comply with requirements in Section 210553 "Identification for Fire-Suppression Piping and Equipment" for valve tags and schedules and signs on surfaces concealing valves; and the NFPA standard applying to the piping system in which valves are installed. Install permanent identification signs indicating the portion of system controlled by each valve.

H. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire-department connections.

I. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

END OF SECTION 210523

# SECTION 210529 - HANGERS AND SUPPORTS FOR FIRE SUPRESSION PIPING AND EQUIPMENT

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal hanger-shield inserts.
5. Fastener systems.
6. Equipment supports.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 210516 "Expansion Fittings and Loops for Fire-Suppression Piping" for pipe guides and anchors.
3. Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment" for vibration isolation devices and seismic restraints.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Equipment supports.

C. Delegated-Design Submittal: For trapeze hangers 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. Detail fabrication and assembly of trapeze hangers.
2. Include design calculations for designing trapeze hangers.

## 1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

## 1.5 QUALITY ASSURANCE

A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.

B. Pipe Welding Qualifications: Qualify procedures and operators according to 2015 ASME Boiler and Pressure Vessel Code, Section IX.

# PART 2 - PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design trapeze pipe hangers and equipment supports.

B. Structural Performance: Hangers and supports for fire-suppression 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.
3. Design seismic-restraint hangers and supports for piping and equipment.

C. NFPA Compliance: Comply with NFPA 13.

D. UL Compliance: Comply with UL 203.

## 2.2 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: Factory-fabricated components, NFPA approved, UL listed, or FM approved for fire-suppression piping support.
2. Galvanized Metallic Coatings: Pregalvanized or hot-dip galvanized.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Copper Pipe and Tube Hangers:

1. Description: Copper-coated-steel, factory-fabricated components, NFPA approved, UL listed, or FM approved for fire-suppression piping support.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

## 2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly, made from structural-carbon-steel shapes, with NFPA-approved, UL-listed, or FM-approved carbon-steel hanger rods, nuts, saddles, and U-bolts.

## 2.4 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:
1. Description: Shop- or field-fabricated pipe-support assembly, made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
2. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.
3. Channels: Continuous slotted carbon-steel channel with inturned lips.
4. Channel Width: Selected for applicable load criteria.
5. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Metallic Coating: No coating.
8. Paint Coating: Green epoxy, acrylic, or urethane.

B. Non-MFMA Manufacturer Metal Framing Systems:
1. Description: Shop- or field-fabricated pipe-support assembly, made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
2. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.
3. Channels: Continuous slotted carbon-steel channel with inturned lips.
4. Channel Width: Select for applicable load criteria.
5. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Metallic Coating: No coating.

8. Paint Coating: Green epoxy, acrylic, or urethane.

## 2.5 THERMAL HANGER-SHIELD INSERTS

A. Insulation-Insert Material: Water-repellent-treated, ASTM C 533, Type I calcium silicate with 100-psi minimum compressive strength.

B. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

C. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

D. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

## 2.6 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: NFPA-approved, UL-listed, or FM-approved threaded-steel stud, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: NFPA-approved, UL-listed, or FM-approved, insert-wedge-type anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
   1. Indoor Applications: Zinc-coated or Stainless steel.
   2. Outdoor Applications: Stainless steel.

## 2.7 EQUIPMENT SUPPORTS

A. Description: NFPA-approved, UL-listed, or FM-approved, welded, shop- or field-fabricated equipment support, made from structural-carbon-steel shapes.

## 2.8 MATERIALS

A. Aluminum: ASTM B 221.

B. Carbon Steel: ASTM A 1011/A 1011M.

C. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

D. Stainless Steel: ASTM A 240/A 240M.

E. Grout: ASTM C 1107/C 1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout, suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

## PART 3 - EXECUTION

### 3.1 APPLICATION

A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.

B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

### 3.2 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with installation requirements of approvals and listings. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size, or install intermediate supports for smaller-diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal strut systems.

D. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete, after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool

manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual. Install in accordance with approvals and listings.

2. Install mechanical-expansion anchors in concrete, after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions. Install in accordance with approvals and listings.

F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

I. Install lateral bracing with pipe hangers and supports to prevent swaying.

J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

K. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

M. Insulated Piping:

1. Attach clamps and spacers to piping.

    a. Piping Operating Above Ambient Air Temperature: Clamp may project through insulation.
    b. Piping Operating Below Ambient Air Temperature: Use thermal hanger-shield insert with clamp sized to match OD of insert.
    c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39 protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

    a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

   a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
   b. NPS 4: 12 inches long and 0.06 inch thick.
   c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
   d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
   e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal Hanger Shields: Install with insulation of same thickness as piping insulation.

## 3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment, and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

## 3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers.

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/D1.1M 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 so contours of welded surfaces match adjacent contours.

## 3.5 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

## 3.6 PAINTING

A. Touchup: Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those 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. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded, shop-painted areas on miscellaneous metal are specified in Section 099123 "Interior Painting."

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A 780/A 780M.

## 3.7 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with NFPA requirements for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports metal trapeze pipe hangers and metal framing systems and attachments for general service applications.

F. Use stainless-steel pipe hangers and stainless-steel or corrosion-resistant attachments for hostile environment applications.

G. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.

H. Use thermal hanger-shield inserts for insulated piping and tubing.

I. Horizontal-Piping Hangers and Supports: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
2. Steel Pipe Clamps (MSS Type 4): For suspension of NPS 1/2 to NPS 24 if little or no insulation is required.
3. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
4. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
5. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
6. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
7. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
8. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
9. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.

J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

K. Hanger-Rod Attachments: Comply with NFPA requirements.

L. Building Attachments: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. C-Clamps (MSS Type 23): For structural shapes.
3. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.

M. Saddles and Shields: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.

2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal Hanger-Shield Inserts: For supporting insulated pipe.

N. Comply with NFPA requirements for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

O. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

P. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 210529

# SECTION 210548 - VIBRATION AND SEISMIC CONTROLS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

## 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. Elastomeric isolation pads.
2. Elastomeric isolation mounts.
3. Restrained elastomeric isolation mounts.
4. Pipe-riser resilient supports.
5. Resilient pipe guides.
6. Elastomeric hangers.
7. Snubbers.
8. Restraint channel bracings.
9. Seismic-restraint accessories.
10. Mechanical anchor bolts.
11. Adhesive anchor bolts.

B. Related Requirements:

1. Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for devices for plumbing equipment and systems.
2. Section 230548 "Vibration and Seismic Controls for HVAC" for devices for HVAC equipment and systems.

### 1.3 DEFINITIONS

A. IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

### 1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and seismic-restraint component required.

    a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction.
    b. Annotate to indicate application of each product submitted and compliance with requirements.

3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Delegated-Design Submittal: For each vibration isolation and seismic-restraint device.

1. Include design calculations and details for selecting vibration isolators and seismic restraints complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
2. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, due to seismic forces required to select vibration isolators, and due to seismic restraints.
3. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system was examined for excessive stress and that none exists.
4. Seismic-Restraint Details:

    a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
    b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
    c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
    d. Preapproval and Evaluation Documentation: By an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of vibration isolation device installation and seismic bracing for fire-suppression piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.

B. Qualification Data: For professional engineer.

C. Welding certificates.

D. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are unavailable, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:

1. Site Class as Defined in the IBC: **C**.
2. Assigned Seismic Use Group or Building Category as Defined in the IBC: **IV**

    a. Component Importance Factor:**1.5**.
    b. Component Response Modification Factor: **Min. 1.5 – Max 6.0**
    c. Component Amplification Factor: **Min. 1.5 – Max 2.0** .

3. Design Spectral Response Acceleration at Short Periods (0.2 Second): **0.193**.
4. Design Spectral Response Acceleration at 1.0-Second Period: **0.122**.
5. Rated strengths, features, and applications shall be as defined in reports by **an evaluation service member of ICC-ES** or **an agency acceptable to authorities having jurisdiction**.

    a. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least **four** times the maximum seismic forces to which they are subjected.

## 2.2 ELASTOMERIC ISOLATION PADS

A. Elastomeric Isolation Pads.
1. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
2. Size: Factory or field cut to match requirements of supported equipment.
3. Pad Material: Oil and water resistant with elastomeric properties.
4. Surface Pattern: Smooth pattern.
5. Infused nonwoven cotton or synthetic fibers.
6. Load-bearing metal plates adhered to pads.
7. Sandwich-Core Material: Resilient and elastomeric.

    a. Surface Pattern: Smooth, Ribbed or Waffle pattern.
    b. Infused nonwoven cotton or synthetic fibers.

## 2.3 ELASTOMERIC ISOLATION MOUNTS

A. Double-Deflection, Elastomeric Isolation Mounts:
1. Mounting Plates:

    a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.
    b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.

2. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

## 2.4 RESTRAINED ELASTOMERIC ISOLATION MOUNTS

A. Restrained Elastomeric Isolation Mounts:
1. Description: All-directional isolator with seismic restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.

    a. Housing: Cast-ductile iron or welded steel.

b. Elastomeric Material: Molded, oil-resistant rubber, neoprene or other elastomeric material.

## 2.5 PIPE-RISER RESILIENT SUPPORT

A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch- thick neoprene.

1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
2. Maximum Load Per Support: 500 psig on isolation material providing equal isolation in all directions.

## 2.6 RESILIENT PIPE GUIDES

A. Description: Telescopic arrangement of two steel tubes or post-and-sleeve arrangement separated by a minimum 1/2-inch- thick neoprene.

1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

## 2.7 ELASTOMERIC HANGERS

A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods:

1. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
2. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

## 2.8 SNUBBERS

A. Description: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.

1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
3. Maximum 1/4-inch air gap, and minimum 1/4-inch- thick resilient cushion.

## 2.9 RESTRAINT CHANNEL BRACINGS

A. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

## 2.10 SEISMIC-RESTRAINT ACCESSORIES

A. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or Reinforcing steel angle clamped to hanger rod.

B. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings.

C. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

D. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

E. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

## 2.11 MECHANICAL ANCHOR BOLTS

A. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

## 2.12 ADHESIVE ANCHOR BOLTS

A. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

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

3.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction.

B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."

B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

C. Comply with requirements in Section 077200 "Roof Accessories" for installation of equipment supports and roof penetrations.

D. Equipment Restraints:

1. Install seismic snubbers on fire-suppression equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.

3. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction that provides required submittals for component.

E. Piping Restraints:

1. Comply with requirements in MSS SP-127.
2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
3. Brace a change of direction longer than 12 feet (3.7 m).

F. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction that provides required submittals for component.

G. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

H. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

I. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

J. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

## 3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Section 211200 "Fire-Suppression Standpipes," Section 211313 "Wet-Pipe Sprinkler Systems," and Section 211316 "Dry-Pipe Sprinkler Systems" for piping flexible connections.

## 3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
5. Test to 90 percent of rated proof load of device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.
8. Verify snubber minimum clearances.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

END OF SECTION 210548

# SECTION 210553 - IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

## 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 labels.
2. Warning signs and labels.
3. Pipe labels.
4. Stencils.
5. Valve tags.
6. Warning tags.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment-Label Schedule: Include a listing of all equipment to be labeled and the proposed content for each label.

D. Valve Schedules: Valve numbering scheme.

## PART 2 - PRODUCTS

### 2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032 inch, stainless steel, 0.025 inch, aluminum, 0.032 inch or anodized aluminum, 0.032 inch thick, with predrilled holes for attachment hardware.

2. Letter Color: White.
3. Background Color: Red.
4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
6. Fasteners: Stainless-steel rivets or self-tapping screws.
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:
1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, with predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Red.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

D. Equipment-Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

## 2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, with predrilled holes for attachment hardware.

B. Letter Color: White.

C. Background Color: Red.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

## 2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service and showing flow direction according to ASME A13.1.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe-Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.

E. Pipe-Label Colors:

1. Background Color: Safety Red.
2. Letter Color: White.

## 2.4 STENCILS

A. Stencils for Piping:

1. Lettering Size: At least 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.
2. Stencil Material: Aluminum.
3. Stencil Paint: Safety Red, exterior, gloss, alkyd enamel or acrylic enamel. Paint may be in pressurized spray-can form.
4. Identification Paint: White, exterior, alkyd enamel or acrylic enamel. Paint may be in pressurized spray-can form.

## 2.5 VALVE TAGS

A. Description: Stamped or engraved with 1/4-inch letters for piping-system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032 inch, stainless steel, 0.025 inch , aluminum, 0.032 inch or anodized aluminum, 0.032 inch thick, with predrilled holes for attachment hardware.
2. Fasteners: Brass wire-link chain, beaded chain or S-hook.
3. Valve-Tag Color: Safety Red.
4. Letter Color: White.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

## 2.6 WARNING TAGS

A. Description: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum.
2. Fasteners: Reinforced grommet and wire or string.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Safety Yellow background with black lettering.

# PART 3 - EXECUTION

## 3.1 PREPARATION

A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

## 3.2 GENERAL INSTALLATION REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be installed.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

## 3.3 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

## 3.4 PIPE LABEL INSTALLATION

A. Piping: Painting of piping is specified in Section 099123 "Interior Painting."

B. Stenciled Pipe-Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, with painted, color-coded bands or rectangles on each piping system.

1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

C. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection excluding short takeoffs. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit a view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

D. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes including pipes where flow is allowed in both directions.

## 3.5 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in fire-suppression piping systems. List tagged valves in a valve-tag schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below:

1. Valve-Tag Size and Shape:

a. Fire-Suppression Standpipe: 1-1/2 inches round or square.
b. Wet-Pipe Sprinkler System: 1-1/2 inches round or square.

## 3.6 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 210553

# SECTION 211119 – FIRE DEPARTMENT CONNECTIONS

## 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. Exposed-type fire-department connections.
2. Flush-type fire-department connections.
3. Yard-type fire-department connections.

### 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 each fire-department connection.

## PART 2 - PRODUCTS

### 2.1 YARD-TYPE FIRE-DEPARTMENT CONNECTION

A. Standard: UL 405.

B. Type: Exposed, freestanding.

C. Pressure Rating: **175 psig minimum**.

D. Body Material: Corrosion-resistant metal.

E. Inlets: 5” Storz connection.

F. Caps: Brass, lugged type, with gasket and chain.

G. Escutcheon Plate: Round, brass, floor type.

H. Outlet: Bottom, with pipe threads.

I. Number of Inlets: **One**.

J. Sleeve: **Not required**.

K. Sleeve Height: Not Required.

L. Escutcheon Plate Marking: Similar to "**AUTO SPKR & STANDPIPE**."

M. Finish: **Polished chrome plated**.

N. Outlet Size: **NPS 4**.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of fire-department connections.

B. Examine roughing-in for fire-suppression standpipe system to verify actual locations of piping connections before fire-department connection installation.

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

### 3.2 INSTALLATION

A. Install yard-type fire-department connections in concrete slab support. Comply with requirements for concrete in Section 033000 "Cast-in-Place Concrete."

B. Comply with requirements for bollards in Section 055000 "Metal Fabrications."

C. Install automatic (ball-drip) drain valve at each check valve for fire-department connection.

END OF SECTION 211119

# SECTION 211200 - FIRE-SUPPRESSION STANDPIPES

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. Section Includes:

1. Pipes, fittings, and specialties.
2. Fire-protection specialty valves.
3. Hose connections.
4. Alarm devices.
5. Manual control stations.
6. Control panels.
7. Pressure gages.

B. Related Requirements:

1. Section 210523 "General-Duty Valves for Water-Based Fire-Suppression Piping."
2. Section 211119 "Fire-Department Connections" for exposed wall-mounted and yard fire hydrants.
3. Section 211313 "Wet-Pipe Sprinkler Systems" for wet-pipe sprinkler piping.
4. Section 284621.11 "Addressable Fire-Alarm Systems" for connections to alarm devices.

### 1.3 DEFINITIONS

A. Standard-Pressure Standpipe Piping: Fire-suppression standpipe piping designed to operate at working pressure 175 psig maximum.

### 1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For fire-suppression standpipes.

1. Include plans, elevations, sections, and attachment details.

2. Include diagrams for power, signal, and control wiring.

C. Delegated-Design Submittal: For standpipe 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. Qualification Data: For Installer.

B. Approved Standpipe Drawings: Working plans, prepared according to NFPA 14, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

C. Welding certificates.

D. Fire-hydrant flow test report.

E. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 14. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."

F. Field quality-control reports.

## 1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-suppression standpipes specialties to include in emergency, operation, and maintenance manuals.

## 1.7 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing fire-suppression standpipes and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

    a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

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

D. NFPA Standards: Fire-suppression standpipe equipment, specialties, accessories, installation, and testing shall comply with NFPA 14.

## 1.8 PROJECT CONDITIONS

A. Interruption of Existing Fire-Suppression Standpipe Service: Do not interrupt fire-suppression standpipe service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary fire-suppression standpipe service according to requirements indicated:

1. Notify Construction Manager no fewer than two days in advance of proposed interruption of fire-suppression standpipe service.
2. Do not proceed with interruption of fire-suppression standpipe service without Construction Manager's written permission.

# PART 2 - PRODUCTS

## 2.1 SYSTEM DESCRIPTIONS

A. Manual Wet-Type, Class I Standpipe System: Includes NPS 2-1/2 hose connections. Has small water supply to maintain water in standpipes. Piping is wet, but water must be pumped into standpipes to satisfy demand.

## 2.2 PERFORMANCE REQUIREMENTS

A. Standard-Pressure, Fire-Suppression Standpipe System Component: Listed for 175-psig minimum working pressure.

B. Delegated Design: Design fire-suppression standpipes, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

C. Fire-suppression standpipe design shall be approved by authorities having jurisdiction.

1. Minimum residual pressure at each hose-connection outlet is as follows:
   a. NPS 2-1/2 (DN 65) Hose Connections: 100 psig.

D. Seismic Performance: Fire-suppression standpipes shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7.

## 2.3 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials and for joining methods for specific services, service locations, and pipe sizes.

## 2.4 BLACK STEEL PIPE AND ASSOCIATED FITTINGS

A. Schedule 40: ASTM A 53/A 53M, Type E, Grade B; with factory- or field-formed ends to accommodate joining method.

B. Schedule 40: ASTM A 135/A 135M, Grade A; with factory- or field-formed ends to accommodate joining method.

C. Schedule 40: ASTM A 795/A 795M, Type E, Grade A; with factory- or field-formed ends to accommodate joining method.

D. Schedule 30: ASTM A 53/A 53M, Type E, Grade B; with factory- or field-formed ends to accommodate joining method.

E. Schedule 30: ASTM A 135/A 135M, Grade A; with factory- or field-formed ends to accommodate joining method.

F. Schedule 30: ASTM A 795/A 795M, Type E, Grade A; with factory- or field-formed ends to accommodate joining method.

G. Thinwall: ASTM A 53/A 53M, Type E; with wall thickness less than Schedule 30 and equal to or greater than Schedule 10; and with factory- or field-formed ends to accommodate joining method.

H. Thinwall: ASTM A 135/A 135M, Grade A; with wall thickness less than Schedule 30 and equal to or greater than Schedule 10; and with factory- or field-formed ends to accommodate joining method.

I. Thinwall: ASTM A 795/A 795M, Type E, Grade A; with wall thickness less than Schedule 30 and equal to or greater than Schedule 10; and with factory- or field-formed ends to accommodate joining method.

J. Schedule 10: ASTM A 135/A 135M or ASTM A 795/A 795M, Schedule 10 in NPS 5 and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10, plain end.

K. Uncoated, Steel Couplings: ASTM A 865/A 865M, threaded.

L. Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

M. Malleable- or Ductile-Iron Unions: UL 860.

N. Cast-Iron Flanges: ASME B16.1, Class 125.

O. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

P. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.

Q. Grooved-Joint, Steel-Pipe Appurtenances:

1.
2. Pressure Rating: 175 psig minimum.
3. Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

## 2.5 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:[AWWA C110, rubber, flat face, 1/8 inch thick.

1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
2. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

D. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

## 2.6 HOSE CONNECTIONS

A. Nonadjustable-Valve Hose Connections:
1. Standard: UL 668 hose valve for connecting fire hose.
2. Pressure Rating: 300 psig minimum.
3. Material: Brass or bronze.
4. Size: NPS 2-1/2, as indicated.
5. Inlet: Female pipe threads.
6. Outlet: Male hose threads with lugged cap, gasket, and chain. Include hose valve threads according to NFPA 1963 and matching local fire-department threads.
7. Pattern: Gate.
8. Finish: Polished chrome-plated.

## 2.7 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Electrically Operated Alarm Bell:
   1. Standard: UL 464.
   2. Type: Vibrating, metal alarm bell.
   3. Size: 6-inch (150-mm) minimum diameter.
   4. Finish: Red-enamel factory finish, suitable for outdoor use.

C. Valve Supervisory Switches:
   1. Standard: UL 346.
   2. Type: Electrically supervised.
   3. Components: Single-pole, double-throw switch with normally closed contacts.
   4. Design: Signals that controlled valve is in other than fully open position.

## 2.8 PRESSURE GAGES

A. Standard: UL 393.

B. Dial Size: 3-1/2- to 4-1/2-inch diameter.

C. Pressure Gage Range: [ero to 250 psig minimum.

D. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.

# PART 3 - EXECUTION

## 3.1 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 14 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.

B. Report test results promptly and in writing.

## 3.2 EXAMINATION

A. Examine roughing-in for hose connections and stations to verify actual locations of piping connections before installation.

B. Examine walls and partitions for suitable thickness, fire- and smoke-rated construction, framing for hose-station cabinets, and other conditions where hose connections and stations are to be installed.

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

## 3.3 SERVICE-ENTRANCE PIPING

A. Connect fire-suppression standpipe piping to water-service piping at service entrance into building. Comply with requirements for exterior piping in Section 211100 "Facility Fire-Suppression Water-Service Piping."

B. Install shutoff valve, pressure gage, drain, and other accessories at connection to fire-suppression water-service piping.

C. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

## 3.4 WATER-SUPPLY CONNECTIONS

A. Install shutoff valve, pressure gage, drain, and other accessories at connection to water-distribution piping.

B. Install shutoff valve, check valve, pressure gage, and drain at connection to water supply.

## 3.5 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

B. Piping Standard: Comply with requirements in NFPA 14 for installation of fire-suppression standpipe piping.

C. Install seismic restraints on piping. Comply with requirements in NFPA 13 for seismic-restraint device materials and installation.

D. Install listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

E. Install drain valves on standpipes. Extend drain piping to outside of building.

F. Install automatic (ball drip) drain valves to drain piping between fire-department connections and check valves. Drain to floor drain or outside building.

G. Install alarm devices in piping systems.

H. Install hangers and supports for standpipe system piping according to NFPA 14. Comply with requirements in NFPA 13 for hanger materials.

I. Install pressure gages on riser or feed main and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft-metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they are not subject to freezing.

J. Fill wet-type standpipe system piping with water.

K. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

L. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

M. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210518 "Escutcheons for Fire-Suppression Piping."

## 3.6 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of pipes and tubes, and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

I. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

J. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to "Quality Assurance" Article.

1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

K. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.

L. Copper-Tubing Grooved Joints: Roll rounded-edge groove in end of tube according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join copper tube and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

M. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

## 3.7 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 14 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. S

## 3.8 HOSE-CONNECTION INSTALLATION

A. Install hose connections adjacent to standpipes.

B. Install freestanding hose connections for access and minimum passage restriction.

## 3.9 FIRE-DEPARTMENT CONNECTION INSTALLATION

A. Install yard-type fire-department connections in concrete slab support. Comply with requirements for concrete in Section 033000 "Cast-in-Place Concrete."

B. Install automatic (ball drip) drain valve at each check valve for fire-department connection.

## 3.10 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 14.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

## 3.11 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect standpipe systems according to NFPA 14, "System Acceptance" Chapter.
4. Energize circuits to electrical equipment and devices.
5. Start and run air compressors.
6. Coordinate with fire-alarm tests. Operate as required.
7. Coordinate with fire-pump tests. Operate as required.
8. Verify that equipment hose threads are same as local fire-department equipment.

C. Fire-suppression standpipe system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

## 3.12 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

3.13 PIPING SCHEDULE

A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

B. Standard-pressure, wet-type fire-suppression standpipe piping, NPS 4 and smaller, shall be the following:
   1.
   2. Schedule 10, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

C. Standard-pressure, wet-type fire-suppression standpipe piping, NPS 5 to NPS 8, shall be the following:
   1. Schedule 10, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

END OF SECTION 211200

# SECTION 211313 - WET-PIPE SPRINKLER 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. Pipes, fittings, and specialties.
2. Cover system for sprinkler piping.
3. Specialty valves.
4. Sprinklers.
5. Alarm devices.
6. Manual control stations.
7. Control panels.
8. Pressure gages.

B. Related Requirements:

1. Section 211119 "Fire Department Connections" for exposed-, flush-, and yard-type fire department connections.
2. Section 230523 "General-Duty Valves for Water-Based Fire-Suppression Piping" for ball, butterfly, check, gate, post-indicator, and trim and drain valves.

### 1.3 DEFINITIONS

A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175-psig maximum.

### 1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For wet-pipe sprinkler systems.

1. Include plans, elevations, sections, and attachment details.
2. Include diagrams for power, signal, and control wiring.

C. Delegated-Design Submittal: For wet-pipe sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. Qualification Data: For qualified Installer.

E. Design Data:

1. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

F. Welding certificates.

G. Field Test Reports:

1. Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
2. Fire-hydrant flow test report.

H. Field quality-control reports.

## 1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wet-pipe sprinkler systems and specialties to include in emergency, operation, and 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. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

## 1.7 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

B. Welding Qualifications: Qualify procedures and operators according to 2010 ASME Boiler and Pressure Vessel Code.

## 1.8 FIELD CONDITIONS

A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:

1. Notify Construction Manager no fewer than two days in advance of proposed interruption of sprinkler service.
2. Do not proceed with interruption of sprinkler service without Construction Manager's written permission.

# PART 2 - PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

A. Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13.

B. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

C. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design wet-pipe sprinkler systems.

1. Sprinkler system design shall be approved by authorities having jurisdiction.
    a. Sprinkler Occupancy Hazard Classifications:
        1) Building Service Areas: Ordinary Hazard, Group 1.
        2) Electrical Equipment Rooms: Ordinary Hazard, Group 1.
        3) General Storage Areas: Ordinary Hazard, Group 2.
        4) Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
        5) Office and Public Areas: Light Hazard.

2. Minimum Density for Automatic-Sprinkler Piping Design:
    a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
    b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
    c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.

3. Maximum Protection Area per Sprinkler: According to UL listing.
4. Maximum Protection Area per Sprinkler:
    a. Office Spaces: 225 sq. ft..
    b. Storage Areas: 130 sq. ft..
    c. Mechanical Equipment Rooms: 130 sq. ft..
    d. Electrical Equipment Rooms: 130 sq. ft..
    e. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.

D. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7.

## 2.2 STEEL PIPE AND FITTINGS

A. Standard-Weight, Black-Steel Pipe: ASTM A 53/A 53M, Pipe ends may be factory or field formed to match joining method.

B. Schedule 10, Black-Steel Pipe: ASTM A 135/A 135M or ASTM A 795/A 795M, Schedule 10 in NPS 5 and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10, plain end.

C. Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.

D. Uncoated-Steel Couplings: ASTM A 865/A 865M, threaded.

E. Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

F. Malleable- or Ductile-Iron Unions: UL 860.

G. Cast-Iron Flanges: ASME 16.1, Class 125.

H. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

1. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick.

a. Class 125 and Class 250, Cast-Iron, Flat-Face Flanges: Full-face gaskets.
b. Class 150 and Class 300, Ductile-Iron or -Steel, Raised-Face Flanges: Ring-type gaskets.

2. Metal, Pipe-Flange Bolts and Nuts: Carbon steel unless otherwise indicated.

I. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.

1. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

J. Grooved-Joint, Steel-Pipe Appurtenances:
1. Pressure Rating: 175-psig minimum.
2. Uncoated Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting, with dimensions matching steel pipe.
3. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213 rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

K. Steel Pressure-Seal Fittings: UL 213, FM Global-approved, 175-psig (1200-kPa) pressure rating with steel housing, rubber O-rings, and pipe stop; for use with fitting manufacturers' pressure-seal tools.

## 2.3 SPECIALTY VALVES

A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

B. Pressure Rating:

1. Standard-Pressure Piping Specialty Valves: 175-psig minimum.

C. Body Material: Cast or ductile iron.

D. Size: Same as connected piping.

E. End Connections: Flanged or grooved.

## 2.4 SPRINKLER PIPING SPECIALTIES

A. Branch Outlet Fittings:
1. Standard: UL 213.
2. Pressure Rating: 175-psig minimum.
3. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
4. Type: Mechanical-tee and -cross fittings.
5. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
6. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
7. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Flow Detection and Test Assemblies:
1. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
2. Pressure Rating: 175-psig minimum.
3. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
4. Size: Same as connected piping.
5. Inlet and Outlet: Threaded or grooved.

C. Branch Line Testers:
1. Standard: UL 199.
2. Pressure Rating: 175 psig.
3. Body Material: Brass.
4. Size: Same as connected piping.
5. Inlet: Threaded.
6. Drain Outlet: Threaded and capped.

7. Branch Outlet: Threaded, for sprinkler.

D. Sprinkler Inspector's Test Fittings:
1. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
2. Pressure Rating: 175-psig minimum.
3. Body Material: Cast- or ductile-iron housing with sight glass.
4. Size: Same as connected piping.
5. Inlet and Outlet: Threaded.

E. Adjustable Drop Nipples:
1. Standard: UL 1474.
2. Pressure Rating: 250-psig minimum.
3. Body Material: Steel pipe with EPDM-rubber O-ring seals.
4. Size: Same as connected piping.
5. Length: Adjustable.
6. Inlet and Outlet: Threaded.

## 2.5 SPRINKLERS

A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

B. Pressure Rating for Automatic Sprinklers: 175-psig minimum.

C. Sprinkler Finishes: Chrome plated where exposed in public view, Brass uprights in areas without ceilings and not within public view.

D. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mounting: Factory applied, white painted concealed cover plate.
2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

E. Sprinkler Guards:
1. Standard: UL 199.
2. Type: Wire cage with fastening device for attaching to sprinkler.

## 2.6 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Electrically Operated Alarm Bell:

1. Standard: UL 464.
2. Type: Vibrating, metal alarm bell.
3. Size: 6-inch diameter.
4. Finish: Red-enamel factory finish, suitable for outdoor use.
5. 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. Water-Flow Indicators:
1. Standard: UL 346.
2. Water-Flow Detector: Electrically supervised.
3. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
4. Type: Paddle operated.
5. Pressure Rating: 250 psig.
6. Design Installation: Horizontal or vertical.

D. Valve Supervisory Switches:
1. Standard: UL 346.
2. Type: Electrically supervised.
3. Components: Single-pole, double-throw switch with normally closed contacts.
4. Design: Signals that controlled valve is in other than fully open position.
5. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## 2.7 PRESSURE GAGES

A. Standard: UL 393.

B. Dial Size: 3-1/2- to 4-1/2-inch diameter.

C. Pressure Gage Range: 0- to 250-psig minimum.

D. Label: Include "WATER" label on dial face.

# PART 3 - EXECUTION

## 3.1 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.

B. Report test results promptly and in writing.

## 3.2 SERVICE-ENTRANCE PIPING

A. Connect sprinkler piping to water-service piping for service entrance to building. Comply with requirements for exterior piping in Section 211100 "Facility Fire-Suppression Water-Service Piping" for exterior piping.

B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping.

C. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

## 3.3 WATER-SUPPLY CONNECTIONS

A. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-distribution piping.

B. Install shutoff valve, check valve, pressure gage, and drain at connection to water supply.

## 3.4 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

B. Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.

C. Install seismic restraints on piping. Comply with NFPA 13 requirements for seismic-restraint device materials and installation.

D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

E. Install unions adjacent to each valve in pipes NPS 2 and smaller.

F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

H. Install sprinkler piping with drains for complete system drainage.

I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

J. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.

K. Install alarm devices in piping systems.

L. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13. In seismic-rated areas, refer to Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment."

M. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft-metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they are not subject to freezing.

N. Fill sprinkler system piping with water.

O. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

P. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

Q. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210518 "Escutcheons for Fire-Suppression Piping."

## 3.5 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.

I. Steel-Piping, Pressure-Sealed Joints: Join lightwall steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.

J. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

K. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

L. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

M. Steel-Piping, Pressure-Sealed Joints: Join Schedule 5 steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.

N. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.

O. Copper-Tubing Grooved Joints: Roll rounded-edge groove in end of tube according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join copper tube and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

P. Copper-Tubing, Pressure-Sealed Joints: Join copper tube and copper pressure-seal fittings with tools recommended by fitting manufacturer.

Q. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.

R. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

S. Plastic-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.

## 3.6 INSTALLATION OF COVER SYSTEM FOR SPRINKLER PIPING

A. Install cover system, brackets, and cover components for sprinkler piping according to manufacturer's "Installation Manual" and NFPA 13 or NFPA 13R for supports.

## 3.7 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Specialty Valves:

1. Install valves in vertical position for proper direction of flow, in main supply to system.
2. Install alarm valves with bypass check valve and retarding chamber drain-line connection.
3. Install deluge valves in vertical position, in proper direction of flow, and in main supply to deluge system. Install trim sets for drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.

## 3.8 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.

B. Install sprinklers into flexible, sprinkler hose fittings, and install hose into bracket on ceiling grid.

## 3.9 FIRE DEPARTMENT CONNECTIONS

A. Shop drawings shall coordinate and confirm the desired location and thread type for the fire department connection with the responding fire department.

B. Fire department connection must be freestanding type, 5” Storz connection.

C. Storz connection on 30 degree fixed (non-swivel) with cap secured by a chain.

D. Ball drip shall be provided in gravel base.

E. All exposed piping and fittings to be galvanized with exception of Storz connection.

## 3.10 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

## 3.11 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
4. Energize circuits to electrical equipment and devices.
5. Coordinate with fire-alarm tests. Operate as required.
6. Coordinate with fire-pump tests. Operate as required.
7. Verify that equipment hose threads are same as local fire department equipment.

B. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

## 3.12 CLEANING

A. Clean dirt and debris from sprinklers.

B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

## 3.13 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain specialty valves and pressure-maintenance pumps.

## 3.14 PIPING SCHEDULE

A. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with grooved ends, grooved-end fittings, grooved-end-pipe couplings, and grooved joints.

B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

C. Copper-tube, extruded-tee connections may be used for tee branches in copper tubing instead of specified copper fittings. Branch-connection joints must be brazed.

D. Standard-pressure, wet-pipe sprinkler system, NPS 2 and smaller, shall be the following:

1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
2. Standard-weight, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
3. Schedule 10 black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

E. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 to NPS 4, shall be one of the following:

1. Schedule 10 black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

## 3.15 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Upright sprinklers.
2. Rooms with Suspended Ceilings: Concealed sprinklers.
3. Wall Mounting: Sidewall sprinklers.

B. Provide sprinkler types in subparagraphs below with finishes indicated.

1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
2. Upright Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION 211313

# SECTION 213113 - ELECTRIC-DRIVE, CENTRIFUGAL FIRE PUMPS

## 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. Vertically mounted, single-stage, split-case fire pumps.
   2. Fire-pump accessories and specialties.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include rated capacities, operating characteristics, performance curves, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For fire pumps, motor drivers, and fire-pump accessories and specialties.

   1. Include plans, elevations, sections, and mounting and attachment details.
   2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include diagrams for power, signal, and control wiring.

### 1.4 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For fire pumps, accessories, and components, from manufacturer.

   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Product Certificates: For each type of fire pump, from manufacturer.

C. Source quality-control reports.

D. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire pumps to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. NFPA Compliance: Comply with NFPA 20.

B. Seismic Performance: Fire pumps shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
2. Component Importance Factor: 1.5.

C. Pump Equipment, Accessory, and Specialty Pressure Rating: 175 psig (1200 kPa) minimum unless higher pressure rating is indicated.

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

2.2 GENERAL REQUIREMENTS FOR CENTRIFUGAL FIRE PUMPS

A. Description: Factory-assembled and -tested fire-pump and driver unit.

B. Base: Fabricated and attached to fire-pump and driver unit, with reinforcement to resist movement of pump during seismic events when base is anchored to building substrate.

C. Finish: Red paint applied to factory-assembled and -tested unit before shipping.

2.3 VERTICALLY MOUNTED, SINGLE-STAGE, SPLIT-CASE FIRE PUMPS

A. Pump:

1. Standard: UL 448, for split-case pumps for fire service.
2. Casing: Axially split case, cast iron, with ASME B16.1 pipe-flange connections.

3. Impeller: Double suction, cast bronze, statically and dynamically balanced, and keyed to shaft.
4. Wear Rings: Replaceable bronze.
5. Shaft and Sleeve: Alloy steel shaft with bronze sleeve.

    a. Shaft Bearings: Grease-lubricated ball bearings in cast-iron housing.
    b. Seals: Stuffing box with minimum of four rings of graphite-impregnated braided yarn and bronze packing gland.

6. Mounting: Pump and driver shafts are vertical, with motor above pump and pump on base.

B. Coupling: Flexible and capable of absorbing torsional vibration and shaft misalignment. Include metal coupling guard.

C. Driver:

1. Standard: UL 1004A.
2. Type: Electric motor; NEMA MG 1, polyphase Design B.

D. Capacities and Characteristics:

1. Rated Capacity: 500 gpm.
2. Motor Horsepower: 25 hp.
3. Motor Speed: 3600 rpm.
4. Electrical Characteristics:

    a. Volts: 460 V.
    b. Phase: Three.
    c. Hertz: 60.

## 2.4 FIRE-PUMP ACCESSORIES AND SPECIALTIES

A. Automatic Air-Release Valves: Comply with NFPA 20 for installation in fire-pump casing.

B. Circulation Relief Valves: UL 1478, brass, spring loaded; for installation in pump discharge piping.
1.

C. Inlet Fitting: Eccentric tapered reducer at pump suction inlet.

D. Outlet Fitting: Concentric tapered reducer at pump discharge outlet.

E. Discharge Cone: Closed or open type.

F. Hose Valve Manifold Assembly:

1. Standard: Comply with requirements in NFPA 20.

2. Header Pipe: ASTM A 53/A 53M, Schedule 40, galvanized steel, with ends threaded according to ASME B1.20.1.
3. Header Pipe Fittings: ASME B16.4, galvanized cast-iron threaded fittings.
4. Automatic Drain Valve: UL 1726.
5. Manifold:

    a. Test Connections: Comply with UL 405; however, provide outlets without clappers instead of inlets.
    b. Body: Flush type, brass or ductile iron, with number of outlets required by NFPA 20.
    c. Nipples: ASTM A 53/A 53M, Schedule 40, galvanized-steel pipe, with ends threaded according to ASME B1.20.1.
    d. Adapters and Caps with Chain: Brass or bronze, with outlet threaded according to NFPA 1963 and matching local fire-department threads.
    e. Escutcheon Plate: Brass or bronze; rectangular.
    f. Hose Valves: UL 668, bronze, with outlet threaded according to NFPA 1963 and matching local fire-department threads.
    g. Exposed Parts Finish: Rough.
    h. Escutcheon Plate Marking: Equivalent to "FIRE PUMP TEST."

## 2.5 GROUT

A. Standard: ASTM C 1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink and recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

## 2.6 SOURCE QUALITY CONTROL

A. Testing: Test and inspect fire pumps according to UL 448 requirements for "Operation Test" and "Manufacturing and Production Tests."

    1. Verification of Performance: Rate fire pumps according to UL 448.

B. Fire pumps will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine equipment bases and anchorage provisions, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance of fire pumps.

B. Examine roughing-in for fire-suppression piping systems to verify actual locations of piping connections before fire-pump installation.

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

3.2 INSTALLATION

A. Fire-Pump Installation Standard: Comply with NFPA 20 for installation of fire pumps, relief valves, and related components.

B. Equipment Mounting:

1. Install fire pumps on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
2. Comply with requirements for vibration isolation and seismic-control devices specified in Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment."

C. Install fire-pump suction and discharge piping equal to or larger than sizes required by NFPA 20.

D. Support piping and pumps separately, so weight of piping does not rest on pumps.

E. Install valves that are same size as connecting piping. Comply with requirements for fire-protection valves specified in Section 211313 "Wet-Pipe Sprinkler Systems."

F. Install pressure gages on fire-pump suction and discharge flange pressure-gage tappings. Comply with requirements for pressure gages specified in Section 211313 "Wet-Pipe Sprinkler Systems."

G. Install piping hangers and supports, anchors, valves, gages, and equipment supports according to NFPA 20.

H. Install flowmeters and sensors. Install flowmeter-system components and make connections according to NFPA 20 and manufacturer's written instructions.

I. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not factory mounted. Furnish copies of manufacturers' wiring diagram submittals to electrical Installer.

J. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

## 3.3 ALIGNMENT

A. Align split-case pump and driver shafts after complete unit has been leveled on concrete base, grout has set, and anchor bolts have been tightened.

B. After alignment is correct, tighten anchor bolts evenly. Fill baseplate completely with grout, with metal blocks and shims or wedges in place. Tighten anchor bolts after grout has hardened. Check alignment and make required corrections.

C. Align piping connections.

D. Align pump and driver shafts for angular and parallel alignment according to HI 1.4 and to tolerances specified by manufacturer.

## 3.4 CONNECTIONS

A. Comply with requirements for piping and valves specified in Section 211313 "Wet-Pipe Sprinkler Systems." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to pumps and equipment to allow service and maintenance.

C. Connect relief-valve discharge to drainage piping or point of discharge.

D. Connect flowmeter-system meters, sensors, and valves to tubing.

E. Connect fire pumps to their controllers.

## 3.5 IDENTIFICATION

A. Identify system components. Comply with requirements for fire-pump marking according to NFPA 20.

## 3.6 FIELD QUALITY CONTROL

A. Test each fire pump with its controller as a unit. Comply with requirements for electric-motor-driver fire-pump controllers specified in Section 262933 "Controllers for Fire-Pump Drivers."

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections.

1. After installing components, assemblies, and equipment, including controller, test for compliance with requirements.
2. Test according to NFPA 20 for acceptance and performance testing.
3. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
4. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
5. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Components, assemblies, and equipment will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

F. Furnish fire hoses in number, size, and length required to reach storm drain or other acceptable location to dispose of fire-pump test water. Hoses are for tests only and do not convey to Owner.

## 3.7 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

## 3.8 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain fire pumps.

END OF SECTION 213113

# SECTION 213413 - PRESSURE-MAINTENANCE PUMPS

## 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. Vertical, multistage, pressure-maintenance pumps.

B. Related Requirements:

1. Section 262933 "Controllers for Fire-Pump Drivers" for pressure-maintenance-pump controllers.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include rated capacities, operating characteristics, performance curves, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For pumps, accessories, and specialties.

1. Include plans, elevations, sections, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

### 1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

### 1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For pumps to include in operation and maintenance manuals.

PART 2 - PRODUCTS

## 2.1 VERTICAL, MULTISTAGE, PRESSURE-MAINTENANCE PUMPS

A. Description: Factory-assembled and -tested, multistage, barrel-type vertical pump as defined in HI 2.1-2.2 and HI 2.3; designed for surface installation with pump and motor direct coupled and mounted vertically.

B. Pump Construction:

1. Barrel: Stainless steel.
2. Suction and Discharge Chamber: Cast iron with flanged inlet and outlet.
3. Pump Head/Motor Mount: Cast iron.
4. Impellers: Stainless steel, balanced, and keyed to shaft.
5. Pump Shaft: Stainless steel.
6. Seal: Mechanical type with carbon rotating face and silicon-carbide stationary seat.
7. Wear Rings: Teflon.
8. Intermediate Chamber Bearings: Aluminum-oxide ceramic or bronze.
9. Chamber-Base Bearing: Tungsten carbide.

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

D. Motor: Single speed with permanently lubricated ball bearings and rigidly mounted to pump head. Comply with requirements in Section 210513 "Common Motor Requirements for Fire Suppression Equipment."

E. Power Cord: Factory-connected to motor for field connection to controller and at least 10 feet long.

F. Nameplate: Permanently attached to pump and indicating capacity and characteristics.

## 2.2 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 210513 "Common Motor Requirements for Fire Suppression Equipment."

1. Motor Sizes: Minimum size as indicated; if not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

PART 3 - EXECUTION

## 3.1 EQUIPMENT INSTALLATION

A. NFPA Standard: Comply with NFPA 20 for installation of pressure-maintenance pumps.

B. Equipment Mounting:

1. Install multistage, pressure-maintenance pumps according to HI 1.4.
2. Install base-mounted pumps on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in [Section 033000 "Cast-in-Place Concrete."

    a. Comply with requirements for vibration isolation and seismic control devices specified in Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment."
    b. Comply with requirements for vibration isolation devices specified in Section 210548.13 "Vibration Controls for Fire-Suppression Piping and Equipment."
    c. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
    d. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
    e. Install anchor bolts to elevations required for proper attachment to supported equipment.
    f. Attach pumps to equipment base using anchor bolts.
    g. Shim pumps as needed to make them level.

3. Install isolation valves in both inlet and outlet pipes near the pump. Comply with requirements for valves specified in Section 211313 "Wet-Pipe Sprinkler Systems."

## 3.2 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform the following tests and inspections:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3. Pressure-maintenance pumps will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

## 3.3 ADJUSTING

A. Lubricate pumps as recommended by manufacturer.

B. Set field-adjustable pressure-switch ranges as indicated.

END OF SECTION 213413

# SECTION 22 00 00 - GENERAL PLUMBING

## PART 1 - GENERAL

### 1.1 SCOPE OF WORK

A. Instructions to Bidders, General Conditions of the Contract, Supplementary General Conditions and Division 01 Specifications Sections bound herewith are a component part of Division 22 specifications. Comply with all provisions, details and instructions of these sections in the accomplishment of work covered under Division 22.

B. Furnish all labor, materials and equipment and incidentals required to make ready for use complete plumbing systems as shown on the Drawings and specified herein.

C. Where Sub-Contracts are used to perform portions of the work, division of labor between sub trades is the responsibility of the Contractor.

D. Furnish all labor, materials and equipment and incidentals required to make ready for use complete plumbing systems as shown on the Drawings and specified herein.

E. Work includes furnishing, installing and testing the equipment and materials specified in other sections of the Division Specifications and shown on the Plumbing Drawings. It is the intent of these Specifications that the plumbing systems shall be suitable in every way for the intended usage. All material and all work which may be reasonably implied as being incidental to the work of this Division shall be furnished at no extra cost.

F. The general scope work includes, but is not limited to, furnishing, coordinating, and installing the following.
   1. Domestic waste and vent systems with connection to site utilities.
   2. Domestic water distribution systems with connection to site utilities.
   3. Fuel gas piping with connection to site gas supply.
   4. Plumbing fixtures, specialties and equipment.
   5. Testing and balancing.

G. Visit all areas of the existing site, buildings and structures (as applicable) in which work under these sections is to be performed. Inspect carefully the existing conditions prior to bidding. Bid submission is evidence that the Contractor has examined the site and existing conditions, understands conditions under which the work will be performed, and takes full responsibility for complete knowledge of all factors governing the work.

H. Schedule all service interruptions in existing facilities at the Owner’s convenience with 24 hours (minimum) notice. Obtain prior approval for each interruption.

I. Thoroughly test all plumbing systems after installation and make any minor corrections, changes or adjustments necessary for proper functioning of the systems and

equipment. All workmanship shall be of the highest quality; substandard work will be rejected.

## 1.2 SUBMITTALS

A. Procedures for submittals: Submit under provisions of relevant sections of the General and Supplemental General Conditions and Division 01 Specifications Sections.

B. Transmit each shop drawing submittal with provided Shop Drawing Submittal Cover Form, attached herewith for each item of equipment/material or each specification section/paragraph.

C. Clearly indicate proposed equipment and/or materials substitutions in shop drawings. Summarize all deviations from the specified quality, functionality, appearance or performance of proposed equipment and/or materials in the preface of each submittal. Include documentation to support deviations.

D. Provide descriptive data on all materials and equipment as required to ascertain compliance with Specifications.

E. Design layout shown on drawings is based on physical sizes of reputable equipment manufacturers. If equipment other than models indicated is installed, any resulting conflicts with space, maintenance access, clearances or codes are the responsibility of the Contractor to correct at his expense.

F. Where specific models and manufacturers of materials and equipment are specified, substitutions as allowed by the specifications and State law will be considered. Substitutions must be equivalent in quality, function, suitability and arrangement to specified equipment. Architect/Engineer to have final authority as to equivalency of substitutions.

G. Equipment model numbers noted in these specifications or on the drawings are intended to establish a minimum standard of quality and do not necessarily relate to specific options or arrangement as shown. Provide equipment with all standard features and optional features as stated and arranged as shown on the drawings.

## 1.3 REGULATORY REQUIREMENTS

A. Perform Work in accordance with all applicable state and local codes, standards and regulations.

B. Furnish all materials and labor which is be required for compliance with codes, standards and regulations, whether specifically mentioned in these specifications or shown on the drawings.

C. Obtain required construction permit from the authority having jurisdiction and arrange, at the proper time, for all inspections required by such authority. Pay all permit and inspection costs required.

## 1.4 COORDINATION OF WORK

A. Contractor is responsible for coordination of work between trades. Provide fully complete and functional systems.

B. Compare plumbing drawings and specifications with the drawings and specifications for other trades.

C. Coordinate plumbing installation with the work of other trades. Report any pertinent discrepancies to the Architect/Engineer and obtain written instructions for any necessary revisions. Before starting any construction, make proper provisions to avoid interferences in a manner approved by the Architect/Engineer. No extras will be allowed for rework of uncoordinated installations.

D. Determine exact route and location of each plumbing item prior to fabrication and/or installation. Adjust location of piping and equipment, etc., to accommodate interferences anticipated and encountered.

E. Right of Way: General priority for right of way is as follows:
   1. Items located per regulatory requirement.
   2. Piping with pitch requirement (plumbing drains, etc.).
   3. Ductwork.
   4. Piping without pitch requirement.
   5. Electrical wiring (conduits, etc.).

F. Arrange all work to permit removal (without damage to other parts) of any equipment requiring periodic replacement.

G. Provide clearance and easy access to any equipment which requires periodic maintenance. Arrange ducts, piping and equipment to permit ready access to valves, cocks, traps, starters, motors, control components, etc., and to clear the opening of swinging doors and access panels.

## 1.5 EQUIPMENT AND MATERIALS (GENERAL)

A. Provide all new materials unless specifically indicated otherwise.

B. Manufacturers and models listed in drawings and specifications are used for layout and to convey to bidders the general style, type, character and quality of product desired. Listed examples are used only to denote the quality standard of product desired and are not intended to restrict bidders to a specific brand, make, manufacturer or specific name.

C. Adjust layout, system connections and coordinate with other trades as required to properly install equivalent products.

D. Where equivalent products are submitted, include all associated costs related to substitution in bid.

E. Furnish materials bearing the manufacturer's name and trade name. Provide UL label where a UL standard has been established for the particular material.

F. Furnish standard products of manufacturers regularly engaged in production of equipment types required for the work. Use the manufacturer's latest approved design.

G. Use the same manufacturer for equipment and materials of the same general type throughout the work to obtain uniform appearance, operation and maintenance.

H. Protect equipment and materials from dirt, water, chemical or mechanical injury and theft at all times during construction. Provide covers or shelter as required.

I. If materials or equipment are damaged at any time prior to final acceptance of the work, repair such damage at no additional cost. If materials or equipment are damaged by water, provide replacement no additional cost.

J. Follow manufacturer's directions completely in the delivery, storage, protection and installation of all equipment and materials. Notify the Architect/Engineer in writing of any conflicts between any requirements of the contract documents and manufacturer's directions. Obtain written instructions before proceeding with the work. The Contractor is responsible for correction of any work that does not comply with the manufacturer's directions or written instructions from the Architect/Engineer at no additional cost.

K. Repair any damage to factory applied paint finish using touch-up paint furnished by the equipment manufacturer. Repaint entire damaged panel or section per the field painting specifications in Division 09 at no additional cost.

## 1.6 OPERATION AND MAINTENANCE MANUALS

A. Refer to individual plumbing sections and Division 01.

## 1.7 PAINTING

A. Protect fixtures, valves, trim, etc. from field painting operations. Do not install escutcheons and trim until painting is complete.

## 1.8 LOCATIONS AND MEASUREMENTS

A. Location of plumbing work is shown on the drawings as accurately as possible. Field-verify all measurements to insure that the work suits the surrounding trim, finishes and/or construction. Provide adjustment as necessary.

B. Make minor relocations of work prior to installation as required or as directed by the Architect/Engineer at no additional cost.

## 1.9 SUPERVISION

A. Contractor to provide an authorized and competent representative to constantly supervise the work from the beginning to completion and final acceptance. Insofar as possible, keep the same foreman and workmen throughout the project duration.

B. Representatives of Architect/Engineer, Owner, and local inspection authorities will make inspections during the progress of the work. Contractor to accommodate such inspections and correct deficiencies noted.

## 1.10 QUALITY AND WORKMANSHIP

A. Contractor to employ skilled tradesmen, laborers and supervisors. Final product to be a neat, well finished, and professional installation.

B. Remove and replace any work considered substandard quality in the judgment of the Architect/Engineer.

## 1.11 EXCAVATION, TRENCHING AND BACKFILLING

A. Provide all excavation, trenching and backfilling as required to complete the work under this Division.

B. Contractor is responsible for investigating conditions prior to excavating and to exercise care during the excavation to avoid any utilities or other objects which may or may not be shown on the drawings.

C. Excavate so as not to endanger or damage existing utilities and structures. If damage occurs, repair damage to the satisfaction of the Architect/Engineer at no additional cost.

D. Lay out location of all ditching at grade and obtain approval from the Architect/Engineer prior excavating.

E. Remove and dispose of all surplus earth from the site.

F. Provide suitable backfill materials as required.

G. Perform excavation, trenching and shoring in accordance with rules and regulations set forth in Article XXI, Bulletin 1 “Trenching” as published in a separate bulletin by the North Carolina Department of Labor, Division of Standards and Inspection Construction Bureau.

H. Bid excavation work as unclassified with no extra payment for removal of rock, unsuitable soils, etc.

## 1.12 CLOSING IN WORK

A. Do not cover up or enclose work until it has been inspected, tested and approved by authorities having jurisdiction over the work. Uncover any such work for inspection and/or test at no additional cost. Restore the work to its original condition after inspection and/or test at no additional cost.

## 1.13 CUTTING AND PATCHING

A. Perform all cutting and patching necessary to install work under this Division.

B. Perform cutting and patching in professional, workmanlike manner.

C. Arrange work to minimize cutting and patching.

D. Do not cut joists, beams, girders, columns or any other structural members without written permission from the Architect/Engineer.

E. Cut opening only large enough to allow easy installation of piping, wiring or ductwork.

F. Patching material to match material removed.

G. Restore patched surface to its original appearance at completion of patching.

H. Where waterproofed surfaces are patched, maintain integrity of waterproofing.

I. Remove rubble and excess patching materials from the premises.

## 1.14 INTERPRETATION OF DRAWINGS

A. Drawings and specifications under this Division are complementary each to the other. Provide any work specified herein and/or indicated on the drawings.

B. Drawings are diagrammatic and indicate generally the location of fixtures, piping, devices, equipment, etc. Follow drawings as closely as possible, but arrange work to suit the finished surroundings and/or trim.

C. The words “furnish”, “provide”, and/or “install” as used in these drawings and specifications are interpreted to include all material and labor necessary to complete the particular item, system, equipment, etc.

D. Any omissions from either the drawings or specifications are unintentional. Contractor is responsible for notifying the Architect/Engineer of any pertinent omissions before submitting a bid. Complete and working systems are required, whether every small item of material is shown and specified or not.

## 1.15 ACCESSIBILITY

A. Locate all equipment which must be serviced, operated, or maintained in fully accessible positions. Equipment to include, but not be limited to, valves, traps, cleanouts, motors, controllers and drain points. If required for accessibility, furnish access doors for this purpose. Minor deviations from drawings may be made to allow for better accessibility.

B. Coordinate exact locations and size of access panels for each concealed device requiring service.

C. Access panels: Steel construction with 16 gauge frames and 18 gauge panels, factory primed with rust inhibiting paint, finish paint by Contractor. Provide suitable UL listed doors where installed in rated construction.

D. Coordinate access panel locations with architectural construction.

E. Access panels are not required for access to work located above a lift-out “T” bar type ceiling.

## 1.16 ELECTRICAL WORK IN CONNECTION WITH PLUMBING WORK

A. Comply with Division 26. Any required Division 22 electrical work not specifically specified to be furnished by Division 26 Contractor shall be provided by Division 22 Contractor.

B. All electrical work performed Division 22 shall comply with Division 26 specification requirements.

C. See Division 26 specifications and electrical connection diagrams for division of labor between Divisions 22 and 26.

D. Coordinate electrical interface of supplied plumbing equipment with electrical system. Division 26 electrical work for plumbing systems is based on values scheduled on plumbing drawings. Division 22 Contractor is responsible for any costs to modify the contracted electrical work to service equipment with electrical characteristics different than those scheduled.

## 1.17 PLUMBING WORK IN CONNECTION WITH OTHER CONTRACTS

A. Provide plumbing services as required for items furnished by other contractors or vendors as shown on the plumbing drawings. Include rough-ins and final connections to equipment. Locations of connections shown on the drawings are approximate and some adjustment of actual connection locations should be anticipated. Coordinate exact connection requirements. Make final connections only after approval of the other contractor or vendor, in the contractor's or vendor's presence.
   1. Natural Gas System- Provide complete gas piping supply from natural gas meter. Coordinate equipment gas requirements with supplier. Contractor is responsible

for contacting natural gas supplier and complying with supplier connection and service piping requirements. Provide all required valves, regulators, accessories as shown on drawings.

2. Site Utilities- In general, work under this Division covers work to five feet outside buildings. Extend and connect work under this Division to site utilities as required.
3. Owner Furnished Equipment- Obtain exact plumbing requirements and rough-in locations for Owner furnished equipment. Provide complete plumbing installation for proper operation of equipment.
4. Laboratory Equipment- Obtaining exact plumbing requirements and rough-in locations for lab fixtures and equipment. Once lab fixtures and equipment installed, PC shall make all final connections for a complete plumbing installation and proper operation of equipment.

## 1.18 CONSTRUCTION IN EXISTING BUILDINGS

A. Note that work performed under this contract is to be accomplished in an existing building. See Division 01 Specifications Sections for additional requirements.

B. Provide safety barriers, protective devices, screening, etc., as required to maintain the safety of visitors in or near the work area.

C. Maintain clean work area. At the end of each working period, remove all debris, boxes, waste, etc. from the premises and dispose of properly.

D. Coordinate installation of new mechanical work in the existing building. Arrange piping and equipment to avoid interference with existing architectural, structural, mechanical and electrical work.

E. Contractor is responsible for any and all damage to existing buildings, grounds, walkways, pavement, etc. occurring during the course of his work. Repair any such damage to finish equal to that prior to damage to the satisfaction of the Architect/Engineer.

## 1.19 ALTERNATE BIDS

A. Alternate Bids are described in relevant sections of the General and Supplemental General Conditions and Division 1 Specification Sections.

## 1.20 PROJECT RECORD DRAWINGS

A. Submit under provisions of relevant sections of the General and Supplemental General Conditions and Specification 017839.

B. As the work progresses, legibly record all field changes on a set of project contract drawings, herein after called the “record drawings.”

C. Accurately show the installed condition of plumbing work on record drawings.

## 1.21 PHASING OF THE WORK

A. Schedule work in accordance with the relevant sections of the General and Supplemental General Conditions and Division 01 Specifications Sections.

## 1.22 PROJECT CLOSEOUT

A. Submit under provisions of relevant sections of the General and Supplemental General Conditions and Division 01 Specifications Sections.

## PART 2 - PRODUCTS (Not Applicable)

## PART 3 - EXECUTION (Not Applicable)

**END OF SECTION**

# SECTION 22 05 13 - COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section includes general requirements for single-phase motors installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

### 1.2 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

## PART 2 - PRODUCTS

### 2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with NEMA MG 1 unless otherwise indicated.

### 2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

### 2.3 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.

2. Split phase.
3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

## PART 3 - EXECUTION (Not Applicable)

**END OF SECTION**

# SECTION 22 05 17 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Sleeves.
2. Stack-sleeve fittings.
3. Sleeve-seal systems.
4. Grout.

### 1.2 ACTION SUBMITTALS

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

## PART 2 - PRODUCTS

### 2.1 SLEEVES

A. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

### 2.2 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Stainless steel.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

### 2.3 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

## PART 3 - EXECUTION

### 3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of plumbing equipment areas or other wet areas 2 inches above finished floor level.

2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 07 92 00 "Joint Sealants."

E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 07 84 13 "Penetration Firestopping."

### 3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space

between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

## 3.3 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:

    a. Galvanized-steel-pipe sleeves.

2. Concrete Slabs-on-Grade:

    a. Galvanized-steel-pipe sleeves with sleeve-seal system.

        1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs above Grade:

    a. Galvanized-steel-pipe sleeves.

4. Interior Partitions:

    a. Galvanized-steel-pipe sleeves.

**END OF SECTION**

# SECTION 22 05 18 - ESCUTCHEONS FOR PLUMBING PIPING

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Escutcheons.
2. Floor plates.

### 1.2 ACTION SUBMITTALS

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

## PART 2 - PRODUCTS

### 2.1 ESCUTCHEONS

A. One-Piece, Cast-Brass Type: With rough-brass finish and setscrew fastener.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.

### 2.2 FLOOR PLATES

A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

## 3.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

**END OF SECTION**

# SECTION 22 05 19 - METERS AND GAGES FOR PLUMBING PIPING

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Thermometers.
2. Gages.
3. Test plugs.

B. Related Sections:

1. Section 22 11 22 "Facility Natural-Gas Piping" for gas meters.

### 1.2 ACTION SUBMITTALS

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

B. Wiring Diagrams: For power, signal, and control wiring.

### 1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of meter and gage, from manufacturer.

### 1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

### 1.5 SPARE PARTS

A. Provide one spare certified calibrated gauge of each type to be utilized for testing/comparison purposes.

## PART 2 - PRODUCTS

### 2.1 LIGHT-ACTIVATED THERMOMETERS

A. Direct-Mounted, Light-Activated Thermometers:

1. Case: Metal; 7-inch nominal size unless otherwise indicated.
2. Scale(s): Deg F and deg C.
3. Case Form: Adjustable angle.
4. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
5. Stem: Aluminum and of length to suit installation.

    a. Design for Thermowell Installation: Bare stem.

6. Display: Digital.
7. Accuracy: Plus or minus 2 deg F.

## 2.2 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR or CUNI.
4. Material for Use with Steel Piping: CRES.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

## 2.3 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Standard: ASME B40.100.
2. Case: Sealed type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
3. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
4. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
5. Movement: Mechanical, with link to pressure element and connection to pointer.
6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi and kPa.
7. Pointer: Dark-colored metal.
8. Window: Glass.
9. Ring: Brass.
10. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

## 2.4 GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.

B. Siphons: Loop-shaped section of brass pipe with NPS 1/4 or NPS 1/2 pipe threads.

C. Valves: Brass or stainless-steel needle, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

## 2.5 TEST PLUGS

A. Description: Test-station fitting made for insertion into piping tee fitting.

B. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

C. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.

D. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

E. Core Inserts: EPDM self-sealing rubber.

## 2.6 TEST-PLUG KITS

A. Furnish one test-plug kit(s) containing one thermometer(s), one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.

B. High-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F.

C. Pressure Gage: Small, Bourdon-tube insertion type with 2- to 3-inch- diameter dial and probe. Dial range shall be at least 0 to 200 psig.

D. Carrying Case: Metal or plastic, with formed instrument padding.

# PART 3 - EXECUTION

## 3.1 INSTALLATION

A. Install thermowells with socket extending to center of pipe and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

G. Install valve and snubber in piping for each pressure gage for fluids (except steam).

H. Install valve and syphon fitting in piping for each pressure gage for steam.

I. Install test plugs in piping tees.

J. Install flow indicators in piping systems in accessible positions for easy viewing.

K. Install connection fittings in accessible locations for attachment to portable indicators.

L. Install thermometers in the following locations:

1. Domestic Hot Water Storage Tank.
2. Inlet and outlet of each domestic water heater.
3. Domestic hot water return piping in mechanical room.

M. Install pressure gages in the following locations:

1. Domestic Water Service Entrance.
2. Inlet and outlet of each domestic water pump.
3. RPZ inlet, RPZ outlet.
4. Natural gas regulator inlet.
5. Natural gas regulator outlet.

## 3.2 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

## 3.3 ADJUSTING

A. After installation, calibrate meters according to manufacturer's written instructions.

B. Adjust faces of meters and gages to proper angle for best visibility.

C. Thermometer stems shall be of length to match thermowell insertion length.

## 3.4 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Water Piping: 0 to 250 deg F.

## 3.5 PRESSURE-GAGE SCHEDULE

A. Pressure gages shall be the following:

1. Sealed, direct-mounted, metal case.

## 3.6 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range Water Piping: 0 to 100 psi.

**END OF SECTION**

# SECTION 22 05 23.12 - BALL VALVES FOR PLUMBING PIPING

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Bronze ball valves.

### 1.2 DEFINITIONS

A. CWP: Cold working pressure.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1. Certification that products comply with NSF 61 Annex G.

### 1.4 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, and soldered ends.
3. Set ball valves open to minimize exposure of functional surfaces.

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.

## PART 2 - PRODUCTS

### 2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded end valves.
2. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
3. ASME B16.18 for solder-joint connections.
4. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 Annex G for valve materials for potable-water service.

D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. Valve Actuator Types:

1. Handlever: For quarter-turn valves.

H. Valves in Insulated Piping:

1. Include 2-inch stem extensions.
2. Extended operating handles of nonthermal-conductive material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
3. Memory stops that are fully adjustable after insulation is applied.

## 2.2 BRONZE BALL VALVES

A. Two-Piece, Bronze Ball Valves with Full Port and Stainless-Steel Trim:

1. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 600 psig.
c. Body Design: Two piece.
d. Body Material: Bronze.
e. Ends: Threaded or soldered.
f. Seats: PTFE.
g. Stem: Stainless steel.
h. Ball: Stainless steel, vented.
i. Port: Full.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

### 3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install valve tags. Comply with requirements in Section 22 05 53 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

### 3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

B. Select valves with the following end connections:

1. For Copper Tubing, NPS 3 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.

### 3.4 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 3 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Two-piece, bronze ball valves with full port and stainless-steel trim.

**END OF SECTION**

# SECTION 22 05 23.14 - CHECK VALVES FOR PLUMBING PIPING

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Bronze swing check valves.

### 1.2 DEFINITIONS

A. CWP: Cold working pressure.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1. Certification that products comply with NSF 61 Annex G.

### 1.4 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect ends.
3. Set 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.

## PART 2 - PRODUCTS

### 2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded end valves.
2. ASME B16.18 for solder joint.
3. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 Annex G for valve materials for potable-water service.

D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. Valve Bypass and Drain Connections: MSS SP-45.

## 2.2 BRONZE SWING CHECK VALVES

A. Class 125, Bronze, Swing Check Valves with Bronze Disc:

1. Description:

a. Standard: MSS SP-80, Type 3.
b. CWP Rating: 200 psig.
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded or soldered. See valve schedule articles.
f. Disc: Bronze.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

## 3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.
2. Lift Check Valves: With stem upright and plumb.

F. Install valve tags. Comply with requirements in Section 22 05 53 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

## 3.3 ADJUSTING

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

## 3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Pump-Discharge Check Valves:

a. NPS 3 and Smaller: Bronze swing check valves with bronze disc.

B. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

C. End Connections:

1. For Copper Tubing, NPS 3 and Smaller: Threaded or soldered.

## 3.5 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 3 and Smaller: Bronze swing check valves, Class 125, bronze disc with soldered or threaded end connections.

**END OF SECTION**

# SECTION 22 05 29 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Thermal-hanger shield inserts.
3. Fastener systems.
4. Equipment supports.

B. Related Sections:

1. Section 05 50 00 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.

### 1.2 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

### 1.3 ACTION SUBMITTALS

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

## PART 2 - PRODUCTS

### 2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

## 2.2 THERMAL-HANGER SHIELD INSERTS

A. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.

B. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.

C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

## 2.3 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

## 2.4 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

## 2.5 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

## PART 3 - EXECUTION

### 3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

C. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

D. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

E. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

F. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

G. Install lateral bracing with pipe hangers and supports to prevent swaying.

H. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

I. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

J. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

K. Insulated Piping:

1. Attach clamps and spacers to piping.

    a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

    a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
    b. NPS 4: 12 inches long and 0.06 inch thick.
    c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
    d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
    e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

## 3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

## 3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M 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 so contours of welded surfaces match adjacent contours.

## 3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

## 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 a minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

## 3.6 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.

F. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.

G. Use padded hangers for piping that is subject to scratching.

H. Use thermal-hanger shield inserts for insulated piping and tubing.

I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
3. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
4. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
5. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
6. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
7. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
9. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
10. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
11. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
12. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
13. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.

J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

N. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

O. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

P. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

**END OF SECTION**

# SECTION 22 05 53 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Pipe labels.
3. Valve tags.

### 1.2 ACTION SUBMITTALS

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

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

## PART 2 - PRODUCTS

### 2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
7. Fasteners: Stainless-steel rivets.

8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

## 2.2 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: Size letters according to ASME A13.1 for piping.

## 2.3 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link chain.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, valve size, valve model number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

## PART 3 - EXECUTION

### 3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

### 3.2 GENERAL INSTALLATION REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

D. For concealed valves, equipment, and devices needing service, provide identification markers visible from floor. Use color dot stickers placed on ceiling grid where valves, equipment, and devices needing service are installed above. Color scheme to be in accordance with Owner's color coding standard.

### 3.3 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

### 3.4 PIPE LABEL INSTALLATION

A. Piping Color Coding: Complying with ASME A13.1.

B. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.

7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

C. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

D. Identification of Gas Piping:

1. Exposed piping shall be identified by a yellow label marked "Gas" in black letters. The marking shall be spaced at intervals not exceeding 5 feet. All piping and tubing systems greater than 0.5-psi service pressure shall be identified by a yellow label with black letters indicating the piping system pressure. Comply with the latest requirements of the North Carolina Plumbing Code.

E. Pipe Label Color Schedule:

1. Domestic Water Piping

a. Background: Complying with ASME A13.1.
b. Letter Colors: Complying with ASME A13.1.

2. Sanitary Waste Piping:

a. Background Color: Complying with ASME A13.1.
b. Letter Color: Complying with ASME A13.1.

## 3.5 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:
a. Domestic Water: 2 inches, round.

2. Valve-Tag Colors:
a. Domestic Water: Natural.

3. Letter Colors:
a. Domestic Water: White.

**END OF SECTION**

# SECTION 22 07 19 - PLUMBING PIPING INSULATION

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section includes insulating the following plumbing piping services:

1. Domestic cold-water piping.
2. Domestic hot-water piping.
3. Domestic recirculating hot-water piping.
4. Horizontal storm-water piping.
5. Horizontal roof drains and rainwater leaders.
6. Supplies and drains for handicap-accessible lavatories and sinks.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied, if any).

### 1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

### 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. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing 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.

C. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Supply and Drain Protective Shielding Guards: ICC A117.1.

## 1.5 DELIVERY, STORAGE, AND HANDLING

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

## 1.6 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

## 1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

# PART 2 - PRODUCTS

## 2.1 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General" and "Indoor Piping Insulation Schedule," articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Mineral-Fiber, Preformed Pipe Insulation:

1. Type I, 850 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

## 2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

## 2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

C. ASJ Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

D. PVC Jacket Adhesive: Compatible with PVC jacket.

## 2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

B. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below-ambient services.

1. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
2. Service Temperature Range: 0 to 180 deg F.
3. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
4. Color: White.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.

1. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
2. Service Temperature Range: Minus 20 to plus 180 deg F.
3. Solids Content: 60 percent by volume and 66 percent by weight.
4. Color: White.

## 2.5 SEALANTS

A. Joint Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: Minus 100 to plus 300 deg F.
4. Color: White or gray.

B. ASJ Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.

## 2.6 FACTORY-APPLIED JACKETS

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

1. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

## 2.7 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Adhesive: As recommended by jacket material manufacturer.
2. Color: Color-code jackets based on system. Color as selected by Architect.
3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
    a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

## 2.8 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Width: 3 inches.
2. Thickness: 11.5 mils.

3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Width: 2 inches.
2. Thickness: 6 mils.
3. Adhesion: 64 ounces force/inch in width.
4. Elongation: 500 percent.
5. Tensile Strength: 18 lbf/inch in width.

## 2.9 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

1. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

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

## 3.2 PREPARATION

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

B. Surface Preparation: Clean and prepare surfaces to be insulated.

## 3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Cleanouts.

## 3.4 PENETRATIONS

A. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

C. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Section 07 84 13 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

D. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 07 84 13 "Penetration Firestopping."

## 3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on

insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

## 3.6 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

C. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

## 3.7 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturers recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

## 3.8 FIELD QUALITY CONTROL

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

B. Perform tests and inspections.

C. Tests and Inspections:

1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

## 3.9 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

## 3.10 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

1. All Pipe Sizes: Insulation shall be the following:
   a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

B. Domestic Hot and Recirculated Hot Water:

1. All Pipe Sizes: Insulation shall be the following:
   a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

C. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:

1. All Pipe Sizes: Insulation shall be the following:
   a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.

D. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F:

1. All Pipe Sizes: Insulation shall be the following:
   a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

E. Horizontal Stormwater and Overflow: Insulation shall be the following:

1. All Pipe Sizes: Insulation shall be the following:
   a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

F. Horizontal Roof Drain and Overflow Drain Bodies: Insulation shall be the following:

1. All Pipe Sizes: Insulation shall be the following:
   a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

## 3.11 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:

1. None.

D. Piping, Exposed where subject to damage (from floor to 8’ above finished floor):

1. PVC color complying with ASME A13.1: 20 mils thick.

**END OF SECTION**

# SECTION 22 11 16 - DOMESTIC WATER PIPING

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Under-building-slab and aboveground domestic water pipes, tubes, and fittings inside buildings.
2. Encasement for piping.

### 1.2 ACTION SUBMITTALS

A. Product Data: For transition fittings and dielectric fittings.

### 1.3 INFORMATIONAL SUBMITTALS

A. System purging and disinfecting activities report.

B. Field quality-control reports.

C. Bacteriological and post-chlorination test results.

D. Water Test Report for Use.

### 1.4 FIELD CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of water service.
2. Do not interrupt water service without Owner's written permission.

## PART 2 - PRODUCTS

### 2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

### 2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.

B. Soft Copper Tube: ASTM B 88, Type L water tube, annealed temper.

C. Copper Unions:

1. MSS SP-123.
2. Cast-copper-alloy, hexagonal-stock body.
3. Ball-and-socket, metal-to-metal seating surfaces.
4. Solder-joint or threaded ends.

### 2.3 PIPING JOINING MATERIALS

A. Solder Filler Metals: ASTM B 32, lead-free alloys.

B. Flux: ASTM B 813, water flushable.

### 2.4 ENCASEMENT FOR PIPING

A. Standard: ASTM A 674 or AWWA C105/A21.5.

B. Form: Sheet or tube.

C. Color: Black or natural.

### 2.5 TRANSITION FITTINGS

A. General Requirements:

1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Sleeve-Type Transition Coupling: AWWA C219.

## 2.6 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Nipples:

1. Standard: IAPMO PS 66.
2. Electroplated steel nipple complying with ASTM F 1545.
3. Pressure Rating and Temperature: 300 psig at 225 deg F.
4. End Connections: Male threaded or grooved.
5. Lining: Inert and noncorrosive, propylene.

# PART 3 - EXECUTION

## 3.1 EARTHWORK

A. Comply with requirements in Division 33 for excavating, trenching, and backfilling.

## 3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

C. Install underground copper tube and ductile-iron pipe in PE encasement according to ASTM A 674 or AWWA C105/A21.5.

D. Install shutoff valve, hose-end drain valve, pressure gage, and test tee with valve inside the building at domestic water-service entrance.

E. Install shutoff valve immediately upstream of each dielectric fitting.

F. Install domestic water piping level without pitch and plumb.

G. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

H. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

I. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

J. Install piping to permit valve servicing.

K. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

L. Install piping free of sags and bends.

M. Install fittings for changes in direction and branch connections.

N. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

O. Install pressure gages on suction and discharge piping for each plumbing pump.

P. Install thermostats in hot-water circulation piping.

Q. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."

R. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."

S. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

## 3.3 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.

E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

F. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

## 3.4 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:

1. Fittings for NPS 2 and Larger: Sleeve-type coupling.

C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.

## 3.5 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or nipples.

## 3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger, support products, and installation in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."

1. Vertical Piping: MSS Type 8 or 42, clamps.
2. Individual, Straight, Horizontal Piping Runs:

a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
b. Longer than 100 Feet: MSS Type 43, adjustable roller hangers.
c. Longer than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

3. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support vertical piping and tubing at base and at each floor.

C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
4. NPS 2-1/2: 108 inches with 1/2-inch rod.
5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.

E. Install supports for vertical copper tubing every 10 feet.

F. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

## 3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
2. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
3. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection.

## 3.8 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

B. Label pressure piping with system operating pressure.

## 3.9 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Piping Inspections:

    a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
    b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

        1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
        2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.

    c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
    d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:

    a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
    b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
    c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
    d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
    e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
    f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

## 3.10 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.

2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.

    a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
    b. Adjust calibrated balancing valves to flows indicated.

5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Check plumbing specialties and verify proper settings, adjustments, and operation.

## 3.11 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:

    a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    b. Fill and isolate system according to either of the following:

        1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
        2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

    c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
    d. Repeat procedures if biological examination shows contamination.
    e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

D. Water supply shall not be placed into service until bacteriological test results of representative water samples analyzed by an Owner approved laboratory are found to be satisfactory. Contractor shall hire an independent laboratory to conduct

bacteriological and post-chlorination test certifying that the water meets EPA quality of the drinking water. The “Water Test Report for Use,” after accepted by the Engineer of Records, is required to be submitted to SCO prior sending request for Final Inspection and Occupancy Permit.

## 3.12 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Under-building-slab, domestic water, building-service piping, NPS 3 and smaller, shall be the following:

1. Soft copper tube, ASTM B 88, Type K; no joints.

C. Aboveground domestic water piping, NPS 3 and smaller, shall be the following:

1. Hard copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and soldered joints.

## 3.13 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use ball valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
2. Throttling Duty: Use ball valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
3. Hot-Water Circulation Piping, Balancing Duty: Calibrated balancing valves.
4. Drain Duty: Hose-end drain valves.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

**END OF SECTION**

# SECTION 22 11 19 - DOMESTIC WATER PIPING SPECIALTIES

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. Section Includes:

1. Backflow preventers.
2. Balancing valves.
3. Temperature-actuated, water mixing valves.
4. Outlet boxes.
5. Hose bibbs.
6. Wall hydrants.
7. Drain valves.
8. Water-hammer arresters.
9. Trap-seal primer valves.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

### 1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

### 1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

## PART 2 - PRODUCTS

### 2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

A. Potable-water piping and components shall comply with NSF 61 Annex G and NSF 14.

### 2.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

### 2.3 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:

1. Refer to Plumbing Fixture Schedule on design drawings.
2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.

B. Plumbing Equipment Backflow Preventers:

1. Standard: ASSE 1022.
2. Operation: Continuous-pressure applications.
3. Size: NPS 1/4 or NPS 3/8.
4. Body: Stainless steel.
5. End Connections: Threaded.

### 2.4 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:

1. Type: Ball valve with two readout ports and memory-setting indicator.
2. Body: bronze.
3. Size: Same as connected piping, but not larger than NPS 2.
4. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

### 2.5 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Primary, Thermostatic, Water Mixing Valves:

1. Standard: ASSE 1017.
2. Pressure Rating: 125 psig minimum unless otherwise indicated.
3. Refer to Plumbing Fixture Schedule on design drawings.

## 2.6 OUTLET BOXES

A. Icemaker Outlet Boxes:

1. Mounting: Recessed.
2. Material and Finish: Enameled-steel or epoxy-painted-steel box and faceplate.
3. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 or smaller copper tube outlet.
4. Supply Shutoff Fitting: NPS 1/2 gate, globe, or ball valve and NPS 1/2 copper, water tubing.

## 2.7 HOSE BIBBS

A. Hose Bibbs:

1. Standard: ASME A112.18.1 for sediment faucets.
2. Refer to Plumbing Fixture Schedule on design drawings.

## 2.8 WALL HYDRANTS

A. Non-freeze Wall Hydrants:

1. Refer to Plumbing Fixture Schedule on design drawings.

## 2.9 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

## 2.10 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:

1. Standard: ASSE 1010 or PDI-WH 201.
2. Type: Metal bellows or Copper tube with piston.
3. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

## 2.11 TRAP-SEAL PRIMER DEVICE

A. Supply-Type, Trap-Seal Primer Device:

1. Standard: ASSE 1018.
2. Pressure Rating: 125 psig minimum.
3. Body: Bronze.
4. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
5. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
6. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

B. Drainage-Type, Trap-Seal Primer Device:

1. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 minimum, trap makeup connection.
2. Size: NPS 1-1/4 minimum.
3. Material: Chrome-plated, cast brass.

## 2.12 WATER FILTERS

A. Filter: One or more water filters complying with NSF 42 and NSF 53 for cyst and lead reduction to below EPA standards; with capacity sized for unit peak flow rate.

# PART 3 - EXECUTION

## 3.1 INSTALLATION

A. 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 unacceptable for this application.
3. Do not install bypass piping around backflow preventers.

B. Install balancing valves in locations where they can easily be adjusted.

C. Install temperature-actuated, water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.

1. Install cabinet-type units recessed in or surface mounted on wall as specified.

D. Install outlet boxes recessed in wall or surface mounted on wall. Install 2-by-4-inch fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 06 10 00 "Rough Carpentry."

E. Install water-hammer arresters in water piping according to PDI-WH 201.

F. Install ball valves with valved bypass on water connections to water filters at ice machine water supply. Comply with valve requirements specified in Section 22 05 23.12 "Ball Valves for Plumbing Piping."

G. Supply-Type, Trap-Seal Primer Device: Install 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. Drainage-Type, Trap-Seal Primer Device: Install as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.

## 3.2 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Reduced-pressure-principle backflow preventers.
2. Calibrated balancing valves.
3. Primary, thermostatic, water mixing valves.
4. Outlet boxes.
5. Supply-type, trap-seal primer valves.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

## 3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test each reduced-pressure-principle backflow preventer according to authorities having jurisdiction and the device's reference standard.

B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

## 3.4 ADJUSTING

A. Set field-adjustable flow set points of balancing valves.

B. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

**END OF SECTION**

# SECTION 22 11 23 - DOMESTIC WATER PUMPS

## 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. In-line, sealless centrifugal pumps.

### 1.3 DEFINITIONS

A. 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.

### 1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include materials of construction, rated capacities, certified performance curves with operating points plotted on curves, operating characteristics, electrical characteristics, and furnished specialties and accessories.

### 1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water pumps to include in operation and maintenance manuals.

### 1.6 QUALITY ASSURANCE

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

B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

### 1.7 DELIVERY, STORAGE, AND HANDLING

A. Retain shipping flange protective covers and protective coatings during storage.

B. Protect bearings and couplings against damage.

C. Comply with pump manufacturer's written rigging instructions for handling.

## PART 2 - PRODUCTS

### 2.1 IN-LINE, SEALLESS CENTRIFUGAL PUMPS

A. Description: Factory-assembled and -tested, in-line, close-coupled, canned-motor, sealless, overhung-impeller centrifugal pumps.

B. Refer to Plumbing Fixture Schedule on design drawings for additional information.

### 2.2 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 22 05 13 "Common Motor Requirements for Plumbing Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

### 2.3 CONTROLS

A. Refer to DDC system diagrams for control of hot-water circulation pump.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine roughing-in of domestic-water-piping system to verify actual locations of connections before pump installation.

### 3.2 PUMP INSTALLATION

A. Comply with HI 1.4.

B. Install in-line, sealless centrifugal pumps with shaft horizontal unless otherwise indicated.

C. Install thermostats in hot-water return piping.

## 3.3 CONNECTIONS

A. Comply with requirements for piping specified in Section 22 11 16 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to pumps to allow service and maintenance.

C. Connect domestic water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles.

## 3.4 IDENTIFICATION

A. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment" for identification of pumps.

## 3.5 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Check piping connections for tightness.
3. Clean strainers on suction piping.
4. Perform the following startup checks for each pump before starting:

    a. Verify bearing lubrication.
    b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
    c. Verify that pump is rotating in the correct direction.
    d. Verify that pump is controlled by DDC system.

5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
6. Start motor.
7. Open discharge valve slowly.
8. Adjust timer settings.

## 3.6 ADJUSTING

A. Adjust domestic water pumps to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust initial temperature set points.

C. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

**END OF SECTION**

# SECTION 22 11 23.13 - DOMESTIC-WATER PACKAGED BOOSTER PUMPS

## 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. Multiplex, variable-speed booster pumps.

B. Related Sections:

1. Section 22 11 23 "Domestic Water Pumps" for domestic-water circulation pumps.

### 1.3 DEFINITIONS

A. VFC: Variable-frequency controller(s).

### 1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For booster pumps. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

### 1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For booster pumps to include in emergency, operation, and maintenance manuals.

## 1.6 QUALITY ASSURANCE

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

B. ASME Compliance: Comply with ASME B31.9 for piping.

C. UL Compliance for Packaged Pumping Systems:

1. UL 508, "Industrial Control Equipment."
2. UL 508A, "Industrial Control Panels."
3. UL 778, "Motor-Operated Water Pumps."
4. UL 1995, "Heating and Cooling Equipment."

D. Booster pumps shall be listed and labeled as packaged pumping systems by testing agency acceptable to authorities having jurisdiction.

## 1.7 DELIVERY, STORAGE, AND HANDLING

A. Retain protective coatings and flange's protective covers during storage.

## 1.8 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

# PART 2 - PRODUCTS

## 2.1 MULTIPLEX, VARIABLE-SPEED BOOSTER PUMPS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Bell & Gossett Domestic Pump; ITT Corporation.
2. Grundfos Pumps Corporation U.S.A.
3. Patterson Pump Company; a subsidiary of the Gorman-Rupp Company.

B. Description: Factory-assembled and tested variable speed domestic water pressure booster system with pumps, piping, isolation and check valves, controls, specialties and accessories mounted on a structural steel base. Pump and electrical protection shall be integrated into the pump controller package. The package shall be arranged in a compact design to allow it to be moved through a standard 36” doorway.

C. Pumps:

1. Pumps shall be close coupled, end suction, with volute housing mounted to allow "back pull out" service of the pump or motor without disturbing piping connections.

2. Casing Construction: Radially split, ASTM A48 CL20 cast iron suitable for 175 PSI working pressure. The pump volute shall be supplied with vent and drain tappings. Connections shall be female NPT. The casing shall be O-ring sealed to the seal housing.
3. Impeller Construction: Closed, single suction, fabricated from cast bronze conforming to ASTM B 584, keyed to shaft and secured by a locking capscrew. Casing Wear Rings: Replaceable, bronze.
4. Pump Shaft and Sleeve Bearings: Steel shaft, with a replaceable bronze shaft sleeve completely covering the wetted area of the shaft under the seal.
5. Seals: Mechanical seals consisting of carbon rotating ring, stainless steel spring, ceramic seat, and flexible bellows and gasket.
6. Motor: Motor shall be NEMA design JM of size and type scheduled on drawings. Motors shall have a 1.15 service factor. Pump motors shall be secured to mounting frame. Booster designs with pump motors supported from the volute only shall not be acceptable.
7. Each pump shall be tested by its manufacturer at shut off and at a minimum of two other operating points at operating speed to verify performance.

A. Check valves: Angle style, pilot operated check valves shall be installed on the discharge of each pump. The valve shall have a fusion bonded epoxy coated ductile iron body with a bronze disc. The check valves shall be able to be serviced or rebuilt without removing them from the pressure booster. Direct acting check valves are not acceptable.
B. Isolation Valves: Two-piece, bronze body, full port ball valves shall be provided to isolate each pump and check valve.
C. Thermal protection: Self-contained thermal-relief valves factory set to discharge at 125°F shall be mounted on each pump.
D. Piping: All piping shall be constructed from Type 304 stainless steel. Suction and Discharge headers shall be designed and constructed for minimal friction loss.
E. Pressure gauges: Pressure gauges shall be liquid filled, bourdon tube type. Gauges shall be supplied for both the suction and discharge headers.
F. Package Base: The pressure booster base shall be designed and fabricated to provide proper structural support for all attached equipment, and provide for anchorage to the structure. The base shall include a rigid structural member for pump and motor support. Main members shall be constructed from heavy weight A-36 structural steel members with reinforcing channels for larger boosters. Steel base shall be painted with machinery enamel.
G. Control Panel: Manufacturer shall provide a UL-508A listed complete electrical system including main disconnect, variable speed pump controller, pressure transducers, instrumentation and controls to automatically start, stop and modulate pump speed to smoothly, efficiently and reliably provide pump variable flow rates at a constant discharge pressure. The booster package shall include full pump, motor and drive safety features required to protect the equipment and piping system.
    1. Main Control Panel: A door-operated non fused main disconnect shall be provided which shall remove power from the entire pressure booster when switched

off. Each Variable Speed Drive (VFD)/Motor shall be protected by a molded case circuit breaker or MSP enclosed in the main control panel.

2. Motor Controller: NEMA ICS 7.1 variable-frequency, variable torque, solid-state pulse-width modulating type. VFD protective features shall include:
   a. Ground fault
   b. Short Circuit
   c. Motor overload
3. Suction and discharge pressure transducers.
   a. Pressure transducers shall be utilized for providing all pressure signals for the pump control logic. Pressure switches are not acceptable.
   b. Pressure transducer shall be a solid-state bonded strain gage type with an accuracy of plus/minus 1 %. Transducer shall be constructed of non-ferrous metal suitable for used with domestic water. Pressure transducers constructed of plastic are not acceptable.
   c. Transducer shall be rated for package discharge and suction pressures as shown on submittal.
   d. Pressure transducer shall utilize a Packard type connector to prevent moisture intrusion.
4. Temperature Sensor
   a. A NTC thermistor or RTD shall be used for sensing the booster pumps' discharge temperatures for temperature limit control logic. Thermostats are not acceptable.
   b. The temperature sensor shall be of the immersion type and shall be immersed in water from the pumps' discharge. It shall be sealed off by a reusable compression type fitting allowing easy removal and insertion.
5. Controller: Touchscreen variable speed pump logic controller in a NEMA 1 enclosure with door operated disconnect to include, power distribution and overload protection for each AFD and the following control features:
   a. Unit shall utilize user-friendly front panel programming that displays parameters in clear text.
   b. Display shall show all system variables in English.
   c. Program settings shall be changeable and stored in non-volatile memory. Program settings shall be retained in memory in the event of loss of power to the controller, without the use of a backup battery.
   d. System operating pressure shall be clearly displayed in PSI or feet of head for ease of use and to provide an operator friendly interface.
   e. Additional parameters, where applicable, shall be displayed in units consistent with pumping systems.
   f. The settings and program in whole or part may be locked out with the use of an operator selectable password. Standard system settings shall include at a minimum the following functions:
      1) Low suction pressure shutdown with auto restart
      2) High discharge pressure shutdown with lockout
      3) High discharge temperature shutdown
      4) Pump failure alarm
      5) Constant pressure setting with variable flow capability
      6) Multiple pump operation with alternation
      7) Pump starting point with allowable, adjustable pressure drop
      8) Minimum speed

9) No flow standby

6. Hydro-pneumatic Tank:
   a. Furnish ASME hydro-pneumatic tank separately for field installation.
   b. Furnish tank of size pressure rating and construction specified on pressure booster schedule.
   c. Furnish hydro-pneumatic tank connection on discharge header with union, isolation valve and drain valve on discharge header of packaged pressure booster.
7. Sequence of Operation:
   a. The pump controller shall receive a 4-20mA signal from each pressure transducer.
   b. The pressure transducer shall monitor system pressure and provide an analog signal to the pump control software, and allow the VFD motor controller to provide a variable Volts/Hz output to the motor.
   c. Whenever the pressure drops below the set system pressure, the lead pump shall start and run at speed required to maintain system pressure setpoint (as set by the operator.) If the pressure setpoint cannot be maintained by one pump, the lag pump shall start to provide the extra flow and pressure automatically.
   d. When demand decreases to a level which can be met by one pump and an adjustable minimum run-timer has elapsed, the lag pump will be stopped.
   e. The lead pump shall alternate based on elapsed run time.
   f. When the system experiences low demand the controller shall test for a no flow condition without the use of external switches or controls. The controller will stop the lead pump after verifying a zero demand condition exists and a minimum run-timer has elapsed. The hydro-pneumatic tank shall supply water to the system until the pressure falls below the restart pressure, at which point the lead pump shall restart
   g. All program settings shall be based on centrifugal pump language.
   h. Program settings shall be password protected. With proper password entry, settings shall be field adjustable to allow changes by the user.
   i. Demand Set Control: The variable speed pressure booster shall employ logic that recalculates the setpoint based on the actual system friction loss between booster discharge and the remote critical fixture. The controller will monitor system demand and continuously change the discharge pressure setpoint based on flow. The controlling set point and flow shall be displayed on the digital screen.

D. Capacities and Characteristics:

1. Refer to Schedule on drawings for further information.

## 2.2 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors.

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in NFPA 70.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine roughing-in for booster pumps to verify actual locations of piping connections before booster-pump installation.

### 3.2 INSTALLATION

A. Equipment Mounting: Install booster pumps on concrete base using elastomeric pads. Comply with requirements for concrete base specified in Section 03 30 00 "Cast-in-Place Concrete."

1. Minimum Deflection: 1/4 inch.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.

B. Support connected domestic-water piping so weight of piping is not supported by booster pumps.

### 3.3 CONNECTIONS

A. Comply with requirements for piping specified in Section 22 11 16 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect domestic-water piping to booster pumps. Install suction and discharge pipe equal to or greater than size of system suction and discharge headers.

1. Install shutoff valves on piping connections to booster-pump suction and discharge headers. Install ball valves same size as suction and discharge headers. Comply with requirements for general-duty valves specified in Section 22 05 23.12 "Ball Valves for Plumbing Piping."

2. Install union connections on suction and discharge headers at connection to domestic-water piping. Comply with requirements for unions and flanges specified in Section 22 11 16 "Domestic Water Piping."
3. Install valved bypass, same size as and between piping, at connections to booster-pump suction and discharge headers. Comply with requirements for domestic-water piping specified in Section 22 11 16 "Domestic Water Piping."
4. Install flexible connectors, same size as piping, on piping connections to booster-pump suction and discharge headers.
5. Install piping adjacent to booster pumps to allow service and maintenance.

## 3.4 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

## 3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Tests and Inspections:

1. Perform visual and mechanical inspection.
2. Leak Test: After installation, charge booster pump and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start booster pumps to confirm proper motor rotation and booster-pump operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Pumps and controls will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

## 3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

## 3.7 ADJUSTING

A. Adjust booster pumps to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust pressure set points.

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting booster pump to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

## 3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain booster pumps.

**END OF SECTION**

# SECTION 22 11 24 - FACILITY NATURAL-GAS PIPING

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Pipes, tubes, and fittings.
2. Piping specialties.
3. Piping and tubing joining materials.
4. Valves.
5. Pressure regulators.

### 1.2 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

### 1.3 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:

1. Piping and Valves: 100 psig minimum unless otherwise indicated.
2. Service Regulators: 65 psig minimum unless otherwise indicated.
3. Minimum Operating Pressure of Service Meter: 5 psig.

B. Natural-Gas System Pressures within Buildings: Two pressure ranges. Primary pressure is more than 0.5 psig but not more than 2 psig, and is reduced to secondary pressure of 0.5 psig or less.

### 1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following:

1. Piping specialties.

2. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
3. Pressure regulators. Indicate pressure ratings and capacities.
4. Dielectric fittings.

B. Delegated-Design Submittal: For natural-gas piping and equipment 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. Detail fabrication and assembly of seismic restraints.
2. Design Calculations: Calculate requirements for selecting seismic restraints.

## 1.5 INFORMATIONAL SUBMITTALS

A. Site Survey: Plans, drawn to scale, on which natural-gas piping is shown and coordinated with other services and utilities.

## 1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For motorized gas valves pressure and regulators to include in emergency, operation, and maintenance manuals.

## 1.7 QUALITY ASSURANCE

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

## 1.8 DELIVERY, STORAGE, AND HANDLING

A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.

B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.

D. Protect stored PE pipes and valves from direct sunlight.

## 1.9 PROJECT CONDITIONS

A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.

B. Interruption of Existing Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide purging and startup of natural-gas supply according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of natural-gas service.
2. Do not proceed with interruption of natural-gas service without Owner's written permission.

## 1.10 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

# PART 2 - PRODUCTS

## 2.1 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

    a. Material Group: 1.1.
    b. End Connections: Threaded or butt welding to match pipe.
    c. Lapped Face: Not permitted underground.
    d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
    e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.

B. Drawn-Temper Copper Tube: Comply with ASTM B 88, Type L.

1. Copper Fittings: ASME B16.22, wrought copper, and streamlined pattern.
2. Bronze Flanges and Flanged Fittings: ASME B16.24, Class 150.

a. Gasket Material: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
b. Bolts and Nuts: ASME B18.2.1, carbon steel or stainless steel.

C. Annealed-Temper Copper Tube: Comply with ASTM B 88, Type L.

1. Copper Fittings: ASME B16.22, wrought copper, and streamlined pattern.

## 2.2 PIPING SPECIALTIES

A. Appliance Flexible Connectors:

1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
3. Corrugated stainless-steel tubing with polymer coating.
4. Operating-Pressure Rating: 0.5 psig.
5. End Fittings: Zinc-coated steel.
6. Threaded Ends: Comply with ASME B1.20.1.
7. Maximum Length: 72 inches

B. Quick-Disconnect Devices: Comply with ANSI Z21.41.

1. Copper-alloy convenience outlet and matching plug connector.
2. Nitrile seals.
3. Hand operated with automatic shutoff when disconnected.
4. For indoor or outdoor applications.
5. Adjustable, retractable restraining cable.

C. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 40 mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

## 2.3 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.

B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

## 2.4 MANUAL GAS SHUTOFF VALVES

A. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.

1. CWP Rating: 125 psig.
2. Threaded Ends: Comply with ASME B1.20.1.
3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
6. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.

B. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.

1. Body: Bronze, complying with ASTM B 584.
2. Ball: Chrome-plated bronze.
3. Stem: Bronze; blowout proof.
4. Seats: Reinforced TFE; blowout proof.
5. Packing: Threaded-body packnut design with adjustable-stem packing.
6. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
7. CWP Rating: 600 psig.
8. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
9. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

C. Bronze Plug Valves: MSS SP-78.

1. Body: Bronze, complying with ASTM B 584.
2. Plug: Bronze.
3. Ends: Threaded, socket, or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
4. Operator: Square head or lug type with tamperproof feature where indicated.
5. Pressure Class: 125 psig.
6. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
7. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

## 2.5 MOTORIZED GAS VALVES

A. Electrically Operated Valves: Comply with UL 429.

1. Pilot operated.
2. Body: Brass or aluminum.
3. Seats and Disc: Nitrile rubber.
4. Springs and Valve Trim: Stainless steel.
5. 120-V ac, 60 Hz, Class B, continuous-duty molded coil, and replaceable.
6. NEMA ICS 6, Type 4, coil enclosure.
7. Normally closed.
8. Visual position indicator.

B. Control Station (Emergency Stop).

1. Flush mounted or surface mounted as construction allows.
2. Power to valves shut off to close in 0.1 seconds or less.
3. Keyed reset.

## 2.6 PRESSURE REGULATORS

A. General Requirements:

1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.

B. Service Pressure Regulators: Comply with ANSI Z21.80.

1. Body and Diaphragm Case: Cast iron or die-cast aluminum.
2. Springs: Zinc-plated steel; interchangeable.
3. Diaphragm Plate: Zinc-plated steel.
4. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
5. Orifice: Aluminum; interchangeable.
6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
7. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
8. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
9. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
10. Maximum Inlet Pressure: 100 psig.

C. Line Pressure Regulators: Comply with ANSI Z21.80.

1. Body and Diaphragm Case: Cast iron or die-cast aluminum.
2. Springs: Zinc-plated steel; interchangeable.
3. Diaphragm Plate: Zinc-plated steel.
4. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
5. Orifice: Aluminum; interchangeable.
6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
7. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
8. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
9. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
10. Maximum Inlet Pressure: 2 psig
11. Provide with leak-limiting device.

## 2.7 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Description:

a. Standard: ASSE 1079.
b. Pressure Rating: 125 psig minimum at 180 deg F.
c. End Connections: Solder-joint copper alloy and threaded ferrous.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.

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

## 3.2 PREPARATION

A. Close equipment shutoff valves before turning off natural gas to premises or piping section.

B. Inspect natural-gas piping according to NFPA 54 to determine that natural-gas utilization devices are turned off in piping section affected.

C. Comply with NFPA 54 requirements for prevention of accidental ignition.

## 3.3 OUTDOOR PIPING INSTALLATION

A. Comply with NFPA 54 for installation and purging of natural-gas piping.

B. Install pressure gage downstream from service regulator.

## 3.4 INDOOR PIPING INSTALLATION

A. Comply with NFPA 54 and NC Fuel Gas Code for installation and purging of natural-gas piping.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.

D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

G. Locate valves for easy access.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Verify final equipment locations for roughing-in.

K. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.

L. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.

1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.

M. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.

N. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.

O. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.

1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
2. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.

a. Exception: Tubing passing through partitions or walls does not require striker barriers.

3. Prohibited Locations:

a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
b. Do not install natural-gas piping in solid walls or partitions.

P. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

Q. Connect branch piping from top or side of horizontal piping.

R. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.

S. Do not use natural-gas piping as grounding electrode.

T. Each above-ground portion of the gas piping system shall be electrically continuous and bonded to an effective ground-fault current path.

U. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.

V. A tee fitting with one opening capped or plugged shall be installed between the MP regulator and its upstream shutoff valve. Such tee fitting shall be positioned to allow connection of a pressure-measuring instrument and to serve as a sediment trap

W. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."

X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

## 3.5 VALVE INSTALLATION

A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.

B. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

C. Install motorized gas valves in all classrooms/labs with natural gas. Provide emergency stop pushbuttons at classroom/lab exit.

## 3.6 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints:

1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
2. Cut threads full and clean using sharp dies.
3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.

## 3.7 HANGER AND SUPPORT INSTALLATION

A. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in the North Carolina Building Code.

B. Comply with requirements for pipe hangers and supports specified in Section 22 05 29 "Hangers and Supports for HVAC Piping and Equipment."

C. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
4. NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.
5. NPS 4 and Larger: Maximum span, 10 feet; minimum rod size, 5/8 inch.

D. Install hangers for horizontal drawn-temper copper tubing with the following maximum spacing and minimum rod sizes:

1. NPS 3/8: Maximum span, 48 inches; minimum rod size, 3/8 inch.
2. NPS 1/2 and NPS 5/8: Maximum span, 72 inches; minimum rod size, 3/8 inch.
3. NPS 3/4 and NPS 7/8: Maximum span, 84 inches; minimum rod size, 3/8 inch.
4. NPS 1: Maximum span, 96 inches; minimum rod size, 3/8 inch.

## 3.8 CONNECTIONS

A. Connect to utility's gas main according to utility's procedures and requirements.

B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.

C. Install piping adjacent to appliances to allow service and maintenance of appliances.

D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.

E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

## 3.9 LABELING AND IDENTIFYING

A. Comply with requirements in Section 22 05 53 "Identification for Plumbing Piping and Equipment" for piping and valve identification.

B. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

## 3.10 PAINTING

A. Comply with requirements in Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting" for painting interior and exterior natural-gas piping.

B. Paint exposed, exterior metal piping, valves, service regulators, and piping specialties, except components, with factory-applied paint or protective coating.

1. Alkyd System: MPI EXT 5.1D.

a. Prime Coat: Alkyd anticorrosive metal primer.
b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
c. Topcoat: Exterior alkyd enamel (gloss).
d. Color: Gray.

C. Paint exposed, interior metal piping, valves, and piping specialties, except components, with factory-applied paint or protective coating.

1. Alkyd System: MPI INT 5.1E.

a. Prime Coat: Alkyd anticorrosive metal primer.
b. Intermediate Coat: Interior alkyd matching topcoat.
c. Topcoat: Interior alkyd (gloss).
d. Color: Yellow.

D. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

## 3.11 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Test, inspect, and purge natural gas according to NFPA 54, NC Fuel Gas Code and authorities having jurisdiction.

C. Natural-gas piping will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports. Copy of the test and inspector report shall be provided to the Engineer of Record and the State Construction Office per Specification Section 01 40 00.

## 3.12 OUTDOOR PIPING SCHEDULE

A. Aboveground natural-gas piping shall be the following:

1. Steel pipe with malleable-iron fittings and threaded joints.

## 3.13 INDOOR PIPING SCHEDULE

A. Aboveground, branch piping NPS 1 and smaller shall be one of the following:

1. Annealed-temper, copper tube with wrought-copper fittings and brazed joints.
2. Steel pipe with malleable-iron fittings and threaded joints.

B. Aboveground, distribution piping shall be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.
2. Drawn-temper copper tube with wrought-copper fittings and brazed joints.

## 3.14 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Valves for pipe sizes NPS 2 and smaller at service meter shall be the following:

1. Bronze plug valve.

B. Distribution piping valves for pipe sizes NPS 2 and smaller shall be the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.

C. Valves in branch piping for single appliance shall be the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.

**END OF SECTION**

# SECTION 22 13 16 - STORM, SANITARY WASTE AND VENT PIPING

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Pipe, tube, and fittings.
2. Specialty pipe fittings.

### 1.2 ACTION SUBMITTALS

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

### 1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

### 1.4 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

## PART 2 - PRODUCTS

### 2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

### 2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service class.

B. Gaskets: ASTM C 564, rubber.

## 2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. CISPI, Hubless-Piping Couplings:

1. Standards: ASTM C 1277 and CISPI 310.
2. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

## 2.4 PVC PIPE AND FITTINGS

A. A.Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

C. Adhesive Primer: ASTM F 656.

D. Solvent Cement: ASTM D 2564.

## 2.5 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
3. Unshielded, Nonpressure Transition Couplings:

    a. Standard: ASTM C 1173.
    b. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
    c. Sleeve Materials:

        1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
        2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
        3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

## PART 3 - EXECUTION

### 3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 31 20 00 "Earth Moving."

### 3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping at indicated slopes.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections.

H. Install piping to allow application of insulation.

I. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

J. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

K. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:

1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
2. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

L. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

M. Install underground PVC piping according to ASTM D 2321.

N. Plumbing Specialties:

1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Comply with requirements for cleanouts specified in Section 22 13 19 "Sanitary Waste Piping Specialties."
2. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Section 22 13 19 "Sanitary Waste Piping Specialties."

O. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

P. Install sleeves for piping penetrations of walls, ceilings, and floors.

Q. Install sleeve seals for piping penetrations of concrete walls and slabs.

R. Install escutcheons for piping penetrations of walls, ceilings, and floors.

## 3.3 JOINT CONSTRUCTION

A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. 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.

C. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

## 3.4 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in OD's.
2. In Drainage Piping: Unshielded and Shielded, nonpressure transition couplings.

## 3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger and support devices and installation specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
3. Vertical Piping: MSS Type 8 or Type 42, clamps.
4. Install individual, straight, horizontal piping runs:

    a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

5. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support horizontal piping and tubing within 12 inches of each fitting and coupling.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
2. NPS 3 (DN 80): 60 inches (1500 mm) with 1/2-inch (13-mm) rod.
3. NPS 4: 60 inches (1500 mm) with 5/8-inch (16-mm) rod.
4. Spacing for 10-foot (3-m) lengths may be increased to 10 feet (3 m). Spacing for fittings is limited to 60 inches (1500 mm).

F. Install supports for vertical cast-iron soil piping every 15 feet (4.5 m).

G. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

## 3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:

1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
5. Comply with requirements for cleanouts and drains specified in Section 22 13 19 "Sanitary Waste Piping Specialties."
6. Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 (DN 65) and larger.

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

E. Make connections according to the following unless otherwise indicated:

1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.

## 3.7 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

## 3.8 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa). From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg (250 Pa). Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

## 3.9 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

## 3.10 PIPING SCHEDULE

A. Aboveground, storm, soil and waste piping NPS 4 and smaller shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.

B. Aboveground, vent piping NPS 4 and smaller shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.

C. Underground, storm, soil, waste, and vent piping shall be the following:

1. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
2. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.

**END OF SECTION**

# SECTION 22 13 19 - SANITARY WASTE PIPING SPECIALTIES

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Cleanouts.
2. Floor drains.
3. Air-admittance valves.
4. Roof flashing assemblies.
5. Through-penetration firestop assemblies.
6. Miscellaneous sanitary drainage piping specialties.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product

### 1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

### 1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

### 1.5 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

## PART 2 - PRODUCTS

### 2.1 CLEANOUTS

A. Exposed Metal Cleanouts:

1. ASME A112.36.2M, Cast-Iron Cleanouts:
2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping

4. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch as required to match connected piping.
5. Closure: Countersunk or raised-head, cast-iron plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Metal Floor Cleanouts:

1. ASME A112.36.2M, Cast-Iron Cleanouts:
2. Standard: ASME A112.36.2M for adjustable housing cast-iron soil pipe with cast-iron ferrule cleanout.
3. Size: Same as connected branch.
4. Body or Ferrule: Cast iron.
5. Clamping Device: Not required.
6. Outlet Connection: Spigot.
7. Closure: Brass plug with straight threads and gasket.
8. Adjustable Housing Material: Cast iron with threads.
9. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
10. Frame and Cover Shape: Square
11. Top Loading Classification: Medium Duty.
12. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanouts.

C. PVC Floor Cleanouts

1. Size: Same as connected drainage piping.
2. Type: Threaded, adjustable housing.
3. Body: PVC
4. Closure Plug: Countersunk brass plug.

D. Cast-Iron Wall Cleanouts:

1. Standard: ASME A112.36.2M. Include wall access.
2. Size: Same as connected drainage piping.
3. Body: Hub-and-spigot, cast-iron soil pipe T-branch as required to match connected piping.
4. Closure: Countersunk or raised-head, brass plug.
5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
6. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
7. Wall Access: Round, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

E. PVC Wall Cleanouts:

1. Size: Same as connected drainage piping.
2. Body: PVC.
3. Closure Plug:

a. Bronze.
b. Countersunk or raised head.
c. Threaded for cover attachment screw.
d. Size: Same as or not more than one size smaller than cleanout size.

4. Wall Access: Round, flat, stainless-steel cover plate with screw.

## 2.2 FLOOR DRAINS

A. Refer to Plumbing Fixture Schedule on design drawings.

## 2.3 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

1. Description: Manufactured assembly approved by roof manufacturer.

## 2.4 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

1. Standard: UL 1479 assembly of sleeve-and-stack fitting with firestopping plug.
2. Size: Same as connected soil, waste, or vent stack.
3. 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.

## 2.5 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

B. Expansion Joints:

1. Standard: ASME A112.21.2M.
2. Body: Cast iron with bronze sleeve, packing, and gland.
3. End Connections: Matching connected piping.
4. Size: Same as connected soil, waste, or vent piping.

C. Floor-Drain, Trap-Seal Primer Fittings:

1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
2. Size: Same as floor drain outlet with NPS 1/2 side inlet.

D. Open Drains:

1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564 rubber gaskets.
2. Size: Same as connected waste piping.

E. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.

    a. NPS 2: 4-inch-minimum water seal.
    b. NPS 2-1/2 and Larger: 5-inch-minimum water seal.

F. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 2 inches above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

G. Stack Flashing Fittings:

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

H. Vent Caps:

1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
2. Size: Same as connected stack vent or vent stack.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. 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.

B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

D. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

E. Assemble open drain fittings and install with top of hub 2 inches above floor.

F. Install deep-seal traps on floor drains and other waste outlets, if indicated.

G. 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.

H. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

I. Install expansion joints where piping crosses building expansion joints.

J. Install wood-blocking reinforcement for wall-mounting-type specialties.

K. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

L. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.

1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
2. Size: Same as floor drain inlet.

## 3.2 CONNECTIONS

A. Comply with requirements in Section 22 13 16 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

## 3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

## 3.4 FLASHING INSTALLATION

A. Comply with roof manufacturer’s requirements.

## 3.5 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

**END OF SECTION**

# SECTION 22 13 23 - SANITARY WASTE INTERCEPTORS

## 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. Grease interceptors.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of interceptor indicated. Include materials of fabrication, dimensions, rated capacities, retention capacities, operating characteristics, size and location of each pipe connection, furnished specialties, and accessories.

B. Shop Drawings: For each type and size of precast-concrete interceptor indicated.

1. Include materials of construction, dimensions, rated capacities, retention capacities, location and size of each pipe connection, furnished specialties, and accessories.

### 1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Interceptors, drawn to scale, on which the following items are shown and coordinated with each other, based on input from Installers of the items involved:

1. Interceptors.
2. Piping connections. Include size, location, and elevation of each.
3. Interface with underground structures and utility services.

## PART 2 - PRODUCTS

### 2.1 GREASE INTERCEPTORS

A. Grease Interceptors: Precast concrete complying with ASTM C 913.

1. Include rubber-gasketed joints, vent connections, manholes, compartments or baffles, and piping or openings to retain grease and to permit wastewater flow.
2. Structural Design Loads:
   a. Medium-Traffic Load: Comply with ASTM C 890, A-12 (ASSHTO HS15-44).

3. Resilient Pipe Connectors: ASTM C 923, cast or fitted into interceptor walls, for each pipe connection.
4. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover.
5. Manhole Frames and Covers: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch-minimum width flange and 26-inch-diameter cover.
   a. Ductile Iron: ASTM A 536, Grade 60-40-18, unless otherwise indicated.
   b. Gray Iron: ASTM A 48, Class 35, unless otherwise indicated.
   c. Include indented top design with lettering cast into cover, using wording equivalent to “GREASE INTERCEPTOR."

B. Capacities and Characteristics:

1. Refer to Schedule on drawings for further information.
2. Installation Position: Underground with manhole riser to grade.

## PART 3 - EXECUTION

### 3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Section 31 20 00 "Earth Moving."

### 3.2 INSTALLATION

A. Install precast-concrete interceptors according to ASTM C 891. Set level and plumb.

B. Install manhole risers from top of underground concrete interceptors to manholes and gratings at finished grade.

C. Set tops of manhole frames and covers flush with finished surface in pavements.

D. Set interceptors level and plumb.

### 3.3 CONNECTIONS

A. Piping installation requirements are specified in Section 22 13 16 "Sanitary Waste and Vent Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Make piping connections between interceptors and piping systems.

## 3.4 IDENTIFICATION

A. Identification materials and installation are specified in Section 31 20 00 "Earth Moving." Arrange for installation of green warning tapes directly over piping and at outside edges of underground interceptors.

1. Use warning tapes or detectable warning tape over ferrous piping.
2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

**END OF SECTION**

# SECTION 22 14 23 - STORM DRAINAGE PIPING SPECIALTIES

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Roof drains.
2. Overflow roof drain

### 1.2 ACTION SUBMITTALS

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

### 1.3 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

## PART 2 - PRODUCTS

### 2.1 ROOF DRAINS

A. Refer to Plumbing Fixture Schedule on design drawings:

### 2.2 OVERFLOW ROOF DRAINS

A. Refer to Plumbing Fixture Schedule on design drawings:

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions.

1. Install flashing collar or flange of roof drain to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
2. Install expansion joints, if indicated, in roof drain outlets.

3. Position roof drains for easy access and maintenance.

B. Install cleanouts in aboveground piping and building drain piping according to the following instructions unless otherwise indicated:

1. Use cleanouts the same size as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate cleanouts at each change in direction of piping greater than 45 degrees.
3. Locate cleanouts at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate cleanouts at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.

F. Install sleeve flashing device with each conductor passing through floors with waterproof membrane.

## 3.2 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

**END OF SECTION**

# SECTION 22 14 29 - SUMP PUMPS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Sump pumps.

### 1.2 ACTION SUBMITTALS

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

### 1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

### 1.4 QUALITY ASSURANCE

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

B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

## PART 2 - PRODUCTS

### 2.1 OIL-MINDER SUMP PUMPS

A. Refer to Plumbing fixture Schedule on design drawings.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Pump Installation Standard: Comply with HI 1.4 for installation of sump pumps.

**END OF SECTION**

# SECTION 22 34 00 - FUEL-FIRED, DOMESTIC-WATER HEATERS

## PART 1 - GENERAL

### 2.1 RELATED DOCUMENTS

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

### 2.2 SUMMARY

B. Section Includes:

1. Commercial, power-vent, gas-fired, storage, domestic-water heaters.
2. Domestic-water heater accessories.

### 2.3 ACTION SUBMITTALS

C. Product Data: For each type and size of domestic-water heater indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

D. Shop Drawings:

1. Wiring Diagrams: For power, signal, and control wiring.

### 2.4 INFORMATIONAL SUBMITTALS

E. Product Certificates: For each type of commercial, gas-fired, domestic-water heater, from manufacturer.

F. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.

G. Source quality-control reports.

H. Field quality-control reports.

I. Warranty: Sample of special warranty.

## 2.5 CLOSEOUT SUBMITTALS

J. Operation and Maintenance Data: For fuel-fired, domestic-water heaters to include in emergency, operation, and maintenance manuals.

## 2.6 QUALITY ASSURANCE

K. 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.

L. ASME Compliance:

1. Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

M. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 Annex G, "Drinking Water System Components - Health Effects."

## 2.7 COORDINATION

N. Coordinate sizes and locations of concrete bases with actual equipment provided.

## 2.8 WARRANTY

O. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fuel-fired, domestic-water heaters that fail in materials or workmanship within specified warranty period.

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

a. Structural failures including storage tank and supports.
b. Faulty operation of controls.
c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Periods: From date of Substantial Completion.

a. Commercial, Gas-Fired, Storage, Domestic-Water Heaters:

1) Storage Tank: Five years.
2) Controls and Other Components: Two year(s).

b. Compression Tanks: Five years.

## PART 2 - PRODUCTS

### 2.1 COMMERCIAL, GAS-FIRED, STORAGE, DOMESTIC-WATER HEATERS

A. Commercial, Power-Vent, Gas-Fired, Storage, Domestic-Water Heaters:

1. Standard: ANSI Z21.10.3/CSA 4.3.
2. Storage-Tank Construction: ASME-code steel with 150-psig working-pressure rating.

    a. Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.

        1) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.
        2) NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges and according to ASME B16.24 for copper and copper-alloy flanges.

    b. Interior Finish: Comply with NSF 61 Annex G barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
    c. Lining: Glass complying with NSF 61 Annex G barrier materials for potable-water tank linings, including extending lining into and through tank fittings and outlets.

3. Factory-Installed Storage-Tank Appurtenances:

    a. Anode Rod: Replaceable magnesium.
    b. Dip Tube: Required unless cold-water inlet is near bottom of tank.
    c. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
    d. Insulation: Comply with ASHRAE/IESNA 90.1. Surround entire storage tank except connections and controls.
    e. Jacket: Steel with enameled finish.
    f. Burner: For use with power-vent, gas-fired, domestic-water heaters and natural-gas fuel.
    g. Automatic Ignition: ANSI Z21.20/CSA C22.2 No. 199, electric, automatic, gas-ignition system.
    h. Temperature Control: Adjustable thermostat.
    i. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.
    j. Combination Temperature-and-Pressure Relief Valves: ANSI Z21.22/CSA 4.4-M. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.

4. Special Requirements: NSF 5 construction.
5. Power-Vent System: Exhaust fan, interlocked with burner.

## 2.2 DOMESTIC-WATER HEATER ACCESSORIES

A. Vent Piping:

1. Description: PVC, as recommended by water heater manufacturer.
2. Termination: Sidewall intake and exhaust. Concentric vents are acceptable.

B. Domestic-Water Compression Tanks:

1. Description: Steel, pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
2. Construction:

    a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
    b. Interior Finish: Comply with NSF 61 Annex G barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
    c. Air-Charging Valve: Factory installed.

3. Capacity and Characteristics:

    a. Working-Pressure Rating: 100 psig.
    b. Capacity Acceptable: 4 gal. minimum.
    c. Air Precharge Pressure: 12 psig.

C. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1.

D. Heat-Trap Fittings: ASHRAE 90.2.

E. Manifold Kits: Domestic-water heater manufacturer's factory-fabricated inlet and outlet piping for field installation, for multiple domestic-water heater installation. Include ball-, butterfly-, or gate-type shutoff valves to isolate each domestic-water heater and calibrated balancing valves to provide balanced flow through each domestic-water heater.

F. Comply with requirements for ball- or butterfly-type shutoff valves specified in Section 22 05 23.12 "Ball Valves for Plumbing Piping" and Section 22 05 23.13 "Butterfly Valves for Plumbing Piping."

1. Comply with requirements for balancing valves specified in Section 22 11 19 "Domestic Water Piping Specialties."

G. Gas Shutoff Valves: ANSI Z21.15/CSA 9.1-M, manually operated. Furnish for installation in piping.

H. Gas Pressure Regulators: ANSI Z21.18/CSA 6.3, appliance type. Include 2-psig pressure rating as required to match gas supply.

I. Automatic Gas Valves: ANSI Z21.21/CSA 6.5, appliance, electrically operated, on-off automatic valve.

J. Combination Temperature-and-Pressure Relief Valves: Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.

1. Gas-Fired, Domestic-Water Heaters: ANSI Z21.22/CSA 4.4-M.

## 2.3 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect assembled domestic-water heaters specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.

B. Hydrostatically test commercial domestic-water heaters to minimum of one and one-half times pressure rating before shipment.

C. Domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 01 40 00 "Quality Requirements" for retesting and reinspecting requirements and Section 01 73 00 "Execution" for requirements for correcting the Work.

D. Prepare test and inspection reports.

# PART 3 - EXECUTION

## 3.1 DOMESTIC-WATER HEATER INSTALLATION

A. Commercial, Domestic-Water Heater Mounting: Install commercial domestic-water heaters on concrete base. Comply with requirements for concrete base specified in Section 03 30 00 "Cast-in-Place Concrete."

1. Exception: Omit concrete bases for commercial domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
2. Maintain manufacturer's recommended clearances.
3. Arrange units so controls and devices that require servicing are accessible.
4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
7. Install anchor bolts to elevations required for proper attachment to supported equipment.

8. Anchor domestic-water heaters to substrate.

B. Install domestic-water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 22 05 23.12 "Ball Valves for Plumbing Piping" and Section 22 05 23.13 "Butterfly Valves for Plumbing Piping."

C. Install gas-fired, domestic-water heaters according to NFPA 54.

1. Install gas shutoff valves on gas supply piping to gas-fired, domestic-water heaters without shutoff valves.
2. Install gas pressure regulators on gas supplies to gas-fired, domestic-water heaters without gas pressure regulators if gas pressure regulators are required to reduce gas pressure at burner.
3. Install automatic gas valves on gas supplies to gas-fired, domestic-water heaters if required for operation of safety control.
4. Comply with requirements for gas shutoff valves, gas pressure regulators, and automatic gas valves specified in Section 23 11 23 "Facility Natural-Gas Piping."

D. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

E. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 22 11 19 "Domestic Water Piping Specialties."

F. Install thermometer on outlet piping of domestic-water heaters. Comply with requirements for thermometers specified in Section 22 05 19 "Meters and Gages for Plumbing Piping."

G. Assemble and install inlet and outlet piping manifold kits for multiple domestic-water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each domestic-water heater. Include shutoff valve and thermometer in each domestic-water heater inlet and outlet, and throttling valve in each domestic-water heater outlet. Comply with requirements for valves specified in Section 22 05 23.12 "Ball Valves for Plumbing Piping" and Section 22 05 23.13 "Butterfly Valves for Plumbing Piping," and comply with requirements for thermometers specified in Section 22 05 19 "Meters and Gages for Plumbing Piping."

H. Install piping-type heat traps on inlet and outlet piping of domestic-water heater storage tanks without integral or fitting-type heat traps.

I. Fill domestic-water heaters with water.

J. Charge domestic-water compression tanks with air.

## 3.2 CONNECTIONS

A. Comply with requirements for domestic-water piping specified in Section 22 11 16 "Domestic Water Piping."

B. Comply with requirements for gas piping specified in Section 23 11 23 "Facility Natural-Gas Piping."

C. Drawings indicate general arrangement of piping, fittings, and specialties.

D. Where installing piping adjacent to fuel-fired, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

## 3.3 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

## 3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 01 40 00 "Quality Requirements" for retesting and reinspecting requirements and Section 01 73 00 "Execution" for requirements for correcting the Work.

C. Prepare test and inspection reports.

## 3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial, gas-fired, storage, domestic-water heaters.

**END OF SECTION**

# SECTION 22 42 13.13 - COMMERCIAL WATER CLOSETS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Water closets.
2. Flushometer valves.
3. Toilet seats.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

### 1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For flushometer valves and electronic sensors to include in operation and maintenance manuals.

### 1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that are packaged with protective covering for storage and identified with labels describing contents.

1. Flushometer-Valve Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than one of each type.

## PART 2 - PRODUCTS

### 2.1 WATER CLOSETS, FLUSHOMETER VALVES, TOILET SEATS

A. Refer to Plumbing Fixture Schedule on design drawings.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Water-Closet Installation:

1. Install level and plumb according to roughing-in drawings.
2. Install floor-mounted water closets to piping or building substrate.

B. Flushometer-Valve Installation:

1. Install flushometer-valve, water-supply fitting on each supply to each water closet.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Install lever-handle flushometer valves for accessible water closets with handle mounted on open side of water closet.
4. Install actuators in locations that are easy for people with disabilities to reach.
5. Hard-wired, electronic-sensor mechanisms.

C. Install toilet seats on water closets.

D. Joint Sealing:

1. Seal joints between water closets and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to water-closet color.

## 3.2 CONNECTIONS

A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.

B. Comply with water piping requirements specified in Section 22 11 16 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."

D. Where installing piping adjacent to water closets, allow space for service and maintenance.

## 3.3 ADJUSTING

A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.

B. Adjust water pressure at flushometer valves to produce proper flow.

## 3.4 CLEANING AND PROTECTION

A. Clean water closets and fittings with manufacturers' recommended cleaning methods and materials.

B. Install protective covering for installed water closets and fittings.

C. Do not allow use of water closets for temporary facilities unless approved in writing by Owner.

**END OF SECTION**

# SECTION 22 42 13.16 - COMMERCIAL URINALS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Urinals.
2. Flushometer valves.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

### 1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For flushometer valves to include in operation and maintenance manuals.

## PART 2 - PRODUCTS

### 2.1 WALL-HUNG URINALS, FLUSHOMETER VALVES

A. Refer to Plumbing Fixture Schedule on design drawings.

B. Trip Mechanism: Hard-wired electronic sensor complying with UL 1951, and listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before urinal installation.

B. Examine walls and floors for suitable conditions where urinals will be installed.

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

## 3.2 INSTALLATION

A. Urinal Installation:

1. Install urinals level and plumb according to roughing-in drawings.
2. Install wall-hung, back-outlet urinals onto waste fitting seals and attached to supports.
3. Install accessible, wall-mounted urinals at mounting height for the handicapped/elderly, according to ICC/ANSI A117.1.

B. Support Installation:

1. Install supports, affixed to building substrate, for wall-hung urinals.
2. Use off-floor carriers with waste fitting and seal for back-outlet urinals.
3. Use carriers without waste fitting for urinals with tubular waste piping.
4. Use chair-type carrier supports with rectangular steel uprights for accessible urinals.

C. Flushometer-Valve Installation:

1. Install flushometer-valve water-supply fitting on each supply to each urinal.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Install lever-handle flushometer valves for accessible urinals with handle mounted on open side of compartment.

D. Wall Flange and Escutcheon Installation:

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.

E. Joint Sealing:

1. Seal joints between urinals and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to urinal color.

## 3.3 CONNECTIONS

A. Connect urinals with water supplies and soil, waste, and vent piping. Use size fittings required to match urinals.

B. Comply with water piping requirements specified in Section 22 11 16 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."

D. Where installing piping adjacent to urinals, allow space for service and maintenance.

## 3.4 ADJUSTING

A. Operate and adjust urinals and controls. Replace damaged and malfunctioning urinals, fittings, and controls. Adjust water pressure at flushometer valves to produce proper flow.

## 3.5 CLEANING AND PROTECTION

A. Clean urinals and fittings with manufacturers' recommended cleaning methods and materials.

B. Install protective covering for installed urinals and fittings.

C. Do not allow use of urinals for temporary facilities unless approved in writing by Owner.

**END OF SECTION**

# SECTION 22 42 16.13 - COMMERCIAL LAVATORIES

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Lavatories.
2. Faucets.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

### 1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

### 1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For lavatories and faucets to include in operation and maintenance manuals.

1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:

a. Servicing and adjustments of automatic faucets.

## PART 2 - PRODUCTS

### 2.1 LAVATORIES AND FAUCETS

A. Refer to Plumbing Fixture Schedule on design drawings.

### 2.2 SUPPLY FITTINGS

A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for supply-fitting materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.

C. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless-steel wall flange.

D. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.

E. Operation: Wheel handle.

F. Risers:

1. NPS 3/8.
2. ASME A112.18.6, braided- or corrugated-stainless-steel, flexible hose riser.

## 2.3 WASTE FITTINGS

A. Standard: ASME A112.18.2/CSA B125.2.

B. Trap:

1. Size: NPS 1-1/2 by NPS 1-1/4.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before lavatory installation.

B. Examine counters and walls for suitable conditions where lavatories will be installed.

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

## 3.2 INSTALLATION

A. Install lavatories level and plumb according to roughing-in drawings.

B. Install supports, affixed to building substrate, for wall-mounted lavatories.

C. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, according to ICC/ANSI A117.1.

D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings.

E. Seal joints between lavatories, counters and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color.

F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories.

## 3.3 CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 22 11 16 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."

## 3.4 ADJUSTING

A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

## 3.5 CLEANING AND PROTECTION

A. After completing installation of lavatories, inspect and repair damaged finishes.

B. Clean lavatories, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed lavatories and fittings.

D. Do not allow use of lavatories for temporary facilities unless approved in writing by Owner.

**END OF SECTION**

# SECTION 22 42 16.16 - COMMERCIAL SINKS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Sinks.
2. Sink faucets.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

### 1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

### 1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

## PART 2 - PRODUCTS

### 2.1 SINKS, SINK FAUCETS

A. Refer to Plumbing Fixture Schedule on design drawings.

B. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for faucet-spout materials that will be in contact with potable water.

### 2.2 SUPPLY FITTINGS

A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for supply-fitting materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.

C. Supply Piping: Chrome-plated brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated brass or stainless-steel wall flange.

D. Supply Stops: Chrome-plated brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.

E. Operation: Loose key.

F. Risers:

1. NPS 3/8

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before sink installation.

B. Examine walls, floors, and counters for suitable conditions where sinks will be installed.

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

### 3.2 INSTALLATION

A. Install sinks level and plumb according to roughing-in drawings.

B. Install supports, affixed to building substrate, for wall-hung sinks.

C. Install accessible wall-mounted sinks at handicapped/elderly mounting height according to ICC/ANSI A117.1.

D. Set floor-mounted sinks in leveling bed of cement grout.

E. Install water-supply piping with stop on each supply to each sink faucet.

1. Exception: Use ball, gate, or globe valves if supply stops are not specified with sink. Comply with valve requirements specified in Section 22 05 23.12 "Ball Valves for Plumbing Piping."
2. Install stops in locations where they can be easily reached for operation.

F. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings.

G. Seal joints between sinks and counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color.

H. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 22 07 19 "Plumbing Piping Insulation."

## 3.3 CONNECTIONS

A. Connect sinks with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 22 11 16 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."

## 3.4 ADJUSTING

A. Operate and adjust sinks and controls. Replace damaged and malfunctioning sinks, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

## 3.5 CLEANING AND PROTECTION

A. After completing installation of sinks, inspect and repair damaged finishes.

B. Clean sinks, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed sinks and fittings.

D. Do not allow use of sinks for temporary facilities unless approved in writing by Owner.

**END OF SECTION**

# SECTION 22 42 23 - COMMERCIAL SHOWERS

## 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. Individual shower receptors.
2. Shower faucets.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, and furnished specialties and accessories.

### 1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For shower faucets to include in maintenance manuals.

### 1.5 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. Faucet Washers and O-Rings: Equal to **10** percent of amount of each type and size installed.
2. Faucet Cartridges and O-Rings: Equal to **5** percent of amount of each type and size installed.

PART 2 - **PRODUCTS**

## 2.1 SHOWER FAUCETS

A. NSF Standard: Comply with NSF 61 Annex G, "Drinking Water System Components - Health Effects," for shower materials that will be in contact with potable water.

B. Shower Faucets: Refer to Plumbing Fixture Schedule for further information.

PART 3 - **EXECUTION**

## 3.1 EXAMINATION

A. Examine roughing-in of water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before shower installation.

B. Examine walls and floors for suitable conditions where showers will be installed.

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

## 3.2 INSTALLATION

A. Assemble shower components according to manufacturers' written instructions.

B. Install showers level and plumb according to roughing-in drawings.

C. Install water-supply piping with stop on each supply to each shower faucet.

1. Exception: Use ball or gate valves if supply stops are not specified with shower. Comply with valve requirements specified in Section 22 05 23.12 "Ball Valves for Plumbing Piping."
2. Install stops in locations where they can be easily reached for operation.

D. Install shower flow-control fittings with specified maximum flow rates in shower arms.

E. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheons requirements specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

F. Seal joints between showers and floors and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 07 92 00 "Joint Sealants."

## 3.3 CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 22 11 16 "Domestic Water Piping."

C. Comply with traps and soil and waste piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."

## 3.4 ADJUSTING

A. Operate and adjust showers and controls. Replace damaged and malfunctioning showers, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

## 3.5 CLEANING AND PROTECTION

A. Clean faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

B. Provide protective covering for installed fixtures and fittings.

C. Do not allow use of showers for temporary facilities unless approved in writing by Owner.

**END OF SECTION**

# SECTION 22 47 16 - PRESSURE WATER COOLERS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section includes pressure water coolers and related components.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of pressure water cooler.

B. Shop Drawings: Include diagrams for power, signal, and control wiring.

### 1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For pressure water coolers to include in maintenance manuals.

### 1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filter Cartridges: Equal to 100 percent of quantity installed for each type and size indicated.

## PART 2 - PRODUCTS

### 2.1 PRESSURE WATER COOLERS

A. Refer to Plumbing Fixture Schedule on design drawings.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.

B. Examine walls and floors for suitable conditions where fixtures will be installed.

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

## 3.2 INSTALLATION

A. Install fixtures level and plumb according to roughing-in drawings. For fixtures indicated for children, install at height required by authorities having jurisdiction.

B. Set freestanding pressure water coolers on floor.

C. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.

D. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball, gate, or globe valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 22 05 23.12 "Ball Valves for Plumbing Piping."

E. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

F. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings.

G. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color.

## 3.3 CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 22 11 16 "Domestic Water Piping."

C. Install ball, gate, or globe shutoff valve on water supply to each fixture. Comply with valve requirements specified in Section 22 05 23.12 "Ball Valves for Plumbing Piping."

D. Comply with soil and waste piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."

## 3.4 ADJUSTING

A. Adjust fixture flow regulators for proper flow and stream height.

B. Adjust pressure water-cooler temperature settings.

## 3.5 CLEANING

A. After installing fixture, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.

C. Provide protective covering for installed fixtures.

D. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

**END OF SECTION**

# SECTION 23 00 00 - GENERAL MECHANICAL

## PART 1 - GENERAL

### 1.1 SCOPE OF WORK

A. The work shall include furnishing, installing and testing the equipment and materials specified in other sections of the Mechanical Specifications and shown on the Drawings. It is the intent of these Specifications that the mechanical systems shall be suitable in every way for the intended usage. All material and all work which may be reasonably implied as being incidental to the work of this Division shall be furnished at no extra cost.

B. Instructions to Bidders, General Conditions of the Contract, Supplementary General Conditions and Division 1 Specifications Sections bound herewith are a component part of Division 23 specifications. Comply with all provisions, details and instructions of these sections in the accomplishment of work covered under Division 23.

C. Furnish all labor, materials and equipment and incidentals required to make ready for use complete mechanical systems as shown on the Drawings and specified herein.

D. Where Sub-Contracts are used to perform portions of the work, division of labor between sub trades is the responsibility of the Contractor.

E. The general scope work includes, but is not limited to, furnishing, coordinating, and installing the following:

1. Heating, air conditioning and ventilation equipment.
2. Ductwork, air distribution.
3. HVAC piping, specialties and equipment.
4. Controls and wiring.
5. Testing and balancing.

F. Visit all areas of the site, buildings and structures (as applicable) in which work under these sections is to be performed. Inspect carefully the existing conditions prior to bidding. Bid submission is evidence that the Contractor has examined the site and existing conditions, understands conditions under which the work will be performed, and takes full responsibility for complete knowledge of all factors governing the work.

G. Schedule all service interruptions in existing facilities at the Owner’s convenience with 24 hours (minimum) notice. Obtain prior approval for each interruption.

H. Thoroughly test all mechanical systems at the completion of work and make any minor correction changes or adjustments necessary for all the proper functioning of the system and equipment. All workmanship shall be of the highest quality; substandard work will be rejected.

## 1.2 SUBMITTALS

A. Procedures for submittals: Submit under provisions of relevant sections of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Transmit each shop drawing submittal with provided Shop Drawing Submittal Cover Form, attached as Appendix B, for each item of equipment/material or each specification section/paragraph

C. Clearly indicate proposed equipment and/or materials substitutions in shop drawings. Summarize all deviations from the specified quality, functionality, appearance or performance of proposed equipment and/or materials in the preface of each submittal. Include documentation to support deviations.

D. Provide descriptive data on all materials and equipment as required to ascertain compliance with Specifications.

E. Design layout shown on drawings is based on physical sizes of reputable equipment manufacturers. If equipment other than models indicated is installed, any resulting conflicts with space, maintenance access, clearances or codes are the responsibility of the Contractor to correct at his expense.

F. Where specific models and manufacturers of materials and equipment are specified, substitutions as allowed by the specifications and State law will be considered. Substitutions must be equivalent in quality, function, suitability and arrangement to specified equipment. Architect/Engineer to have final authority as to equivalency of substitutions.

G. Equipment model numbers noted in these specifications or on the drawings are intended to establish a minimum standard of quality and do not necessarily relate to specific options or arrangement as shown. Provide equipment with all standard features and optional features as stated and arranged as shown on the drawings.

## 1.3 REGULATORY REQUIREMENTS

A. Perform Work in accordance with all applicable state and local codes, standards and regulations.

B. Furnish all materials and labor which is be required for compliance with codes, standards and regulations, whether specifically mentioned in these specifications or shown on the drawings.

C. Obtain required construction permit from the authority having jurisdiction and arrange, at the proper time, for all inspections required by such authority. Pay all permit and inspection costs required.

## 1.4 COORDINATION OF WORK

A. Contractor is responsible for coordination of work between trades. Provide fully complete and functional systems.

B. Compare mechanical drawings and specifications with the drawings and specifications for other trades.

C. Coordinate mechanical installation with the work of other trades. Report any pertinent discrepancies to the Architect/Engineer and obtain written instructions for any necessary revisions. Before starting any construction, make proper provisions to avoid interferences in a manner approved by the Architect/Engineer. No extras will be allowed for rework of uncoordinated installations.

D. Determine exact route and location of each mechanical item prior to fabrication and/or installation. Adjust location of ducts, piping and equipment, etc., to accommodate interferences anticipated and encountered.

E. Right of Way: General priority for right of way is as follows:

1. Items located per regulatory requirement.
2. Piping with pitch requirement (plumbing drains, etc.).
3. Ductwork.
4. Piping without pitch requirement.
5. Electrical wiring (conduits, etc.).

F. Arrange all work to permit removal (without damage to other parts) of any equipment requiring periodic replacement.

G. Provide clearance and easy access to any equipment which requires periodic maintenance. Arrange ducts, piping and equipment to permit ready access to valves, cocks, traps, starters, motors, control components, etc., and to clear the opening of swinging doors and access panels.

## 1.5 EQUIPMENT AND MATERIALS (GENERAL)

A. Provide all new materials unless specifically indicated otherwise.

B. Manufacturers and models listed in drawings and specifications are used for layout and to convey to bidders the general style, type, character and quality of product desired. Listed examples are used only to denote the quality standard of product desired and are not intended to restrict bidders to a specific brand, make, manufacturer or specific name.

C. Adjust layout, system connections and coordinate with other trades as required to properly install equivalent products.

D. Where equivalent products are submitted, include all associated costs related to substitution in bid.

E. Furnish materials bearing the manufacturer's name and trade name. Provide UL label where a UL standard has been established for the particular material.

F. Furnish standard products of manufacturers regularly engaged in production of equipment types required for the work. Use the manufacturer's latest approved design.

G. Use the same manufacturer for equipment and materials of the same general type throughout the work to obtain uniform appearance, operation and maintenance.

H. Protect equipment and materials from dirt, water, chemical or mechanical injury and theft at all times during construction. Provide covers or shelter as required.

I. If materials or equipment are damaged at any time prior to final acceptance of the work, repair such damage at no additional cost. If materials or equipment are damaged by water, provide replacement no additional cost.

J. Follow manufacturer's directions completely in the delivery, storage, protection and installation of all equipment and materials. Notify the Architect/Engineer in writing of any conflicts between any requirements of the contract documents and manufacturer's directions. Obtain written instructions before proceeding with the work. The Contractor is responsible for correction of any work that does not comply with the manufacturer's directions or written instructions from the Architect/Engineer at no additional cost.

K. Repair any damage to factory applied paint finish using touch-up paint furnished by the equipment manufacturer. Repaint entire damaged panel or section per the field painting specifications in Division 9 at no additional cost.

## 1.6 OPERATION AND MAINTENANCE MANUALS

A. Refer to individual mechanical sections and Division 01.

## 1.7 PAINTING

A. Refer to Division 09.

B. Protect sensors, controllers, etc. against painting. Do not install thermostats, devices or trim until painting is complete.

## 1.8 LOCATIONS AND MEASUREMENTS

A. Location of mechanical work is shown on the drawings as accurately as possible. Field verify all measurements to insure that the work suits the surrounding structure, trim, finishes and/or construction. Provide adjustment as necessary.

B. Make minor relocations of work prior to installation as required or as directed by the Architect/Engineer at no additional cost.

## 1.9 SUPERVISION

A. Contractor to provide an authorized and competent representative to constantly supervise the work from the beginning to completion and final acceptance. Insofar as possible, keep the same foreman and workmen throughout the project duration.

B. Representatives of Architect/Engineer, Owner, and local inspection authorities will make inspections during the progress of the work. Contractor to accommodate such inspections and correct deficiencies noted.

## 1.10 QUALITY AND WORKMANSHIP

A. Contractor to employ skilled tradesmen, laborers and supervisors. Final product to present a neat, well finished, and professional installation.

B. Remove and replace any work considered substandard quality in the judgment of the Architect/Engineer.

## 1.11 CLOSING IN WORK

A. Do not cover up or enclose work until it has been inspected, tested and approved by authorities having jurisdiction over the work. Uncover any such work for inspection and/or test at no additional cost. Restore the work to its original condition after inspection and/or test at no additional cost.

## 1.12 CUTTING AND PATCHING

A. Perform all cutting and patching necessary to install work under this Division.

B. Perform cutting and patching in professional, workmanlike manner.

C. Arrange work to minimize cutting and patching.

D. Do not cut joists, beams, girders, columns or any other structural members without written permission from the Architect/Engineer.

E. Cut opening only large enough to allow easy installation of piping, wiring or ductwork.

F. Patching material to match material removed.

G. Restore patched surface to its original appearance at completion of patching.

H. Where waterproofed surfaces are patched, maintain integrity of waterproofing.

I. Remove rubble and excess patching materials from the premises.

## 1.13 INTERPRETATION OF DRAWINGS

A. Drawings and specifications under this Division are complementary each to the other. Provide any work specified herein and/or indicated on the drawings.

B. Drawings are diagrammatic and indicate generally the location of fixtures, piping, devices, equipment, etc. Follow drawings as closely as possible, but arrange work to suit the finished surroundings and/or trim.

C. The words “furnish”, “provide”, and/or “install” as used in these drawings and specifications are interpreted to include all material and labor necessary to complete the particular item, system, equipment, etc.

D. Any omissions from either the drawings or specifications are unintentional. Contractor is responsible for notifying the Architect/Engineer of any pertinent omissions before submitting a bid. Complete and working systems are required, whether every small item of material is shown and specified or not.

## 1.14 ACCESSIBILITY

A. Locate all equipment which must be serviced, operated, or maintained in fully accessible positions. Equipment to include, but not be limited to, valves, traps, cleanouts, motors, controllers, and dampers. If required for accessibility, furnish access doors for this purpose. Minor deviations from drawings may be made to allow for better accessibility. Lack of access doors on drawings does not relieve Contractor of responsibility to provide access doors, if needed to properly service equipment.

B. Coordinate exact locations and size of access panels for each concealed device requiring service.

C. Access panels: Steel construction with 16 gauge frames and 18 gauge panels, factory primed with rust inhibiting paint, finish paint by Contractor. Provide suitable UL listed doors where installed in rated construction.

D. Coordinate access panel locations with architectural construction.

E. Access panels are not required for access to work located above a lift-out “T” bar type ceiling.

## 1.15 ELECTRICAL WORK IN CONNECTION WITH MECHANICAL CONTRACTS

A. Comply with Division 26. Any required Division 23 electrical work not specifically specified to be furnished by Division 26 Contractor shall be provided by Division 23 Contractor.

B. All electrical work performed Division 23 shall comply with Division 26 specification requirements.

C. See Division 26 specifications and electrical connection diagrams for division of labor between Divisions 23 and 26.

D. Coordinate electrical interface of supplied mechanical equipment with electrical system. Division 26 electrical work for mechanical systems is based on values scheduled on mechanical drawings. Division 23 Contractor is responsible for any costs to modify the contracted electrical work to service equipment with electrical characteristics different than those scheduled.

## 1.16 MECHANICAL WORK IN CONNECTION WITH OTHER CONTRACTS

A. Provide mechanical services as required for items furnished by other contractors or vendors as shown on the Drawings. Actual requirements may vary from Drawings. Coordinate with equipment installed. Make final connections only after approval of the other contractor or vendor, in the contractor's or vendor’s presence.

## 1.17 ALTERNATE BIDS

A. Alternate Bids, IF ANY, are described in relevant sections of the General and Supplemental General Conditions and Division 1 Specification Sections.

## 1.18 PROJECT RECORD DRAWINGS

A. Submit under provisions of relevant sections of the General and Supplemental General Conditions and Specification 017839.

B. As the work progresses, legibly record all field changes on a set of project contract drawings, herein after called the “record drawings.”

C. Record drawings shall accurately show the installed condition of mechanical work.

## 1.19 PHASING OF THE WORK

A. Schedule work in accordance with the relevant sections of the General and Supplemental General Conditions and Division 1 Specifications Sections.

## 1.20 PROJECT CLOSEOUT

A. Submit under provisions of relevant sections of the General and Supplemental General Conditions and Division 1 Specifications Sections.

## PART 2 - PRODUCTS (NOT USED)

## PART 3 - EXECUTION (NOT USED)

**END OF SECTION**

# SECTION 23 05 13 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

### 1.2 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

## PART 2 - PRODUCTS

### 2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with NEMA MG 1 unless otherwise indicated.

B. Comply with IEEE 841 for severe-duty motors.

### 2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3,300 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

### 2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor. .

B. Efficiency: Energy efficient, complying with NEMA Standard Publication General Specification for Consultants, Industrial and Municipal: NEMA Premium Efficiency Electric Motors (600 Volts or Less).

C. Service Factor: 1.15.

D. Multispeed Motors: Separate winding for each speed.

E. Rotor: Random-wound, squirrel cage.

F. Bearings: Re-greasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

G. Temperature Rise: Match insulation rating.

H. Insulation: Class F.

I. Code Letter Designation:

1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

## 2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

## 2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
2. Split phase.
3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

## PART 3 - EXECUTION (Not Applicable)

**END OF SECTION**

# SECTION 23 05 16 - EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Flexible-hose packless expansion joints.
2. Pipe loops and swing connections.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

### 1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For expansion joints to include in maintenance manuals.

### 1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.

B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

### 2.2 PACKLESS EXPANSION JOINTS

A. Flexible-Hose Packless Expansion Joints:

1. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose.
2. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.

3. Expansion Joints for Copper Tubing NPS 2 and Smaller: Copper-alloy fittings with solder-joint end connections.

    a. Bronze hoses and single-braid bronze sheaths with 450 psig at 70 deg F and 340 psig at 450 deg F ratings.

4. Expansion Joints for Steel Piping NPS 2-1/2 to NPS 6: Carbon-steel fittings with flanged end connections.

    a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 200 psig at 70 deg F and 145 psig at 600 deg F ratings.

## PART 3 - EXECUTION

### 3.1 EXPANSION JOINT INSTALLATION

A. Install expansion joints where piping crosses building expansion joints.

B. Install expansion joints of sizes matching sizes of piping in which they are installed.

C. Install rubber packless expansion joints according to FSA-PSJ-703.

### 3.2 PIPE LOOP AND SWING CONNECTION INSTALLATION

A. Connect risers and branch connections to mains with at least five pipe fittings, including tee in main.

B. Connect risers and branch connections to terminal units with at least four pipe fittings, including tee in riser.

C. Connect mains and branch connections to terminal units with at least four pipe fittings, including tee in main.

**END OF SECTION**

# SECTION 23 05 17 - SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Sleeves.
2. Sleeve-seal systems.
3. Grout.

### 1.2 ACTION SUBMITTALS

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

## PART 2 - PRODUCTS

### 2.1 SLEEVES

A. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

### 2.2 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Stainless steel.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

### 2.3 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.



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D. Packaging: Premixed and factory packaged.

## PART 3 - EXECUTION

### 3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 07 92 00 "Joint Sealants."

E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 07 84 13 "Penetration Firestopping."

### 3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space



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between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

## 3.3 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:

   a. Galvanized-steel-pipe sleeves.

2. Concrete Slabs-on-Grade:

   a. Galvanized-steel-pipe sleeves with sleeve-seal system.

      1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs above Grade:

   a. Galvanized-steel-pipe sleeves.

4. Interior Partitions:

   a. Galvanized-steel-pipe sleeves.

**END OF SECTION**



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# SECTION 23 05 18 - ESCUTCHEONS FOR HVAC PIPING

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Escutcheons.
2. Floor plates.

### 1.2 ACTION SUBMITTALS

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

## PART 2 - PRODUCTS

### 2.1 ESCUTCHEONS

A. One-Piece, Cast-Brass Type: With rough-brass finish and setscrew fastener.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.

### 2.2 FLOOR PLATES

A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install floor plates and escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

C. Install floor plates for piping penetrations of equipment-room floors.

### 3.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

**END OF SECTION**

# SECTION 23 05 19 - METERS AND GAGES FOR 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. Section Includes:

1. Thermometers.
2. Gages.
3. Test plugs.

B. Related Sections:

1. Section 23 11 24 "Facility Natural-Gas Piping" for gas meters.

### 1.3 ACTION SUBMITTALS

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

B. Wiring Diagrams: For power, signal, and control wiring.

### 1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of meter and gage, from manufacturer.

### 1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

### 1.6 SPARE PARTS

A. Provide one spare certified calibrated gauge of each type to be utilized for testing/comparison purposes.

## PART 2 - PRODUCTS

### 2.1 LIGHT-ACTIVATED THERMOMETERS

A. Direct-Mounted, Light-Activated Thermometers:

1. Case: Metal; 7-inch nominal size unless otherwise indicated.
2. Scale(s): Deg F and deg C.
3. Case Form: Adjustable angle.
4. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
5. Stem: Aluminum and of length to suit installation.

    a. Design for Air-Duct Installation: With ventilated shroud.
    b. Design for Thermowell Installation: Bare stem.

6. Display: Digital.
7. Accuracy: Plus or minus 2 deg F.

### 2.2 DUCT-THERMOMETER MOUNTING BRACKETS

A. Description: Flanged bracket with screw holes, for attachment to air duct and made to hold thermometer stem.

### 2.3 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR or CUNI.
4. Material for Use with Steel Piping: CRES.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

### 2.4 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Standard: ASME B40.100.
2. Case: Sealed type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
3. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
4. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
5. Movement: Mechanical, with link to pressure element and connection to pointer.
6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi and kPa.
7. Pointer: Dark-colored metal.
8. Window: Glass.
9. Ring: Brass.
10. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

## 2.5 GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.

B. Siphons: Loop-shaped section of brass pipe with NPS 1/4 or NPS 1/2 pipe threads.

C. Valves: Brass or stainless-steel needle, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

## 2.6 TEST PLUGS

A. Description: Test-station fitting made for insertion into piping tee fitting.

B. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

C. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.

D. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

E. Core Inserts: EPDM self-sealing rubber.

## 2.7 TEST-PLUG KITS

A. Furnish one test-plug kit(s) containing one thermometer(s), one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.

B. High-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F.

C. Pressure Gage: Small, Bourdon-tube insertion type with 2- to 3-inch- diameter dial and probe. Dial range shall be at least 0 to 200 psig.

D. Carrying Case: Metal or plastic, with formed instrument padding.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Install thermowells with socket extending to center of pipe and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install duct-thermometer mounting brackets in walls of ducts. Attach to duct with screws.

G. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

H. Install valve and snubber in piping for each pressure gage for fluids (except steam).

I. Install valve and syphon fitting in piping for each pressure gage for steam.

J. Install test plugs in piping tees.

K. Install flow indicators in piping systems in accessible positions for easy viewing.

L. Install connection fittings in accessible locations for attachment to portable indicators.

M. Install thermometers in the following locations:

1. Inlet and outlet of each hydronic zone.
2. Inlet and outlet of each hydronic coil in air-handling units.
3. Outside-, return-, supply-, and mixed-air ducts.

N. Install pressure gages in the following locations:

1. Suction and discharge of each pump.

## 3.2 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

## 3.3 ADJUSTING

A. After installation, calibrate meters according to manufacturer's written instructions.

B. Adjust faces of meters and gages to proper angle for best visibility.

## 3.4 THERMOMETER SCHEDULE

A. Thermometers at inlet and outlet of each hydronic zone shall be the following:

1. Direct-mounted, light-activated type.

B. Thermometers at inlet and outlet of each hydronic coil in air-handling units and built-up central systems shall be the following:

1. Direct-mounted, light-activated type.

C. Thermometers at outside-, return-, supply-, and mixed-air ducts shall be the following:

1. Direct-mounted, light-activated type.

D. Thermometer stems shall be of length to match thermowell insertion length.

## 3.5 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Heating, Hot-Water Piping: 0 to 250 deg F.

B. Scale Range for Air Ducts: 0 to 150 deg F.

## 3.6 PRESSURE-GAGE SCHEDULE

A. Pressure gages at suction and discharge of each pump shall be the following:

1. Sealed, direct-mounted, metal case.

## 3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Heating, Hot-Water Piping: 0 to 100 psi.

**END OF SECTION**

# SECTION 23 05 23.11 - GLOBE VALVES FOR 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. Section Includes:

1. Bronze angle valves.
2. Bronze globe valves.
3. Iron globe valves.
4. Chainwheels.

### 1.3 DEFINITIONS

A. CWP: Cold working pressure.

### 1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.

### 1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle and globe valves closed to prevent rattling.

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 REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded-end valves.
2. ASME B16.1 for flanges on iron valves.
3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
4. ASME B16.18 for solder joint.
5. ASME B31.9 for building services piping valves.

C. Refer to HVAC valve schedule articles for applications of valves.

D. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

E. Valve Sizes: Same as upstream piping unless otherwise indicated.

F. Valves in Insulated Piping: With 2-inch stem extensions.

### 2.2 BRONZE ANGLE VALVES

A. Class 150 Bronze Angle Valves:

1. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 300 psig.
c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
d. Ends: Threaded.
e. Stem and Disc: PTFE.
f. Packing: Asbestos free.
g. Handwheel: Malleable iron.

### 2.3 BRONZE GLOBE VALVES

A. Class 150 Bronze Globe Valves:

1. Description:

a. Standard: MSS SP-80, Type 2.
b. CWP Rating: 300 psig.

c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
d. Ends: Threaded.
e. Stem: Bronze.
f. Disc: PTFE.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron.

## 2.4 IRON GLOBE VALVES

A. Class 250 Iron Globe Valves:

1. Description:

a. Standard: MSS SP-85, Type I.
b. CWP Rating: 500 psig.
c. Body Material: ASTM A 126, gray iron with bolted bonnet.
d. Ends: Flanged.
e. Trim: Bronze.
f. Packing and Gasket: Asbestos free.
g. Operator: Handwheel or chainwheel.

## 2.5 CHAINWHEELS

A. Description: Valve actuation assembly with sprocket rim, chain guides, chain.

1. Sprocket Rim with Chain Guides: Ductile or cast iron, of type and size required for valve.
2. Chain: Hot-dip-galvanized steel, of size required to fit sprocket rim.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

## 3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install chainwheels on operators for globe valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.

F. Install valve tags. Comply with requirements in Section 23 05 53 "Identification for HVAC Piping and Equipment" for valve tags and schedules.

## 3.3 ADJUSTING

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

## 3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Throttling Service: Globe or angle valves.

B. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

C. Select valves with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules.
3. For Steel Piping, NPS 2 and Smaller: Threaded ends.
4. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules.

## 3.5 HEATING-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller: Bronze angle or globe valves, Class 150, bronze disc, with soldered ends.

B. Pipe NPS 2-1/2 and Larger: Iron globe valves, Class 250 with flanged ends.

**END OF SECTION**

# SECTION 23 05 23.12 - BALL VALVES FOR 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. Section Includes:

1. Bronze ball valves.
2. Steel ball valves.
3. Iron ball valves.

### 1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. SWP: Steam working pressure.

### 1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.

### 1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, and weld ends.
3. Set ball valves open to minimize exposure of functional surfaces.

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 operating handles or stems as lifting or rigging points.

## PART 2 - PRODUCTS

### 2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded-end valves.
2. ASME B16.1 for flanges on iron valves.
3. ASME B16.5 for flanges on steel valves.
4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
5. ASME B31.9 for building services piping valves.

C. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

D. Refer to HVAC valve schedule articles for applications of valves.

E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. Valve Actuator Types:

1. Handlever: For quarter-turn valves smaller than NPS 4.

H. Valves in Insulated Piping:

1. Include 2-inch stem extensions.
2. Extended operating handle of nonthermal-conductive material, and protective sleeves that allow operation of valves without breaking the vapor seals or disturbing insulation.
3. Memory stops that are fully adjustable after insulation is applied.

I. Valve Bypass and Drain Connections: MSS SP-45.

### 2.2 BRONZE BALL VALVES

A. Two-Piece Bronze Ball Valves with Full Port and Stainless-Steel Trim:

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.
h. Stem: Stainless steel.
i. Ball: Stainless steel, vented.
j. Port: Full.

## 2.3 STEEL BALL VALVES

A. Class 150 Steel Ball Valves with Full Port and Stainless-Steel Trim:

1. Description:

a. Standard: MSS SP-72.
b. CWP Rating: 285 psig.
c. Body Design: Split body.
d. Body Material: Carbon steel, ASTM A 216, Type WCB.
e. Ends: Flanged.
f. Seats: PTFE.
g. Stem: Stainless steel.
h. Ball: Stainless steel, vented.
i. Port: Full.

## 2.4 IRON BALL VALVES

A. Class 125 Iron Ball Valves:

1. Description:

a. Standard: MSS SP-72.
b. CWP Rating: 200 psig.
c. Body Design: Split body.
d. Body Material: ASTM A 126, gray iron.
e. Ends: Flanged.
f. Seats: PTFE.
g. Stem: Stainless steel.
h. Ball: Stainless steel.
i. Port: Full.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

## 3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install valve tags. Comply with requirements in Section 23 05 53 "Identification for HVAC Piping and Equipment" for valve tags and schedules.

## 3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valves with specified SWP classes or CWP ratings are unavailable, the same types of valves with higher SWP classes or CWP ratings may be substituted.

B. Select valves with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Steel Piping, NPS 2 and Smaller: Threaded ends.
4. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.

## 3.4 HEATING-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller: Two piece, full port, bronze with stainless-steel trim.

B. Pipe NPS 2-1/2 and Larger:

1. Iron ball valves.

    a. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.

2. Class 150 steel ball valves.

**END OF SECTION 23 05 23.12**

# SECTION 23 05 23.13 - BUTTERFLY VALVES FOR 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. Section Includes:

1. Iron, single-flange butterfly valves.

### 1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

### 1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.

### 1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, and ends.
3. Set butterfly valves closed or slightly open.

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 REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B16.1 for flanges on iron valves.
2. ASME B16.5 for pipe flanges and flanged fittings, NPS 1/2 through NPS 24.
3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
4. ASME B31.9 for building services piping valves.

C. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

D. Valve Sizes: Same as upstream piping unless otherwise indicated.

E. Valve Actuator Types:

1. Handlever: For valves NPS 6 and smaller.

F. Valves in Insulated Piping: With 2-inch stem extensions with extended necks.

### 2.2 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. Iron, Single-Flange Butterfly Valves with Aluminum-Bronze Disc:

1. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: 150 psig.
c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
e. Seat: EPDM.
f. Stem: One- or two-piece stainless steel.
g. Disc: Aluminum bronze.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine mating flange faces for damage. 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.

D. Do not attempt to repair defective valves; replace with new valves.

### 3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install valve tags. Comply with requirements in Section 23 05 53 "Identification for HVAC Piping and Equipment" for valve tags and schedules.

### 3.3 ADJUSTING

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

### 3.4 HEATING-WATER VALVE SCHEDULE

A. Pipe NPS 2-1/2 and Larger:

1. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12: 200 CWP, EPDM seat, aluminum-bronze disc.

**END OF SECTION**

# SECTION 23 05 23.14 - CHECK VALVES FOR HVAC PIPING

## PART 1 - **GENERAL**

### 1.1 RELATED DOCUMENTS

A. Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section Includes:

1. Bronze swing check valves.
2. Iron swing check valves.

### 1.3 DEFINITIONS

A. CWP: Cold working pressure.

### 1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.

### 1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, and ends.
3. 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.

PART 2 - **PRODUCTS**

## 2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded-end valves.
2. ASME B16.1 for flanges on iron valves.
3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
4. ASME B31.9 for building services piping valves.

C. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

D. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

E. Valve Sizes: Same as upstream piping unless otherwise indicated.

F. Valve Bypass and Drain Connections: MSS SP-45.

## 2.2 BRONZE SWING CHECK VALVES

A. Class 150, Bronze Swing Check Valves with Bronze Disc:

1. Description:

a. Standard: MSS SP-80, Type 3.
b. CWP Rating: 300 psig.
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: Bronze.

## 2.3 IRON SWING CHECK VALVES

A. Class 250, Iron Swing Check Valves with Metal Seats:

1. Description:

a. Standard: MSS SP-71, Type I.
b. NPS 2-1/2 to NPS 12, CWP Rating: 500 psig.
c. NPS 14 to NPS 24, CWP Rating: 300 psig.
d. Body Design: Clear or full waterway.

e. Body Material: ASTM A 126, gray iron with bolted bonnet.
f. Ends: Flanged.
g. Trim: Bronze.
h. Gasket: Asbestos free.

PART 3 - **EXECUTION**

## 3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine 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.

D. Do not attempt to repair defective valves; replace with new valves.

## 3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.

F. Install valve tags. Comply with requirements for valve tags and schedules in Section 23 05 53 "Identification for HVAC Piping and Equipment."

## 3.3 ADJUSTING

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

## 3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Pump-Discharge Check Valves:

a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
b. NPS 2-1/2 and Larger: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal-seat check valves.

B. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules.
3. For Steel Piping, NPS 2 and Smaller: Threaded ends.
4. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules.

## 3.5 HEATING-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Bronze Swing Check Valves: Class 150, bronze disc.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Swing Check Valves: Class 250, metal seats.

**END OF SECTION 23 05 23.14**

# SECTION 23 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Fastener systems.
5. Equipment supports.

### 1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of the Valve and Fittings Industry Inc.

### 1.4 ACTION SUBMITTALS

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

### 1.5 QUALITY ASSURANCE

A. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

## PART 2 - PRODUCTS

### 2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.

4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

## 2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

## 2.3 THERMAL-HANGER SHIELD INSERTS

A. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.

B. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.

C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

## 2.4 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

## 2.5 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

## 2.6 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

# PART 3 - EXECUTION

## 3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

D. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

F. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

G. Install hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

H. Install lateral bracing with pipe hangers and supports to prevent swaying.

I. Install building attachments within concrete slabs or attach to structural steel.

J. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

L. Insulated Piping:

1. Attach clamps and spacers to piping.

    a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

    a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
    b. NPS 4: 12 inches long and 0.06 inch thick.

5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

## 3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

## 3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M 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 so contours of welded surfaces match adjacent contours.

## 3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

## 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 a minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

## 3.6 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.

F. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.

G. Use padded hangers for piping that is subject to scratching.

H. Use thermal-hanger shield inserts for insulated piping and tubing.

I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
3. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
4. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
5. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
6. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
7. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
9. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
10. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
11. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
12. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.

13. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
14. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
15. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
16. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
17. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
18. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.

5. C-Clamps (MSS Type 23): For structural shapes.
6. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
7. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
8. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
9. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
10. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

11. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
12. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
13. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

N. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

O. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

**END OF SECTION**

# SECTION 23 05 48 - MECHANICAL VIBRATION AND SEISMIC CONTROLS

## PART 1 - GENERAL

### 1.01 RELATED DOCUMENTS

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

### 1.02 SUMMARY

A. This Section includes the following:

1. Elastomeric isolation pads and mounts.
2. Freestanding and restrained spring isolators.
3. Elastomeric hangers.
4. Spring hangers.
5. Seismic snubbers.
6. Restraining cables.

### 1.03 DEFINITIONS

A. OSHPD: Office of Statewide Health Planning & Development for the State of California. OSHPD assigns a unique anchorage preapproval "R" number to each seismic restraint it tests. The number describes a specific device applied as tested.

### 1.04 PROJECT CONDITIONS

A. Site Class as Defined in the IBC: D.

B. $S_s$, Mapped Maximum Considered Earthquake Spectral Response at Short Periods: 0.193g

C. S1, Mapped Maximum Considered Earthquake Spectral Response at 1-Second Period: 0.122g

D. Assigned Seismic Use Group or Building Category as Defined in the IBC: IV

E. Assigned Seismic Design Category as Defined in the IBC: C

### 1.05 SUBMITTALS

A. Vibration Isolator And Seismic-Restraint Schedule: In accordance with site requirements.

B. Product Data: Include load deflection curves for each vibration isolation device.

C. Shop Drawings: Signed and sealed by a qualified professional engineer. Include the following:

1. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.
3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.
4. Seismic-Restraint Details: Detail fabrication and attachment of seismic restraints and snubbers. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.
5. Submittals for Interlocking Snubbers: Include load deflection curves up to 1/2-inch deflection in x, y, and z planes.

## 1.06 QUALITY ASSURANCE

A. Seismic-restraint devices shall have horizontal and vertical load testing and analysis performed according to OSHPD and shall bear anchorage preapproval "R" number, from OSHPD or another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer. Testing and calculations must include both shear and tensile loads and 1 test or analysis at 45 degrees to the weakest mode.

# PART 2 - PRODUCTS

## 2.01 VIBRATION ISOLATORS

A. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.

1. Material: Standard neoprene.
2. Durometer Rating: 50.
3. Number of Layers: 1.

B. Elastomeric Mounts: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to

equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.

1. Durometer Rating: 50.

C. Spring Isolators: Freestanding, laterally stable, open-spring isolators.

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 100 psig.
6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

D. Elastomeric Hangers: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.

E. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.

## 2.02 SEISMIC-RESTRAINT DEVICES

A. Resilient Isolation Washers and Bushings: 1-piece, molded, bridge-bearing neoprene complying with AASHTO M 251 and having a durometer of 50, plus or minus 5, with a flat washer face.

B. Seismic Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.

1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.

2. Resilient Isolation Washers and Bushings: 1-piece, molded, bridge-bearing neoprene complying with AASHTO M 251 and having a durometer of 50, plus or minus 5.

C. Restraining Cables: Galvanized steel aircraft cables with end connections made of steel assemblies that swivel to final installation angle and utilize two clamping bolts for cable engagement.

D. Anchor Bolts: Seismic-rated, drill-in, and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements, installation tolerances, and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

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

### 3.02 INSTALLATION

A. Install seismic snubbers on isolated equipment. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.

B. Install restraining cables at each trapeze and individual pipe hanger. At trapeze anchor locations, shackle piping to trapeze. Install cables so they do not bend across sharp edges of adjacent equipment or building structure.

C. Install steel angles or channel, sized to prevent buckling, clamped with ductile-iron clamps to hanger rods for trapeze and individual pipe hangers. At trapeze anchor locations, shackle piping to trapeze. Requirements apply equally to hanging equipment. Do not weld angles to rods.

D. Install resilient bolt isolation washers on equipment anchor bolts.

### 3.03 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports. Perform the following field quality-control testing:

1. Isolator seismic-restraint clearance.

2. Isolator deflection.
3. Snubber minimum clearances.

## 3.04 ADJUSTING

A. Adjust isolators after piping systems have been filled and equipment is at operating weight.

B. Adjust active height of spring isolators.

C. Adjust snubbers according to manufacturer's written recommendations.

D. Adjust seismic restraints to permit free movement of equipment within normal mode of operation.

E. Torque anchor bolts according to equipment manufacturer's written recommendations to resist seismic forces.

## 3.05 CLEANING

A. After completing equipment installation, inspect vibration isolation and seismic-control devices. Remove paint splatters and other spots, dirt, and debris.

**END OF SECTION**

# SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

## 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 labels.
2. Pipe labels.
3. Duct labels.
4. Stencils.
5. Valve tags.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

## PART 2 - PRODUCTS

### 2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.

4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
7. Fasteners: Stainless-steel rivets.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

## 2.2 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction according to ASME A13.1.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: Size letters according to ASME A13.1 for piping.

## 2.3 STENCILS

A. Stencils for Ducts:

1. Lettering Size: Minimum letter height of 1-1/4 inches for viewing distances up to 15 feet and proportionately larger lettering for greater viewing distances.
2. Stencil Paint: Exterior, gloss, acrylic enamel. Paint may be in pressurized spray-can form.

B. Stencils for Access Panels and Door Labels, Equipment Labels, and Similar Operational Instructions:

1. Lettering Size: Minimum letter height of 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.
2. Stencil Paint: Exterior, gloss, acrylic enamel. Paint may be in pressurized spray-can form.

## 2.4 VALVE TAGS

A. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link chain.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

# PART 3 - EXECUTION

## 3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

## 3.2 GENERAL INSTALLATION REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

D. For concealed valves, equipment, and devices needing service, provide identification markers visible from floor. Use color dot stickers placed on ceiling grid where valves, equipment, and devices needing service are installed above. Color scheme to be in accordance with Owner’s color coding standard.

## 3.3 EQUIPMENT LABEL INSTALLATION

A. All major HVAC equipment, including air handlers, air terminal units, fans and pumps shall be properly identified with equipment tag stating equipment ID, ratings and date of installation.

B. Install or permanently fasten labels on each major item of mechanical equipment.

C. Locate equipment labels where accessible and visible.

## 3.4 PIPE LABEL INSTALLATION

A. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, on each piping system.

1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

B. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 25 feet along each run. Reduce intervals to 15 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

C. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

D. Pipe Label Color Schedule:

1. Heating -Water Piping: White letters on a safety-green background.
2. Refrigerant Piping: White letters on a safety-purple background.

## 3.5 DUCT LABEL INSTALLATION

A. Stenciled Duct Label: Stenciled labels showing service and flow direction may be provided instead of plastic-laminated duct labels, at Installer's option.

B. Locate labels near points where ducts enter into and exit from concealed spaces and at maximum intervals of 25 feet in each space where ducts are exposed or concealed by removable ceiling system.

## 3.6 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

    a. Heating Hot Water: 2 inches, round.

2. Valve-Tag Colors:

    a. Heating Hot Water: White letters on a safety-green background.

## 3.7 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

**END OF SECTION**

# SECTION 23 05 93 - 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 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section Includes:

1. Balancing Air Systems:

    a. Constant-volume air systems (including unit heaters, exhaust fans and split systems).
    b. Variable-air-volume systems (RTUs and Terminal Units).

2. Balancing Hydronic Piping Systems:

    a. Variable-flow hydronic systems.

3. Testing, Adjusting, and Balancing Equipment:

    a. Motors.
    b. Condensing units.
    c. Heat-transfer coils.

4. Domestic water recirculation.
5. Domestic hot water system.
6. Control system verification.

### 1.3 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. BAS: Building automation systems.

C. NEBB: National Environmental Balancing Bureau.

D. TAB: Testing, adjusting, and balancing.

E. TABB: Testing, Adjusting, and Balancing Bureau.

F. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

G. TDH: Total dynamic head.

## 1.4 PREINSTALLATION MEETINGS

A. TAB Conference: If requested by the Owner, conduct a TAB conference at Project site after approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Provide a minimum of 14 days' advance notice of scheduled meeting time and location.

1. Minimum Agenda Items:

a. The Contract Documents examination report.
b. The TAB plan.
c. Needs for coordination and cooperation of trades and subcontractors.
d. Proposed procedures for documentation and communication flow.

## 1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.

C. Strategies and Procedures Plan: Within days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

D. System Readiness Checklists: Within 30 days of Contractor's Notice to Proceed, submit system readiness checklists as specified in "Preparation" Article.

E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.

F. Certified TAB reports.

G. Sample report forms.

H. Record log of duct leakage tests submitted to designer and/or commissioning agent upon completion.

I. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

## 1.6 QUALITY ASSURANCE

A. TAB Specialists Qualifications: Certified by NEBB or AABC.

1. TAB Field Supervisor: Employee of the TAB specialist and certified by NEBB or AABC.
2. TAB Technician: Employee of the TAB specialist and certified by NEBB or AABC as a TAB technician.

B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

## 1.7 FIELD CONDITIONS

A. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

# PART 2 - PRODUCTS (Not Applicable)

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.

B. Examine installed systems for balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine equipment performance data including fan and pump curves.

1. 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.
2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's

"HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

F. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

G. Examine test reports specified in individual system and equipment Sections.

H. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

I. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

J. Examine strainers. Verify that startup screens have been replaced by permanent screens with indicated perforations.

K. Examine control valves for proper installation for their intended function of throttling, diverting, or mixing fluid flows.

L. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

M. Examine system pumps to ensure absence of entrained air in the suction piping.

N. Examine operating safety interlocks and controls on HVAC equipment.

O. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

## 3.2 PREPARATION

A. Prepare a TAB plan that includes the following:

1. Equipment and systems to be tested.
2. Strategies and step-by-step procedures for balancing the systems.
3. Instrumentation to be used.
4. Sample forms with specific identification for all equipment.

B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:

1. Airside:

a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
b. Duct systems are complete with terminals installed.
c. Volume, smoke, and fire dampers are open and functional.
d. Clean filters are installed.
e. Fans are operating, free of vibration, and rotating in correct direction.

f. Variable-frequency controllers' startup is complete and safeties are verified.
g. Automatic temperature-control systems are operational.
h. Ceilings are installed.
i. Windows and doors are installed.
j. Suitable access to balancing devices and equipment is provided.

2. Hydronics:

a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed.
b. Piping is complete with terminals installed.
c. Water treatment is complete.
d. Systems are flushed, filled, and air purged.
e. Strainers are pulled and cleaned.
f. Control valves are functioning per the sequence of operation.
g. Shutoff and balance valves have been verified to be 100 percent open.
h. Pumps are started and proper rotation is verified.
i. Pump gage connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
j. Variable-frequency controllers' startup is complete and safeties are verified.
k. Suitable access to balancing devices and equipment is provided.

## 3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts. Mark exterior of repaired duct insulation with location of test holes for Commissioning purposes.
2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 23 07 13 "Duct Insulation" and Section 23 07 19 "HVAC Piping Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

## 3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

L. Verify that air duct system is sealed as specified in Section 23 31 13 "Metal Ducts."

## 3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure 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 from Construction Manager 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.

B. 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.

C. 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.

D. Verify final system conditions.

1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to 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.

## 3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Adjust the variable-air-volume systems as follows:

1. Verify that the system static pressure sensor is located two-thirds of the distance down the duct from the fan discharge.
2. Verify that the system is under static pressure control.
3. For belt-driven exhaust fan, balance at or above 90% of the maximum speed utilizing pulley and/or sheave adjustment.
4. Select the terminal unit that is most critical to the supply-fan airflow. Measure inlet static pressure, and adjust system static pressure control set point so the

entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.

5. Calibrate and balance each terminal unit for maximum and minimum design airflow as follows:

    a. Adjust controls so that terminal is calling for maximum airflow. Some controllers require starting with minimum airflow. Verify calibration procedure for specific project.
    b. Measure airflow and adjust calibration factor as required for design maximum airflow. Record calibration factor.
    c. When maximum airflow is correct, balance the air outlets downstream from terminal units.
    d. Adjust controls so that terminal is calling for minimum airflow.
    e. Measure airflow and adjust calibration factor as required for design minimum airflow. Record calibration factor. If no minimum calibration is available, note any deviation from design airflow.
    f. When in full cooling or full heating, ensure that there is no mixing of hot-deck and cold-deck airstreams unless so designed.
    g. On constant volume terminals, in critical areas where room pressure is to be maintained, verify that the airflow remains constant over the full range of full cooling to full heating. Note any deviation from design airflow or room pressure.

6. After terminals have been calibrated and balanced, test and adjust system for total airflow. Adjust fans to deliver total design airflows within the maximum allowable fan speed listed by fan manufacturer.

    a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
    b. Set terminals for maximum airflow. If system design includes diversity, adjust terminals for maximum and minimum airflow so that connected total matches fan selection and simulates actual load in the building.
    c. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
    d. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
    e. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

7. 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 any artificial loading of filters at the time static pressures are measured.

8. Set final return and outside airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.

    a. Balance the return-air ducts and inlets the same as described for constant-volume air systems.
    b. Verify that terminal units are meeting design airflow under system maximum flow.

9. Re-measure the inlet static pressure at the most critical terminal unit and adjust the system static pressure set point to the most energy-efficient set point to maintain the optimum system static pressure. Record set point and give to controls contractor.
10. Verify final system conditions as follows:

    a. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to match design if necessary.
    b. Re-measure and confirm that total airflow is within design.
    c. Re-measure final fan operating data, rpms, volts, amps, and static profile.
    d. Mark final settings.
    e. Test system in economizer mode. Verify proper operation and adjust if necessary. Measure and record all operating data.
    f. Verify tracking between supply and return fans.

## 3.7 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports for pumps, coils, and heat exchangers. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required coil and heat exchanger flow rates with pump design flow rate.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. In addition to requirements in "Preparation" Article, prepare hydronic systems for testing and balancing as follows:

1. Check liquid level in expansion tank.
2. Check highest vent for adequate pressure.
3. Check flow-control valves for proper position.
4. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
5. Verify that motor starters are equipped with properly sized thermal protection.
6. Check that air has been purged from the system.
7. Adjust expansion tank pressure to make-up water pressure.

## 3.8 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

A. Adjust pumps to deliver total design gpm.

1. Measure total water flow.

    a. Position valves for full flow through coils.

b. Measure flow by main flow meter, if installed.
c. Determine flow by pump TDH.

2. Measure pump TDH as follows:

a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
c. Convert pressure to head and correct for differences in gage heights.
d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.
e. With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.

3. Monitor motor performance during procedures and do not operate motor in an overloaded condition.

B. Adjust flow-measuring devices installed in mains and branches to design water flows.

1. Measure flow in main and branch pipes.
2. Adjust main and branch balance valves for design flow.
3. Re-measure each main and branch after all have been adjusted.

C. Adjust flow-measuring devices installed at terminals for each space to design water flows.

1. Measure flow at terminals.
2. Adjust each terminal to design flow.
3. Re-measure each terminal after it is adjusted.
4. Position control valves to bypass the coil, and adjust the bypass valve to maintain design flow.
5. Perform temperature tests after flows have been balanced.

D. For systems with pressure-independent valves at terminals:

1. Measure differential pressure and verify that it is within manufacturer's specified range.
2. Perform temperature tests after flows have been verified.

E. For systems without pressure-independent valves or flow-measuring devices at terminals:

1. Measure and balance coils by either coil pressure drop or temperature method.
2. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

F. Verify final system conditions as follows:

1. Re-measure and confirm that total water flow is within design.
2. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.

3. Mark final settings.

G. Verify that memory stops have been set.

## 3.9 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals, and proceed as specified above for hydronic systems.

B. Adjust the variable-flow hydronic system as follows:

1. Verify that the differential-pressure sensor is located as indicated.
2. Determine whether there is diversity in the system.

C. For systems with no diversity:

1. Adjust pumps to deliver total design gpm.

a. Measure total water flow.

1) Position valves for full flow through coils.
2) Measure flow by main flow meter, if installed.
3) If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.

b. Measure pump TDH as follows:

1) Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
2) Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
3) Convert pressure to head and correct for differences in gage heights.
4) Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
5) With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.

c. Monitor motor performance during procedures and do not operate motor in an overloaded condition.

2. Adjust flow-measuring devices installed in mains and branches to design water flows.

a. Measure flow in main and branch pipes.
b. Adjust main and branch balance valves for design flow.
c. Re-measure each main and branch after all have been adjusted.

3. Adjust flow-measuring devices installed at terminals for each space to design water flows.

a. Measure flow at terminals.
b. Adjust each terminal to design flow.
c. Re-measure each terminal after it is adjusted.
d. Position control valves to bypass the coil and adjust the bypass valve to maintain design flow.
e. Perform temperature tests after flows have been balanced.

4. For systems with pressure-independent valves at terminals:

   a. Measure differential pressure and verify that it is within manufacturer's specified range.
   b. Perform temperature tests after flows have been verified.

5. For systems without pressure-independent valves or flow-measuring devices at terminals:

   a. Measure and balance coils by either coil pressure drop or temperature method.
   b. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

6. Prior to verifying final system conditions, determine the system differential-pressure set point.
7. If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hz, at completion open discharge valve 100 percent and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.
8. Mark final settings and verify that all memory stops have been set.
9. Verify final system conditions as follows:

   a. Re-measure and confirm that total water flow is within design.
   b. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
   c. Mark final settings.

10. Verify that memory stops have been set.

D. For systems with diversity:

1. Determine diversity factor.
2. Simulate system diversity by closing required number of control valves, as approved by the design engineer.
3. Adjust pumps to deliver total design gpm.

   a. Measure total water flow.

      1) Position valves for full flow through coils.
      2) Measure flow by main flow meter, if installed.
      3) If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.

   b. Measure pump TDH as follows:

1) Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
2) Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
3) Convert pressure to head and correct for differences in gage heights.
4) Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
5) With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.

c. Monitor motor performance during procedures and do not operate motor in an overloaded condition.

4. Adjust flow-measuring devices installed in mains and branches to design water flows.

a. Measure flow in main and branch pipes.
b. Adjust main and branch balance valves for design flow.
c. Re-measure each main and branch after all have been adjusted.

5. Adjust flow-measuring devices installed at terminals for each space to design water flows.

a. Measure flow at terminals.
b. Adjust each terminal to design flow.
c. Re-measure each terminal after it is adjusted.
d. Position control valves to bypass the coil, and adjust the bypass valve to maintain design flow.
e. Perform temperature tests after flows have been balanced.

6. For systems with pressure-independent valves at terminals:

a. Measure differential pressure, and verify that it is within manufacturer's specified range.
b. Perform temperature tests after flows have been verified.

7. For systems without pressure-independent valves or flow-measuring devices at terminals:

a. Measure and balance coils by either coil pressure drop or temperature method.
b. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

8. Open control valves that were shut. Close a sufficient number of control valves that were previously open to maintain diversity, and balance terminals that were just opened.
9. Prior to verifying final system conditions, determine system differential-pressure set point.

10. If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hz, at completion open discharge valve 100 percent and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.
11. Mark final settings and verify that memory stops have been set.
12. Verify final system conditions as follows:

    a. Re-measure and confirm that total water flow is within design.
    b. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
    c. Mark final settings.

13. Verify that memory stops have been set.

## 3.10 PROCEDURES FOR MOTORS

A. Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Phase and hertz.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter size and thermal-protection-element rating.
8. Service factor and frame size.

B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

C. Record final motor speed or frequency at balanced conditions in addition to nameplate speed.

## 3.11 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record fan and motor operating data.

## 3.12 PROCEDURES FOR HEAT-TRANSFER COILS

A. Measure, adjust, and record the following data for each water coil:

1. Entering- and leaving-water temperature.
2. Water flow rate.

3. Water pressure drop for major (more than 20 gpm) equipment coils, excluding unitary equipment such as reheat coils, unit heaters, and fan-coil units.
4. Dry-bulb temperature of entering and leaving air.
5. Wet-bulb temperature of entering and leaving air for cooling coils.
6. Airflow.

B. Measure, adjust, and record the following data for each electric heating coil:

1. Nameplate data.
2. Airflow.
3. Entering- and leaving-air temperature at full load.
4. Voltage and amperage input of each phase at full load.
5. Calculated kilowatt at full load.
6. Fuse or circuit-breaker rating for overload protection.

C. Measure, adjust, and record the following data for each steam coil:

1. Dry-bulb temperature of entering and leaving air.
2. Airflow.
3. Inlet steam pressure.

D. Measure, adjust, and record the following data for each refrigerant coil:

1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.

## 3.13 PROCEDURES FOR DOMESTIC HOT WATER SYSTEM

A. Adjust pumps to deliver total design gpm.

1. Measure total water flow.

a. Position valves for full flow.
b. Measure flow by main flow meter, if installed.
c. If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.

2. Measure pump TDH as follows:

a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
c. Convert pressure to head and correct for differences in gage heights.
d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.
e. With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.

3. Monitor motor performance during procedures and do not operate motor in an overloaded condition.

B. Verify final system conditions as follows:

1. Re-measure and confirm that total water flow is within design.
2. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
3. Mark final settings.

## 3.14 CONTROLS VERIFICATION

A. In conjunction with system balancing, perform the following:

1. Verify temperature control system is operating within the design limitations.
2. Confirm that the sequences of operation are in compliance with Contract Documents.
3. Verify that controllers are calibrated and function as intended.
4. Verify that controller set points are as indicated.
5. Verify the operation of lockout or interlock systems.
6. Verify the operation of valve and damper actuators.
7. Verify that controlled devices are properly installed and connected to correct controller.
8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.

B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

## 3.15 TOLERANCES

A. Set HVAC system's airflow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
2. Air Outlets and Inlets (other): Plus or minus 10 percent.
3. Heating-Water Flow Rate: Plus or minus 5 percent.

B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

## 3.16 PROGRESS REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems balancing devices. Recommend changes and additions to systems balancing devices to facilitate proper performance measuring and balancing. Recommend

changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: Prepare weekly progress 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.

## 3.17 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.
3. Certify validity and accuracy of field data.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance; do not include Shop Drawings and Product Data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB specialist.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:

    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.

15. Test conditions for fans and pump performance forms including the following:

    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Face and bypass damper settings at coils.
    e. Fan drive settings including settings and percentage of maximum pitch diameter.
    f. Inlet vane settings for variable-air-volume systems.
    g. Settings for supply-air, static-pressure controller.
    h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data:

    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. Center-to-center dimensions of sheave and amount of adjustments in inches.
    j. Number, make, and size of belts.
    k. Number, type, and size of filters.

2. Motor Data:

    a. Motor 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. Center-to-center dimensions of sheave and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):

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. Outdoor airflow in cfm.
i. Return airflow in cfm.
j. Outdoor-air damper position.
k. Return-air damper position.
l. Pressure set-point in inches wg.

F. Apparatus-Coil Test Reports:

1. Coil Data:

a. System identification.
b. Location.
c. Coil type.
d. Number of rows.
e. Fin spacing in fins per inch o.c.
f. Make and model number.
g. Face area in sq. ft..
h. Tube size in NPS.
i. Tube and fin materials.
j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

a. Airflow rate in cfm.
b. Average face velocity in fpm.
c. Air pressure drop in inches wg.
d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
e. Return-air, wet- and dry-bulb temperatures in deg F.
f. Entering-air, wet- and dry-bulb temperatures in deg F.
g. Leaving-air, wet- and dry-bulb temperatures in deg F.
h. Water flow rate in gpm.
i. Water pressure differential in feet of head or psig.
j. Entering-water temperature in deg F.
k. Leaving-water temperature in deg F.
l. Refrigerant expansion valve and refrigerant types.
m. Refrigerant suction pressure in psig.
n. Refrigerant suction temperature in deg F.
o. Inlet steam pressure in psig.

G. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

a. System identification.

b. Location.
c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches, and bore.
h. Center-to-center dimensions of sheave and amount of adjustments in inches.

2. Motor Data:

a. Motor 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. Center-to-center dimensions of sheave, and amount of adjustments in inches.
g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Suction static pressure in inches wg.
f. Pressure set-point in inches wg.

H. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

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. Indicated airflow rate in cfm.
h. Indicated velocity in fpm.
i. Actual airflow rate in cfm.
j. Actual average velocity in fpm.
k. Barometric pressure in psig.

I. Air-Terminal-Device Reports:

1. Unit Data:

a. System and air-handling unit identification.

b. Location and zone.
c. Apparatus used for test.
d. Area served.
e. Make.
f. Number from system diagram.
g. Type and model number.
h. Size.
i. Effective area in sq. ft..

2. Test Data (Indicated and Actual Values):

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. Final calibration factor for achieving design air flow.
h. Individual inlet and outlet readings and sum at maximum air flow rate and at minimum air flow rate in cfm.
i. Space temperature in deg F.

J. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data:

a. System and air-handling-unit identification.
b. Location and zone.
c. Room or riser served.
d. Coil make and size.
e. Flowmeter type.

2. Test Data (Indicated and Actual Values):

a. Airflow rate in cfm.
b. Entering-water temperature in deg F.
c. Leaving-water temperature in deg F.
d. Water pressure drop in feet of head or psig.
e. Entering-air temperature in deg F.
f. Leaving-air temperature in deg F.

K. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:

1. Unit Data:

a. Unit identification.
b. Location.
c. Service.
d. Make and size.

e. Model number and serial number.
f. Water flow rate in gpm.
g. Water pressure differential in feet of head or psig.
h. Required net positive suction head in feet of head or psig.
i. Pump rpm.
j. Impeller diameter in inches.
k. Motor make and frame size.
l. Motor horsepower and rpm.
m. Voltage at each connection.
n. Amperage for each phase.
o. Full-load amperage and service factor.
p. Seal type.

2. Test Data (Indicated and Actual Values):

a. Static head in feet of head or psig.
b. Pump shutoff pressure in feet of head or psig.
c. Actual impeller size in inches.
d. Full-open flow rate in gpm.
e. Full-open pressure in feet of head or psig.
f. Final discharge pressure in feet of head or psig.
g. Final suction pressure in feet of head or psig.
h. Final total pressure in feet of head or psig.
i. Final water flow rate in gpm.
j. Voltage at each connection.
k. Amperage for each phase.
l. Pressure set-point in feet of head or psig.

L. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

## 3.18 VERIFICATION OF TAB REPORT

A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Construction Manager and commissioning authority. Prepare test and inspection reports.

B. Verification of TAB will include 10% of all redundant equipment such as terminal units. Verification of TAB will include limited readings of 100% of major equipment (all AHUs, EFs, etc.).

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, Owner may contact AABC Headquarters regarding the AABC National Performance Guaranty.

## 3.19 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

**END OF SECTION**

# SECTION 23 07 13 - DUCT INSULATION

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section includes insulating the following duct services:

1. Indoor, supply, return, exhaust and outdoor air.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (factory-applied).

### 1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Field quality-control reports.

### 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. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing 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.

### 1.5 DELIVERY, STORAGE, AND HANDLING

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

## 1.6 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and finishes and for space required for maintenance.

## 1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

# PART 2 - PRODUCTS

## 2.1 INSULATION MATERIALS

A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule article for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

F. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

G. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied FSK jacket complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal

conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

## 2.2 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

C. FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

## 2.3 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

B. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.

1. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
2. Service Temperature Range: 0 to 180 deg F.
3. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
4. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.

1. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
2. Service Temperature Range: Minus 50 to plus 220 deg F.
3. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
4. Color: White.

## 2.4 SEALANTS

A. FSK Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: Aluminum.

## 2.5 FACTORY-APPLIED JACKETS

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

1. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

## 2.6 TAPES

A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Width: 3 inches.
2. Thickness: 6.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

## 2.7 SECUREMENTS

A. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

    a. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
    b. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
    c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

4. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

    a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

5. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

### 2.8 CORNER ANGLES

A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

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

### 3.2 PREPARATION

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

### 3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

    a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

## 3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.

1. Comply with requirements in Section 07 84 13 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

E. Insulation Installation at Floor Penetrations:

1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 07 84 13 "Penetration Firestopping."

## 3.5 INSTALLATION OF MINERAL-FIBER INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.

b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
d. Do not overcompress insulation during installation.
e. Impale insulation over pins and attach speed washers.
f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

3. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

   a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
   b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

4. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

   a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.

b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
d. Do not overcompress insulation during installation.
e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

   a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
   b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

## 3.6 FIELD QUALITY CONTROL

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

B. Perform tests and inspections.

C. Tests and Inspections:

1. Inspect ductwork, randomly selected by Architect, by removing insulation in layers in reverse order of their installation. Extent of inspection shall be limited to five location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

## 3.7 DUCT INSULATION SCHEDULE, GENERAL

A. Items Not Insulated:

1. Factory-insulated flexible ducts.
2. Factory-insulated plenums and casings.
3. Flexible connectors.
4. Vibration-control devices.
5. Factory-insulated access panels and doors.

## 3.8 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Rectangular, round duct (supply, return, exhaust and outside air) in conditioned space, insulation shall be the following:

1. Mineral-Fiber Blanket: 2 inches thick and 0.75-lb/cu. ft. nominal density.
2. Mineral-Fiber Board: 2 inches thick and 2-lb/cu. ft. nominal density.

B. Round duct (supply, return, exhaust and outside air) in attic/unconditioned space, insulation shall be the following:

1. Mineral-Fiber Blanket: 3 inches thick and 0.75-lb/cu. ft. nominal density.
2. Mineral-Fiber Board: 3 inches thick and 2-lb/cu. ft. nominal density.

C. Rectangular duct (supply, return, exhaust and outside air) in attic/unconditioned space, insulation shall be the following:

1. Mineral-Fiber Board: 3 inches thick and 2-lb/cu. ft. nominal density.

**END OF SECTION**

# SECTION 23 07 19 - HVAC PIPING INSULATION

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. Section includes insulating the following HVAC piping systems:

1. Condensate drain piping, indoors.
2. Heating hot-water piping, indoors.

B. Related Sections:

1. Section 23 07 13 "Duct Insulation."

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

### 1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Field quality-control reports.

### 1.5 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. 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.

## 1.6 DELIVERY, STORAGE, AND HANDLING

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

## 1.7 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

## 1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

# PART 2 - PRODUCTS

## 2.1 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Mineral-Fiber, Preformed Pipe Insulation:

1. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

E. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

## 2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

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

## 2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

D. ASJ Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

## 2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

B. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below-ambient services.

1. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
2. Service Temperature Range: 0 to 180 deg F.
3. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
4. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below-ambient services.

1. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
2. Service Temperature Range: Minus 50 to plus 220 deg F.

3. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
4. Color: White.

D. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.

1. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
2. Service Temperature Range: Minus 20 to plus 180 deg F.
3. Solids Content: 60 percent by volume and 66 percent by weight.
4. Color: White.

## 2.5 SEALANTS

A. ASJ Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.

## 2.6 FACTORY-APPLIED JACKETS

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

1. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

## 2.7 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Adhesive: As recommended by jacket material manufacturer.
2. Color:

   a. Heating Hot Water Supply and Return – Orange.

3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

## 2.8 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Width: 3 inches.
2. Thickness: 11.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Width: 2 inches.
2. Thickness: 6 mils.
3. Adhesion: 64 ounces force/inch in width.
4. Elongation: 500 percent.
5. Tensile Strength: 18 lbf/inch in width.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 PREPARATION

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

B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

## 3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.

3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

    a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

## 3.4 PENETRATIONS

A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

B. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Section 07 84 13 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

C. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 07 84 13 "Penetration Firestopping."

## 3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on

insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

## 3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturers recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturers recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.

2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

## 3.7 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

## 3.8 FIELD-APPLIED JACKET INSTALLATION

A. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturers recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

## 3.9 FINISHES

A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

## 3.10 FIELD QUALITY CONTROL

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

B. Perform tests and inspections.

C. Tests and Inspections:

1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

## 3.11 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

## 3.12 INDOOR PIPING INSULATION SCHEDULE

A. Condensate and Equipment Drain Water below 60 Deg F:

1. All Pipe Sizes: Insulation shall be the following:

a. Flexible Elastomeric: 1 inch thick.

B. Heating-Hot-Water Supply and Return, 200 Deg F and Below:

1. Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe, Type I: 2 inches thick.

## 3.13 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Piping, Exposed where subject to damage (from floor to 8’ above finished floor):

1. PVC, Color-Coded by System: 20 mils thick.

## 3.14 OUTDOOR, FIELD-APPLIED FINISH SCHEDULE

A. Piping, Exposed:

1. PVC: 30 mils thick.

**END OF SECTION**

# SECTION 23 08 00 - COMMISSIONING OF 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.

### 1.2 DEFINITIONS

A. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.

B. Commissioning Authority: Owners representative who leads, plans, schedules, and coordinates the commissioning team to implement the commissioning process.

C. HVAC&R: Heating, Ventilating, Air Conditioning, and Refrigeration.

D. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

### 1.3 INFORMATIONAL SUBMITTALS

A. Certificates of readiness.

B. Certificates of completion of installation, prestart, and startup activities.

### 1.4 SUMMARY

A. Section includes commissioning process requirements for HVAC&R systems, assemblies, and equipment.

B. Related Sections:

1. Division 01 Section "General Commissioning Requirements" for general commissioning process requirements.

### 1.5 ALLOWANCES

A. Labor, instrumentation, tools, and equipment costs for technicians for the performance of commissioning testing are covered by the "Schedule of Allowances" Article in Division 01 Section "Allowances."

### 1.6 UNIT PRICES

A. Commissioning testing allowance may be adjusted up or down by the "List of Unit Prices" Article in Division 01 Section "Unit Prices" when actual man-hours are computed at the end of commissioning testing.

### 1.7 CONTRACTOR'S RESPONSIBILITIES

A. Perform commissioning tests at the direction of the Commissioning Authority.

B. Attend construction phase controls coordination meeting.

C. Attend testing, adjusting, and balancing review and coordination meeting.

D. Participate in HVAC&R systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the Commissioning Authority.

E. Provide information requested by the Commissioning Authority for final commissioning documentation.

F. Provide measuring instruments and logging devices to record test data and provide data acquisition equipment to record data for the complete range of testing for the required test period.

## 1.8 COMMISSIONING AUTHORITY'S RESPONSIBILITIES

A. Provide Project-specific construction checklists and commissioning process test procedures for actual HVAC&R systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.

B. Direct commissioning testing.

C. Verify testing, adjusting, and balancing of Work are complete.

D. Provide test data, inspection reports, and certificates in Systems Manual.

## 1.9 COMMISSIONING DOCUMENTATION

A. Provide the following information to the Commissioning Authority for inclusion in the commissioning plan:

1. Plan for delivery and review of submittals, systems manuals, and other documents and reports.
2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
3. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for HVAC&R systems, assemblies, equipment, and components to be verified and tested.
4. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.
5. Certificate of readiness certifying that HVAC&R systems, subsystems, equipment, and associated controls are ready for testing.
6. Test and inspection reports and certificates.
7. Corrective action documents.
8. Verification of testing, adjusting, and balancing reports.

## 1.10 SUBMITTALS

A. Certificates of readiness.

B. Certificates of completion of installation, prestart, and startup activities.

## PART 2 PRODUCTS (Not Used)

## PART 3 EXECUTION

### 3.1 TESTING PREPARATION

A. Certify that HVAC&R systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.

B. Certify that HVAC&R instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.

C. Certify that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.

D. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

E. Inspect and verify the position of each device and interlock identified on checklists.

F. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.

G. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the Commissioning Authority.

### 3.2 TESTING AND BALANCING VERIFICATION

A. Prior to performance of testing and balancing Work, provide copies of reports, sample forms, checklists, and certificates to the Commissioning Authority.

B. Notify the Commissioning Authority at least 10 days in advance of testing and balancing Work and provide access for the Commissioning Authority to witness testing and balancing Work.

C. Provide technicians, instrumentation, and tools to verify testing and balancing of HVAC&R systems at the direction of the Commissioning Authority.

1. The Commissioning Authority will notify testing and balancing Subcontractor 10 days in advance of the date of field verification. Notice will not include data points to be verified.
2. The testing and balancing Subcontractor shall use the same instruments (by model and serial number) that were used when original data were collected.
3. Failure of an item includes, other than sound, a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final testing, adjusting, and balancing report. For sound pressure readings, a deviation of 3 dB shall result in rejection of final testing. Variations in background noise must be considered.
4. Remedy the deficiency and notify the Commissioning Authority so verification of failed portions can be performed.

## 3.3 GENERAL TESTING REQUIREMENTS

A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the Commissioning Authority.

B. Scope of HVAC&R testing shall include entire HVAC&R installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. Testing shall include measuring capacities and effectiveness of operational and control functions.

C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.

D. The Commissioning Authority along with the HVAC&R Subcontractor, testing and Balancing Subcontractor, and HVAC&R Instrumentation and Control Subcontractor shall prepare detailed testing plans, procedures, and checklists for HVAC&R systems, subsystems, and equipment.

E. Tests will be performed using design conditions whenever possible.

F. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the Commissioning Authority and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.

G. The Commissioning Authority may direct that set points be altered when simulating conditions is not practical.

H. The Commissioning Authority may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.

I. If tests cannot be completed because of a deficiency outside the scope of the HVAC&R system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.

J. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

## 3.4 HVAC&R SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES

A. Boiler Testing and Acceptance Procedures: Testing requirements are specified in Division 23 boiler Sections. Provide submittals, test data, inspector record, and boiler certification to the Commissioning Authority.

B. HVAC&R Instrumentation and Control System Testing: Field testing plans and testing requirements are specified in Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operations for HVAC Controls." Assist the Commissioning Authority with preparation of testing plans.

C. Pipe system cleaning, flushing, hydrostatic tests and chemical treatment requirements are specified in Division 23 piping Sections. HVAC&R Subcontractor shall prepare a pipe system cleaning, flushing, and hydrostatic testing plan. Provide cleaning, flushing, testing, and treating plan and final reports to the Commissioning Authority. Plan shall include the following:

1. Sequence of testing and testing procedures for each section of pipe to be tested, identified by pipe zone or sector identification marker. Markers shall be keyed to Drawings for each pipe sector, showing the physical location of each designated pipe test section. Drawings keyed to pipe zones or sectors shall be formatted to allow each section of piping to be physically located and identified when referred to in pipe system cleaning, flushing, hydrostatic testing, and chemical treatment plan.
2. Description of equipment for flushing operations.
3. Minimum flushing water velocity.
4. Tracking checklist for managing and ensuring that all pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.

D. Energy Supply System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of fuel-oil, gas, steam, and hot-water systems and equipment at the direction of the Commissioning Authority. The Commissioning Authority shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.

E. Refrigeration System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of air-cooled chillers, refrigerant compressors and condensers, and other refrigeration systems. The Commissioning Authority shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.

F. HVAC&R Distribution System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of air, steam, and hydronic distribution systems; special exhaust; and other distribution systems, including HVAC&R terminal equipment and unitary equipment.

G. Vibration and Sound Tests: Provide technicians, instrumentation, tools, and equipment to test performance of vibration isolation and seismic controls.

H. The following is a summary of the HVAC&R system and equipment types that will be commissioned. The complete final list will be identified in detail at the start of construction, prior to the project commissioning kick-off meeting. The list will be updated during the construction period to reflect any changes to the construction document scope of work.
   1. Electric cabinet unit heaters.
   2. Electric unit heaters.
   3. Variable air volume Rooftop Units.
   4. Ductless split systems
   5. All exhaust fans.
   6. Variable air volume (VAV) boxes with electric reheat coils.
   7. Automatic Direct Digital Control (DDC) systems.

**END OF SECTION**

# SECTION 23 09 00 - TEMPERATURE CONTROLS AND BUILDING AUTOMATION SYSTEMS

## PART 1 – GENERAL

### 1.1 DESCRIPTION OF WORK

A. This Section includes control equipment and services required to provide a complete Direct Digital Control (DDC) Building Automation System (BAS) for HVAC systems and components as indicated on the drawings and specified herein.

B. The BAS for this project shall be based on the Delta Controls platform and installed under the direction of the Owner's standard BAS contractor. The system shall include local controllers, networking, graphics, programming, commissioning, and training necessary to provide a fully functional BAS.

C. Cloud-based supervisory services shall be provided utilizing Delta enteliWEB and enteliCLOUD. Cloud services shall be supervisory in nature only and shall not be required for basic HVAC system operation.

D. All control logic, graphics, schedules, alarms, trends, and databases installed as part of this project shall become the property of the County. A complete list of passwords, logins, and administrative credentials shall be turned over to the County at the completion of system commissioning.

E. The control system installed as part of this project will be connected to the Brunswick County Ethernet to provide for both graphical and logical display of the HVAC system. Coordination with County IT staff shall be required.

F. The use of "gateways" and other interface devices or software to convert propriety systems to open systems will not be acceptable on this project.

G. Mechanical equipment furnished with BACnet, Modbus, or other open-protocol interfaces shall be fully integrated into the BAS. Equipment suppliers shall provide complete point lists and all configuration software, hardware, and passwords required for integration.

H. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.

I. DDC contractor is responsible for providing and installing all variable frequency drives not included with equipment as specified in Section 26 29 23 – Variable Frequency Motor Controllers.

J. Refer to the drawings for Sequences of Operation and additional requirements applicable to this Section.

K. The following equipment shall be controlled:

1. Package Roof Top Units
2. VAV Boxes
3. Heating Hot Water System
4. Power Ventilators
5. Direct Expansion Systems
6. Unit Heaters
7. Domestic Hot Water Recirculation

## 1.2 RELATED SECTIONS

A. Division 23 – Mechanical Specifications

B. Division 26 - Electrical Specifications

## 1.3 OWNER'S STANDARD CONTROLS CONTRACTOR

A. The Building Automation System shall be furnished, installed, programmed, and commissioned by Champion Systems, Inc., Greensboro, North Carolina, as the Owner's standard BAS contractor.

B. No other controls contractor shall be permitted to install the BAS unless previously approved in writing by the County.

## 1.4 CYBERSECURITY AND ACCESS CONTROL

A. All web-based and cloud communications shall utilize encrypted protocols (HTTPS/TLS).

B. User access shall be role-based and password protected, with permissions configurable by the County.

C. Multi-Factor Authentication (MFA) Shall Be Required For All Remote And Cloud-Based Access, Including Administrative-Level Users.

D. Local on-site access to the BAS shall remain available during loss of internet or cloud connectivity.

E. The BAS shall not require inbound firewall ports for normal operation and shall utilize outbound-only connections for cloud services.

F. All system databases, control programs, graphics, trends, and configurations shall remain the property of the County.

## 1.5 SYSTEM ARCHITECTURE

A. The BAS shall utilize native BACnet/IP communications.

B. Controllers shall be capable of standalone operation and shall maintain all control sequences during loss of network, internet, or cloud connectivity.

C. All controllers shall communicate over IP-based networks. Proprietary communication protocols shall not be permitted.

## 1.6 CLOUD SUPERVISION

A. Cloud-based supervisory services shall provide:

1. Web-based graphical user interface
2. Alarm notification and management
3. Trending and data storage
4. User and role management

B. Loss of cloud connectivity shall not impair local system control or operation.

## 1.7 ACCEPTABLE MANUFACTURERS AND INTERFACES

A. Basis of Design: Delta Controls

B. Substitutions shall not be permitted without prior written approval from the County.

## 1.8 QUALITY ASSURANCE

A. Controls Contractor shall be an authorized factory representative for Delta Controls and shall be regularly engaged in the installation and commissioning of similar BAS systems.

B. Controls Contractor shall demonstrate a minimum of three (3) completed projects of similar scope and complexity within the past five (5) years.

C. All installation, programming, startup, testing, and commissioning shall be performed by factory-trained personnel directly employed by the Controls Contractor.

D. All work shall comply with applicable codes, standards, and manufacturer requirements..

## 1.9 SHOP DRAWINGS AND SUBMITTALS

A. Product Data: Submit for approval the manufacturer's technical product data for each component furnished as part of the control system. Data shall include dimensions, capacities, performance characteristics, electrical requirements, and material finishes. Data shall also include installation and start-up requirements.

B. Shop Drawings: Submit for approval control drawings detailing the following:

1. Network Block Diagrams or System Riser Diagrams: These diagrams shall depict all DDC components that make up the network. They shall provide specific detail on network terminations, and panel power requirements. Identify circuits that will be used to power the DDC panels. Each DDC panel within the diagram shall state the equipment that it is controlling.
2. Point-to-point Termination Detail: These drawings shall be created for each unique control application type. Drawings that are typical of one another shall state the quantity that they represent, and the specifics for each. All wiring and piping required to install and operate the system shall be represented in these details. For terminations that are unknown at the time of submittal, properly designate these as “Field determined terminations,” and include in the As-built Drawings after completion. All wiring and piping shall be either number or color-coded on the drawings.
3. Provide individual details for each control type, as described in the Sequence of Operation.
4. Provide damper and valve schedules showing sizes, characteristics, model numbers, and specific locations.
5. For prefabricated control panels, provide panel interior and exterior layout details. These details shall depict the equipment layout and shall detail the panel wiring and piping.

C. Database Information: The submittal package shall contain detailed information on the point naming convention that is to be used. Furthermore, provide documentation on all sequences of operation that cannot be performed by stand-alone controls, and require high-level programs to be created.

## 1.10 OPERATION AND MAINTENANCE MANUALS

A. Upon completion of the installation and prior to training, provide manuals containing the following information:

1. Upon completion of the work, provide a complete set of ‘as-built’ drawings and application software on compact disk. Drawings shall be provided as AutoCAD™ files and in .pdf format. Three copies of the ‘as-built’ drawings shall be provided in addition to the documents in .pdf format on compact disk. Each web page shall have the appropriate links to these following documents. Verify links are active from the web pages generated under this contract:
   a. Sequence Of Operations
   b. Controller(s) Product Specifications and wiring diagrams
   c. Automation System Architecture Drawing

2. Installation, Calibration and Troubleshooting Procedures for all equipment and components
3. Location of all controllers, sensors, transformers, and other components
4. Control Drawings as specified above with all modifications, changes, and wiring details that depict actual installation
5. Sequence of Operation for each Mechanical system
6. Preventive Maintenance Proposal
7. DDC Flow Chart for each system
8. Listing of the entire DDC database, software and programs
9. List of master passwords for total access to system
10. Valve, damper, well, and tap schedules

B. Provide laminated control diagrams in each control panel for each air handling system and other major controlled equipment.

C. Backup CD to be left on-site that will allow the Owner to fully download the entire DDC System software, including programming point database and configuration and graphic screens, if required.

D. An Operators Manual shall be provided with graphic and text explanations of keyboard use for all operator functions including graphic mode.

E. A Programmers Manual shall be provided online with graphic and text descriptions of all keyboard functions required for software modifications and developments. The use and installation of high-level programming language shall be included in this manual.

F. Computerized printouts of all data file construction including all point information, physical terminal relationships, scales and offsets, alarm limits, messages, schedules, etc.

## 1.11 SYSTEM COMMISSIONING

A. All points connected to the BAS shall operate fully in accordance with this specification before final completion is determined.

B. Equipment Start-up: Upon completion of installation, all equipment being controlled shall be initially started and tested on site, using a portable operator interface connected to individual controllers.

1. Verify that all inputs are properly being read.
2. Measure, calibrate, and adjust all analog inputs, including temperature sensors.
3. Stroke all analog outputs from 0% to 100% and verify all linkage adjustments are accurate.
4. Valves and dampers shall fully close and provide tight shut-off with no leakage.
5. Verify all digital outputs are properly energizing the controlled device.
6. Adjust setpoints so equipment can run properly. Temporary setpoints and schedules are acceptable for this phase of commissioning.

C. Communication Network Start-up: Verify from a browser that all of the controllers are communicating and providing real time data to the browser. Verify communication speed is acceptable and meets the requirements of this specification.

D. Software Verification: All programs and software functions shall be verified for proper sequence of operation.

E. Coordination: Work with the air-balancing contractor, ventilation contractor, piping contractor, and electrical contractor to provide complete system commissioning.

F. Commissioning Report: The owner will furnish a report template outlining the points and actions required for devices attached to the DDC system. It is the controls contractors' responsibility to have this report completed before owner training.

## 1.12 TRAINING

A. Provide BAS training for up to four owner personnel, as determined by owner's management. Upon completion of each phase of training, a work order shall be signed by both the Controls Contractor and the Owner's personnel.

B. Provide the Owner the necessary hardware, software and documentation to commission the system.

C. Initial training shall occur during System Commissioning. The Controls Contractor shall permit and encourage the Owner to observe the commissioning process. The Controls Contractor shall verify with the Owner the commissioning report.

D. Immediately after commissioning is complete as specified, the Controls Contractor shall provide a four-hour, on-site session detailing the layout of the BAS. This shall include network wiring routes, control panel locations, transformer locations, etc.

E. Within five working days from the time of system commissioning, one set of Operation and Maintenance manuals shall be turned over directly to the Owner. The Controls Contractor shall then provide another on-site session to review the entire manual(s) with the Owner. This session shall also include but not be limited to:

1. Fundamental operation of the system
2. Training on setpoint adjustment and scheduling modifications
3. Operation and sequencing of control loops for all mechanical equipment being controlled
4. Completed commissioning report
5. Passwords for system including "master" password to allow total access to all points

## 1.13 WARRANTY

A. Warranty for the entire control system shall commence upon completion of the system commissioning as specified.

B. Provide a two-year warranty on all DDC controllers.

C. Provide a five-year warranty on all control valves and damper actuators

D. Provide a one-year warranty on all other items

E. Provide a one-year warranty on workmanship and labor.

F. Provide an optional 3rd year price for warranty on DDC controllers

G. Provide telephone support and answer questions throughout the warranty period.

## PART 2 - PRODUCTS

### 2.1 GENERAL

A. Provide all hardware, software, accessories, and services necessary to furnish a complete, fully operational Building Automation System as specified herein.

B. All components shall be new, of current manufacture, and listed by a nationally recognized testing laboratory where applicable.

C. Provide a BAS system that utilizes the following open protocol communications: Public Unitary Protocol (PUP), Modbus, and or the PHP standard. The use of “gateways” and other interface devices or software to convert propriety systems to open systems will not be acceptable on this project. This is to ensure the continuity with the other systems installed in the County.

### 2.2 AREA/SYSTEM CONTROLLER

A. Area controllers shall be native BACnet/IP devices manufactured by Delta Controls and suitable for controlling central HVAC systems including air handling units, rooftop units, hydronic systems, and exhaust and make-up air systems.

B. Area controllers shall be capable of fully standalone operation. All control sequences, schedules, alarms, interlocks, and safeties shall execute locally at the controller level and shall not depend on continuous network, internet, or cloud connectivity.

C. Controllers shall utilize nonvolatile memory to retain all programs, setpoints, schedules, trends, alarms, and configuration data during power loss without the use of batteries.

D. Controllers shall provide sufficient processing capacity and memory to support the specified control sequences with not less than twenty percent (20%) spare capacity for future expansion.

E. Controllers shall provide sufficient processing capacity and memory to support the specified control sequences with not less than twenty percent (20%) spare capacity for future expansion.

F. Area controllers shall provide a combination of on-board and expandable input/output (I/O) sufficient for the application. Expansion modules shall be native to the controller manufacturer and shall communicate without the use of proprietary gateways.

G. Minimum I/O capabilities shall include:

1. Universal Inputs configurable for analog or digital signals.
2. Analog Outputs suitable for modulating control.
3. Digital Outputs suitable for relay or triac control.

H. Controllers shall support trending, alarming, scheduling, and time-of-day functions locally.

I. Controllers shall be suitable for the environmental conditions of the installed location and rated for operation within manufacturer-published temperature and humidity limits.

J. Controllers shall be UL listed and comply with applicable electrical and safety standards.

## 2.3 UNITARY CONTROLLERS

A. Unitary controllers shall be native BACnet devices manufactured by Delta Controls and suitable for controlling packaged and unitary HVAC equipment including rooftop units, split systems, heat pumps, fan coil units, make-up air units, and similar equipment.

B. Unitary controllers shall be capable of fully standalone operation. All control sequences, safeties, interlocks, alarms, and scheduling functions shall execute locally at the controller level and shall not rely on continuous network, internet, or cloud connectivity.

C. Unitary controllers shall utilize nonvolatile memory to retain programs, setpoints, schedules, trends, and alarms during power loss without the use of batteries.

D. Unitary controllers shall be provided with sufficient on-board input/output (I/O) capacity to support the specified sequences of operation, including temperature control, fan control, economizer control where applicable, heating and cooling staging or modulation, and safety interlocks.

E. Unitary controllers shall support local trending, alarming, and time-of-day scheduling.

F. Unitary controllers shall communicate with the BAS using BACnet/IP or BACnet MS/TP as appropriate for the application.

G. Unitary controllers shall be suitable for the environmental conditions of the installed location and rated for operation within manufacturer-published temperature and humidity limits.

H. Unitary controllers shall be UL listed and comply with applicable electrical and safety standards.

## 2.4 WEB BROWSER INTERFACE

A. General: The color graphic system shall provide an intuitive, user friendly, mouse driven, operator system permitting the system operators with the authorized privilege access to a logical sequence of dynamic color graphic screens. The logical sequence of screens shall start with a campus layout, if applicable, followed by an individual building floor plan layout allowing the operator to further investigate conditions within individual areas. The graphics shall provide a virtual “walk around tour” of the building envelope.

1. The system shall be capable of supporting an unlimited number of clients using a standard Web browser such as Internet Explorer™ or Google Chrome™.
2. The Web browser shall provide the same view of the system, in terms of graphics, schedules, calendars, logs, etc., and provide the same interface methodology as is provided by the Graphical User Interface. Systems that require different views or that require different means of interacting with objects such as schedules, or logs, shall not be permitted.
3. The Web browser client shall support at a minimum, the following functions:
   a. User log-on identification and password shall be required. If an unauthorized user attempts access, a blank web page shall be displayed. Security using Java authentication and encryption techniques to prevent unauthorized access shall be implemented.
   b. Storage of the graphical screens shall be in the AC, without requiring any graphics to be stored on the client machine. Systems that require graphics storage on each client are not acceptable.
   c. Real-time values displayed on a Web page shall update automatically without requiring a manual “refresh” of the Web page.
4. The system shall provide the capability to specify a user’s (as determined by the log-on user identification) home page. Provide the ability to limit a specific user to their defined home page. From the home page, links to other views, or pages in the system shall be possible, if allowed by the system administrator.
5. Graphic screens on the Web Browser client shall support hypertext links to other locations on the Internet or on Intranet sites, by specifying the Uniform Resource Locator (URL) for the desired link.

## 2.5 TEMPERATURE SENSORS

A. Thermistor temperature sensors shall be 10,000 ohm at 77°F with Precon type-3 material. Accuracy shall be +/-0.36°F between the ranges of 32.0 - 158.0°F.

1. Room Sensors
   a. The room sensor shall incorporate an on-board 10k thermistor for room temperature sensing.
   b. The room sensor shall provide a five-position slide switch to allow the occupant to offset the programmed temperature setpoint of the unit controller by a programmable amount.
   c. A push-button switch located on the room sensor shall be monitored by the unit controller. The status of the switch shall be usable in a supervisory

control logic or algorithm or to override to an occupied mode for a programmable amount of time.

d. The room sensor shall include an override LED that shall illuminate when an override has been requested. Under normal scheduled operation, the LED shall flash periodically indicating proper operation of the unit controller.

e. The room sensor shall be provided with a two-position slide switch to allow the occupant of the space to override the fan output to be energized or operate in automatic mode.

f. The room sensor cover shall be provided with tamper resistant screws.

2. Duct Sensors
   a. Single point duct mounted sensors shall have a minimum 9" rigid probe and be used when the duct size is less than 24".
   b. Averaging duct mounted sensors shall have a minimum 12.5' long averaging element and be used when the duct size is greater than 24".
3. Well Sensors
   a. Liquid immersion sensors shall have a stainless steel probe and a brass well. Length of the sensor well shall be selected based on the diameter of the pipe to provide accurate, reliable sensing of the liquid temperature.
4. Outside Sensors
   a. The sensing element shall be sheathed in a stainless steel tube and mounted inside a ventilated, treated, PVC sun shield to minimize the radiant energy and wind effects.

B. Digital Zone Sensors: where indicated on the drawings, a graphical display thermostat shall be provided exhibiting the following specifications

1. Installation
   a. The stat will be a 2-wire device for power and communications.
   b. The wiring should be polarity insensitive and shall not require specific cabling other than 18 AWG twisted shielded.
   c. A 2-piece design is required with base and display so that the base can be mounted prior to commissioning and the display can be mounted during the finished stages.
2. Temperature sensing
   a. The stat shall utilize a Dallas DS1621 digital chip for temperature sensing
   b. The sensor shall be accurate to + 0.9 degrees F over a span of 55-105 F.
3. Display: the display shall be a true graphical display with at least the capability of 122 x 32 pixels.
4. Programming: the stat shall allow configuration of the controller through menu driven attributes.
   a. The stat should allow for adjustment of setpoint via buttons mounted on the face.
   b. A 2-level password protection shall be incorporated for balancing menus and installer set-up options.
   c. Balancing and configuration programming shall be accomplished by accessing menus through the stat and will not require any other type of portable interface.

## 2.6 HUMIDITY TRANSMITTERS

A. Transmitters shall be of 2-wire, 4-20 mA output type with a resistance or capacitance element having an accuracy of +/- 2% between 20-95% Rh. Transmitter shall include protection against reverse polarity and supply voltage transients. An accuracy adjustment shall be provided with each transmitter to allow for recalibration as necessary.

1. Duct Mounted
   a. Sensor shall have a minimum 6" rigid probe with a pressure cast aluminum weatherproof box with gasketed cover.
2. Wall Mounted
   a. The room sensor cover shall be provided with tamper resistant screws.
3. Outside Mounted
   a. The sensing element shall be mounted inside a ventilated, treated, plastic PCV sun shield to minimize the radiant energy and wind effects.
   b. The enclosure shall be pressure cast aluminum, weatherproof box with a gasketed cover.

## 2.7 PRESSURE TRANSMITTERS

A. Pressure transmitters shall be of 2-wire, 4-20 mA output type with a capacitance element having an accuracy of +/- 1% over the entire range. Transmitter shall include protection against reverse polarity and supply voltage transients. An accuracy and zero span adjustment shall be provided with each transmitter to allow for recalibration as necessary.

1. Duct Static Pressure
2. Building Differential Pressure
   a. Maximum safe momentary overpressure shall be eight times the pressure range.
   b. Pressure transmitter shall be of solid-state design.
   c. Approved Manufacturer: Modus T30 series or equivalent.
3. Liquid Differential Pressure
   a. The operating range shall be -40.0 - 176.0°F.
   b. Maximum safe overpressure shall be 150% of the rated pressure.
   c. Shall be contained in an aluminum NEMA-1 enclosure.

## 2.8 FLOW TRANSMITTERS

A. Airflow

1. The sensor shall be a 4-20 mA output type with the accuracy of +/- 1% with flow straighteners in circular duct applications. In rectangular duct applications, the accuracy shall be +/- 2% with flow straighteners.
2. Velocity range of 100 to 10,000 FPM air at S.T.P.
3. Flow station shall be constructed of steel with flanged face for easy mounting. The flow straighteners shall be constructed of aluminum or steel.
4. Approved manufacturer: Auto-Flow or equivalent.

B. Liquid Flow

1. The sensor shall be a 4-20 mA output type with the repeatability of +/-0.1% of value.
2. Temperature limits: -20.0 to 850.0°F
3. Material is dependent upon that of the size and type of pipe material
   a. Approved manufacturer: Dieterich Standard

## 2.9 AIR QUALITY TRANSMITTERS

A. The sensor shall be a 4-20 mA/1-5VDC output type and designed to monitor IAQ/CO2 levels in accordance with ASHRAE standard 62-1989.

## 2.10 FREEZESTATS

A. Shall be heavy duty temperature controls that incorporate a vapor charged sensing element.

B. The low temperature cut-out must be adjustable.

C. The sensor shall have a 4-wire, two circuit contact that is designed to close when the main contact opens.

D. Must be wired in series with the fan.

E. Shall be wired into DDC system as an input.

## 2.11 SMOKE DETECTORS

A. Shall have a dry set of contacts for the BAS and be compatible with the existing building's fire system.

## 2.12 AIR PROVING SWITCHES

A. The air proving switches shall have an operating range of 0.15 – 5.0" WC and have a setpoint adjustment.

B. Wiring connections shall be three screw type, common, normally open, and normally closed.

C. Approved manufacturer: Dwyer 1900 series or equivalent.

## 2.13 LIQUID PROVING SWITCHES

A. The proving switch shall measure the difference in pressure exerted upon its sensing elements and operate a SPDT switch at the differential pressure setpoint.

B. The differential pressure setpoint must be adjustable between the ranges of 8 - 60 psig and the switch differential shall be 1.5 psi.

C. Approved manufacturer: Penn A-74 series or equivalent.

## 2.14 DAMPER POSITION SWITCHES

A. Shall be crank mounted and provide two snap-action SPDT contacts. Each switch shall be adjustable with a minimum differential of 9°F.

B. Approved manufacturer: Barber-Colman AM-321 or equivalent

## 2.15 ACTUATORS

A. Electronic

1. Electronic actuators shall be acceptable if proposed model is driven directly by either 4-20 mA or 0-10VDC, requires low voltage supply power (30VAC/VDC or less), and provides adequate torque to meet the application.
2. Electronic actuators shall be direct-coupled type, manufactured by Belimo Air Controls.
3. Spring return actuators are required on systems with economizers. Systems with minimum outside air shall be non spring return.

## 2.16 ENCLOSURES

A. Enclosures shall be NEMA-1 rated steel, finished to control oxidation in a highly humid atmosphere.

B. Each enclosure shall have a hinged door and keyed lock.

## 2.17 CONTROL VALVES

A. Provide factory fabricated control valves with operators as required by this specification. Provide selection as determined by manufacturer for installation requirements and pressure class, based on maximum pressure and temperature in piping system. Provide valve size in accordance with specified maximum pressure drop across control valve. Equipment control valves with heavy duty actuators, with proper shut off rating for each individual application. All control valves shall be Belimo and have a 5 year warranty on all materials.

B. Water Service Valves: Equal percentage characteristics for throttling service, linear characteristics for three-way mixing or diverting service, with a range of 30 to 1, and maximum full flow pressure drop of 5 psig. (Not less than 3 psig; not more than 7 psig). Two-position valves shall be line size.

C. Single Seated Valves: Cage type trim, providing seating and guiding surfaces for plug on “top and bottom” guided plugs.

D. Valve Trim and Stems: Polished stainless steel.

E. Packing: Spring-loaded Teflon, self-adjusting.

F. Bodies, 2" and Smaller: Bronze with screwed end connections, replaceable brass seat. 125 psig rated, minimum.

G. Bodies, 2 1/2" and Larger: Cast iron with flanged end connections, replaceable brass seat. 125 psig rated, minimum.

H. Butterfly Valves: Butterfly valves may be used for two-position or three3-way mixing or diverting service for water applications 6" size and larger, provided valve pressure and temperature limitations are not exceeded by maximum pressures and temperatures in the piping system.

1. Refer to Division 23 0523.13 for butterfly valve requirements.

## 2.18 DAMPERS

A. Provide automatic control dampers as indicated. All dampers shall be low leakage airfoil blade types (Ruskin CD-50 or Arrow AFD).

1. Construction:
   a. Frames: Extruded aluminum hat channel, 0.125" minimum thickness.
   b. Blades: Extruded aluminum airfoil type, 6" maximum blade width.
   c. Hardware: Molded synthetic bearings. Zinc plated steel axles, linkage brackets, connecting rods, and mounting bolts.
   d. Seals: Flexible metal compression seals on frame at blade ends; extruded vinyl inflatable blade edge seals.
2. Leakage: Not more than 6 CFM per square foot damper area at differential pressure of 4” w.g. with applied torque at damper of 50 inch-pounds.
3. Operating Limits:
   a. Temperature: -20 - 200°F
   b. Pressure: 6” w.g. differential
   c. Velocity: Up to 4000 FPM
4. Select opposed blade dampers for proportional service. Parallel blade dampers may be used for two-position service, or in mixed air application that promotes air mixing.
5. Damper sizes shall be provided as indicated on the drawings. Damper sizes may be provided different from those indicated on the drawings, if improved performance can be demonstrated with calculations.

B. Combination Fire/Smoke Dampers: Dampers are furnished under the work of Division 233300 Refer to that section for operator type.

## 2.19 HVAC CONTROL PANELS

A. Each major piece of equipment shall have an approved pre-wired control panel assembly.

B. DDC controls shall be mounted and installed within pre-wired control panel assembly.

## PART 3 - EXECUTION

## 3.1 WIRING

A. Unless noted otherwise, all electrical wiring required to interconnect the components of the control system shall be furnished and installed by the Controls Contractor. Perform all wiring in accordance with the requirements listed below, code requirements and Division 26.

B. Power wiring required for controllers and control panels shall be furnished and installed by the Electrical Contractor. Power for these components shall be dedicated power circuits for the express use of the individual controller or control panel. Circuits shall be furnished and designated by the Electrical Contractor. All circuit breakers and other electrical components required to provide this dedicated circuit shall be the responsibility of the Electrical Contractor.

C. Power wiring required for the Area Controller shall also be dedicated as specified above, and if available in the building, shall be an emergency power circuit.

D. Power wiring required for the Host PC Workstation shall be through a wall receptacle. If available within the room location, connect to an emergency power receptacle.

E. All line voltage wiring shall be installed within EMT conduit. Conduit shall be adequately supported in accordance with local codes and Division 16.

F. All low voltage wiring shall be installed within EMT conduit, except when ran in ceiling spaces. Low voltage wiring installed in ceiling spaces must be plenum rated wiring in accordance with local codes. All wiring in ceiling spaces must be properly supported to the building so as not to droop. Install wiring as close to the deck as possible to avoid damage from other trades or materials.

G. All conduit and wiring shall be installed in parallel lines to the building structure, corridors, and hallways.

H. Communication wiring shall be installed using shielded cable. The communication network wiring shall be clearly marked with a specific color code. Communication wiring shall not be installed near noise producing equipment, such as ballasts, magnetic starters, etc.

I. All analog inputs and analog outputs shall be wired using shielded cable.

J. All digital outputs shall be wired using 18 gauge stranded wire.

K. All wiring in mechanical rooms, walls shall be installed in EMT conduit. Concealed conduit and wiring is required in all finished spaces.

## 3.2 DDC EQUIPMENT

A. All components shall be installed in protective enclosures. All wiring within the DDC enclosure shall be either number coded or color coded. Both the enclosure and the controller shall be properly grounded in accordance with manufacturer's recommendation. Documentation shall be firmly attached to the enclosure within a

plastic envelope. Documentation shall state point-to-point termination detail, description of each individual point, location of power source for the controller, and ID number or address within the network.

B. All DDC control panels shall be mounted on walls within equipment rooms, custodial closets, or electrical rooms. Only application-specific controllers (ASCs) for VAV boxes, heat pumps, unit ventilators, rooftop units, or package units may be mounted on the equipment.

## 3.3 HOST PC WORKSTATION

A. The PC shall be located in the Maintenance Office or as shown on the plans. Prior to delivery, coordinate location with the Engineer and the Owner. The PC and peripherals shall not be installed until the room location has been cleaned, so as to avoid damage by dust and debris.

B. Any software installed on the PC shall become the property of Brunswick County. All licenses shall list Brunswick County as the owner or user as required.

## 3.4 BROWSER BASED INTERFACE

A. Provide web pages depicting the actual layout for all major equipment, including but not limited to:

1. Air Handling Equipment
2. VAV Boxes, Unit Heaters, and other Zone Terminal Equipment
3. Central Plan Equipment
4. Setpoint screens with associates attributes including but not limited to actual setpoint, calculated setpoint, deadband and proportional control band.

B. Provide graphic representation of the building, including building floor plans. Provide common information and status within these screens, such as zone temperature, equipment status, etc.

C. Coordinate with the Engineer and the Owner prior to loading and testing.

D. Web pages shall not use frames. Graphic pages shall use the same look as graphics delivered by Envirocon Inc. Screens shall be uncluttered and intuitive.

E. The graphical screens and libraries used shall be turned over to the owner and added to the owner’s standard graphical library for use as the owner sees fit on future projects.

F. All graphics and screens designs shall be approved the HVAC Manager.

## 3.5 SENSING DEVICE INSTALLATION

A. Freezestats: Provide where indicated in the sequences on discharge side of the first coil, downstream of the filter section. Serpentine the element across the face of the coil and fasten using support rods.

B. Space Sensors/Transmitters: Provide as required by the sequences and shown on the drawings. Mount at 60” above finished floor. Wire to respective PUC or ASC to provide stand-alone control.

C. Duct Mounted Sensors/Transmitters: Provide as required by the sequences. Averaging type sensors shall be supplied for all mixed air and discharge air locations. Serpentine across the duct opening at even increments and provide proper fastening.

D. Liquid Immersion Sensor/Transmitter: Provide as required by the sequences. All wells shall be installed by the piping contractor, and sensor installed by the Controls Contractor using thermal conductive compound. Strap on sensors are not acceptable, except for aquastats.

## 3.6 CONTROLLED DEVICES

A. Dampers: Dampers shall be installed by the sheet metal contractor, and any linkage assembly shall be performed by the Controls Contractor. Dampers shall operate smoothly throughout their entire stroke.

B. Valves: Valves shall be installed by the piping contractor. Coordinate locations so that valves are piped properly and installed in an acceptable location. Valves shall provide proper shut-off as specified in this section.

C. Actuators: All actuators shall be installed by the Controls Contractor, unless specified otherwise. All power wiring shall be the responsibility of the Controls Contractor. Provide supply air as required. Where freezing conditions may occur, provide ether localized desiccant drying.

D. Pipe Access: All thread-Olets shall be supplied and installed by the Mechanical Contractor and coordinated with the Controls Contractor. Controls Contractor to provide and install all buld wells as required.

# PART 4 - SEQUENCES OF OPERATION

## 4.1 GENERAL REQUIREMENTS

A. The following control sequences shall identify the manner and method in which the equipment shall operate. Any additional components required to perform these sequences shall be the responsibility of the Controls Contractor.

B. In addition to the narrative sequences, refer to the Input/Output Point Schedules. All controls mentioned in the Point Schedule shall be furnished as part of the BAS.

**END OF SECTION**

# SECTION 23 21 13 - HYDRONIC PIPING

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. Section includes pipe and fitting materials and joining methods for the following:

1. Hot-water heating piping.
2. Makeup-water piping.
3. Condensate-drain piping.
4. Air vent piping.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of the following:

1. Plastic pipe and fittings with solvent cement.

### 1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Flushing plan identifying drainage locations to flush entire system.

C. Calculations for flow requirement to achieve high velocity throughout piping system to loosen slag. Provide temporary pump to accommodate calculated flow rate. New pumps shall not be utilized for flushing.

D. Chemical treatment plan including cleaning detergents and flushing with clean water until detergents are removed.

E. Field quality-control reports.

### 1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

1. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:

1. Hot-Water Heating Piping: 150 psig at 200 deg F.
2. Makeup-Water Piping: 80 psig at 150 deg F.
3. Condensate-Drain Piping: 150 deg F.

### 2.2 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.

B. DWV Copper Tubing: ASTM B 306, Type DWV.

C. Wrought-Copper Unions: ASME B16.22.

### 2.3 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; welded and seamless, Grade B, and wall thickness as indicated in "Piping Applications" Article.

B. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in "Piping Applications" Article.

C. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in "Piping Applications" Article.

D. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

E. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

1. Material Group: 1.1.
2. End Connections: Butt welding.
3. Facings: Raised face.

## 2.4 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless otherwise indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

D. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

E. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

## 2.5 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Description:

a. Standard: ASSE 1079.
b. Pressure Rating: 125 psig minimum at 180 deg F.
c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric-Flange Insulating Kits:

1. Description:

a. Non-conducting materials for field assembly of companion flanges.
b. Pressure Rating: 150 psig.
c. Gasket: Neoprene or phenolic.
d. Bolt Sleeves: Phenolic or polyethylene.
e. Washers: Phenolic with steel backing washers.

## PART 3 - EXECUTION

### 3.1 PIPING APPLICATIONS

A. Hot-water heating piping, aboveground, NPS 2 and smaller, shall be the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

B. Hot-water heating piping, aboveground, NPS 2-1/2 and larger, shall be any of the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
2. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.

C. Makeup-water piping installed aboveground shall be the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

D. Condensate-Drain Piping: Type DWV, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

E. Air-Vent Piping:

1. Inlet: Same as service where installed.
2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.

F. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.

### 3.2 PIPING INSTALLATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

O. Install branch connections to mains per drawings.

P. Install valves according to Section 23 05 23.11 "Globe Valves for HVAC Piping," Section 23 05 23.12 "Ball Valves for HVAC Piping," Section 23 05 23.13 "Butterfly Valves for HVAC Piping, and “Section 23 05 23.14” Check Valves for HVAC Piping

Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

S. Install shutoff valve immediately upstream of each dielectric fitting.

T. Comply with requirements in Section 23 05 16 "Expansion Fittings and Loops for HVAC Piping" for installation of expansion loops, expansion joints, anchors, and pipe alignment guides.

U. Comply with requirements in Section 23 05 53 "Identification for HVAC Piping and Equipment" for identifying piping.

V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 23 05 17 "Sleeves and Sleeve Seals for HVAC Piping."

W. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 23 05 18 "Escutcheons for HVAC Piping."

## 3.3 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flange kits.

## 3.4 HANGERS AND SUPPORTS

A. Comply with requirements in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment" for hanger, support, and anchor devices. Comply with the following requirements for maximum spacing of supports.

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.

C. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 7 feet.
2. NPS 1: Maximum span, 7 feet.
3. NPS 1-1/2: Maximum span, 9 feet.
4. NPS 2: Maximum span, 10 feet.
5. NPS 2-1/2: Maximum span, 11 feet.
6. NPS 3 and Larger: Maximum span, 12 feet.

D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/4Maximum span, 7 feet; minimum rod size, 3/8 inch.
4. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
6. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
7. NPS 3 and Larger: Maximum span, 10 feet; minimum rod size, 3/8 inch.

E. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

## 3.5 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

D. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

E. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

## 3.6 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install control valves in accessible locations close to connected equipment.

C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.

D. Install ports for pressure gages and thermometers at coil inlet and outlet connections. Comply with requirements in Section 23 05 19 "Meters and Gages for HVAC Piping."

## 3.7 FIELD QUALITY CONTROL

A. Notify Designer and Commissioning Agent before flushing. Inspection and approval of strainer screens upon completion of flushing is required. Provide temporary construction strainer screens as necessary.

B. Prepare hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.

5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

C. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
3. Isolate expansion tanks and determine that hydronic system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times the "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
5. Hydrostatic pressure test shall be held for 2 hours with no loss of pressure. Pressure shall be measured at highest point of test section to ensure entire section is at or above required test pressure. Test shall be witnessed by designer or owner’s representative. Test report shall include a drawing to identify pipe section tested, date, duration of test, start pressure and end pressure.
6. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
7. Prepare written report of testing.

D. Perform the following before operating the system:

1. Open manual valves fully.
2. Inspect pumps for proper rotation.
3. Set makeup pressure-reducing valves for required system pressure.
4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

**END OF SECTION**

# SECTION 23 21 16 - HYDRONIC PIPING SPECIALTIES

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. Section includes special-duty valves and specialties for the following:

1. Hot-water heating piping.
2. Condensate-drain piping.
3. Air-vent piping.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of the following:

1. Valves: Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
2. Air-control devices.
3. Hydronic specialties.

### 1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air-control devices and special-duty valves to include in emergency, operation, and maintenance manuals.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:

1. Hot-Water Heating Piping: 100 psig at 200 deg F.
2. Condensate-Drain Piping: 150 deg F.
3. Air-Vent Piping: 200 deg F.
4. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

## 2.2 VALVES

A. Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Section 23 05 23.11 "Globe Valves for HVAC Piping," Section 23 05 23.12 "Ball Valves for HVAC Piping," Section 23 05 23.13 "Butterfly Valves for HVAC Piping," and Section 23 05 23.14 "Check Valves for HVAC Piping."

B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Section 23 09 00 “Instrumentation and Control for HVAC.”

C. Bronze, Calibrated-Orifice, Balancing Valves:

1. Body: Bronze, ball or plug type with calibrated orifice or venturi
2. Ball: Brass or stainless steel.
3. Plug: Resin.
4. Seat: PTFE.
5. End Connections: Threaded or socket.
6. Pressure Gage Connections: Integral seals for portable differential pressure meter.
7. Handle Style: Lever, with memory stop to retain set position.
8. CWP Rating: Minimum 125 psig.
9. Maximum Operating Temperature: 250 deg F.

D. Automatic Flow-Control Valves:

1. Body: Brass or ferrous metal
2. Piston and Spring Assembly: Stainless steel, tamper proof, self-cleaning, and removable.
3. Combination Assemblies: Include bronze or brass-alloy ball valve.
4. Identification Tag: Marked with zone identification, valve number, and flow rate.
5. Size: Same as pipe in which installed.
6. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations.
7. Minimum CWP Rating: 175 psig.
8. Maximum Operating Temperature: 200 deg F.

## 2.3 AIR-CONTROL DEVICES

A. Manual Air Vents:

1. Body: Bronze.
2. Internal Parts: Nonferrous.
3. Operator: Screwdriver or thumbscrew.
4. Inlet Connection: NPS 1/2.
5. Discharge Connection: NPS 1/8.
6. CWP Rating: 150 psig.
7. Maximum Operating Temperature: 225 deg F.

B. Automatic Air Vents:

1. Body: Bronze or cast iron.

2. Internal Parts: Nonferrous.
3. Operator: Noncorrosive metal float.
4. Inlet Connection: NPS 1/2.
5. Discharge Connection: NPS 1/4.
6. CWP Rating: 150 psig.
7. Maximum Operating Temperature: 240 deg F.

## 2.4 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: Stainless-steel, 40-mesh strainer, or perforated stainless-steel basket.
4. CWP Rating: 125 psig.

B. T-Pattern Strainers:

1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
2. End Connections: Grooved ends.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 57 percent free area.
4. CWP Rating: 750 psig.

C. Expansion Fittings: Comply with requirements in Section 23 05 16 "Expansion Fittings and Loops for HVAC Piping."

# PART 3 - EXECUTION

## 3.1 VALVE APPLICATIONS

A. Install shutoff-duty valves at each branch connection to supply mains and at supply connection to each piece of equipment.

B. Install calibrated-orifice, balancing valves at each branch connection to return main.

C. Install check valves at each pump discharge and elsewhere as required to control flow direction.

D. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

## 3.2 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

B. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Install manual vents at heat-transfer coils and elsewhere as required for air venting.

**END OF SECTION**

# SECTION 23 21 23 - HYDRONIC PUMPS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Close-coupled, in-line centrifugal pumps.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of pump. Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves.

### 1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.

B. Report for pump alignment and start-up.

### 1.4 MAINTENANCE MATERIAL SUBMITTALS

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. Mechanical Seals: One mechanical seal(s) for each pump.

## PART 2 - PRODUCTS

### 2.1 CLOSE-COUPLED, IN-LINE CENTRIFUGAL PUMPS

A. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally or vertically.

B. Capacities and Characteristics:

1. Refer to Pump Schedule on design drawings.

C. Pump Construction:

1. Casing: Radially split, cast iron, with threaded gage tappings at inlet and outlet and threaded companion-flange connections.
2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For constant-speed pumps, trim impeller to match specified performance.
3. Pump Shaft: Stainless steel.
4. Seal: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N bellows and gasket. Include water slinger on shaft between motor and seal.
5. Seal: Packing seal consisting of stuffing box with a minimum of four rings of graphite-impregnated braided yarn with bronze lantern ring between center two graphite rings, and bronze packing gland.
6. Pump Bearings: Permanently lubricated ball bearings.

D. Motor: Single speed and rigidly mounted to pump casing.

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 23 05 13 "Common Motor Requirements for HVAC Equipment."
    a. Enclosure: Open, dripproof.
    b. Enclosure Materials: Cast iron.
    c. Motor Bearings: Permanently lubricated ball bearings.
    d. Efficiency: Premium efficient.
    e. NEMA Design: 12.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.

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

### 3.2 PUMP INSTALLATION

A. Comply with HI 1.1-1.2 and HI 1.3.

B. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories.

C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.

## 3.3 CONNECTIONS

A. Where installing piping adjacent to pump, allow space for service and maintenance.

B. Connect piping to pumps. Install valves that are same size as piping connected to pumps.

C. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.

D. Install pressure gages on pump suction and discharge or at integral pressure-gage tapping or install single gage with multiple-input selector valve.

E. Provide variable frequency motor controller for each hydronic pump located per plans. Variable frequency motor controllers shall comply with Specification section 26 29 23 - Variable Frequency Motor Controllers.

F. Ground equipment according to Section 26 05 26 “Grounding and Bonding for Electrical Systems." Connect wiring according to Section 26 05 19 “Building Wire and Cable."

## 3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Check piping connections for tightness.
3. Clean strainers on suction piping.
4. Perform the following startup checks for each pump before starting:
    a. Verify bearing lubrication.
    b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
    c. Verify that pump is rotating in the correct direction.
5. Prime pump by opening suction valves and closing drains and prepare pump for operation.
6. Start motor. Open discharge valve slowly.

## 3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps.

**END OF SECTION**

# SECTION 23 31 13 - 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. Single-wall rectangular ducts and fittings.
2. Single-wall round ducts and fittings.
3. Double-wall round ducts and fittings.
4. Sheet metal materials.
5. Sealants and gaskets.
6. Hangers and supports.

B. Related Sections:

1. Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 23 33 00 "Air Duct Accessories" for dampers, duct-mounting access doors and panels, turning vanes, and flexible ducts.

### 1.3 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

### 1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following products:

1. Sealants and gaskets.

B. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.

3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.

## 1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

# PART 2 - PRODUCTS

## 2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

## 2.2 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

## 2.3 DOUBLE-WALL ROUND DUCTS AND FITTINGS

A. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.

1. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
3. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Inner Duct: Minimum 0.028-inch solid sheet steel.

C. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
3. Coat insulation with antimicrobial coating.
4. Cover insulation with polyester film complying with UL 181, Class 1.

## 2.4 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

## 2.5 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Solvent-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Base: Synthetic rubber resin.
3. Solvent: Toluene and heptane.
4. Solids Content: Minimum 60 percent.
5. Shore A Hardness: Minimum 60.
6. Water resistant.
7. Mold and mildew resistant.
8. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
9. Service: Indoor or outdoor.
10. Substrate: Compatible with galvanized sheet steel.

C. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.

D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

E. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

## 2.6 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

F. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

G. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

# PART 3 - EXECUTION

## 3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 23 33 00 "Air Duct Accessories" for fire and smoke dampers.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials.

## 3.2 INSTALLATION OF EXPOSED DUCTWORK

A. All interior exposed ductwork to be double wall round.

B. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

C. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

D. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter.

E. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

F. Repair or replace damaged sections and finished work that does not comply with these requirements.

## 3.3 DUCT SEALING

A. Seal all duct, with the exception of transfer ducts, in accordance with SMACNA seal class "A"; all seams, joints, and penetrations shall be sealed:

## 3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
3. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

## 3.5 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 23 33 00 "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

## 3.6 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer.

## 3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
2. Test the following systems:

    a. Supply Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections totaling no less than 100 percent of total installed duct area for each designated pressure class.
    b. Return Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections totaling no less than 100 percent of total installed duct area for each designated pressure class.
    c. Exhaust Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections totaling no less than 100 percent of total installed duct area for each designated pressure class.
    d. Outdoor Air Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections totaling no less than 100 percent of total installed duct area for each designated pressure class.

3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
4. Test for leaks before applying external insulation.
5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
6. Give seven days' advance notice for testing.

C. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.
2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."

    a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

## 3.8 START UP

A. Air Balance: Comply with requirements in Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC."

## 3.9 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel.

B. Ducts:

1. Ducts Connected to Fan Coil Units and Terminal Units:

a. Pressure Class: Positive 1-inch wg.
b. SMACNA Leakage Class for Rectangular: 6.
c. SMACNA Leakage Class for Round: 3.

2. Ducts Connected to Variable-Air-Volume Air-Handling Units:

a. Pressure Class: Positive 3-inch wg.
b. SMACNA Leakage Class for Rectangular: 6.
c. SMACNA Leakage Class for Round: 3.

3. Ducts Connected to Equipment Not Listed Above:

a. Pressure Class: Positive 2-inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 6.
d. SMACNA Leakage Class for Round: 3.

C. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel.

D. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

a. Velocity 1000 fpm or Lower:

1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
2) Mitered Type RE 4 without vanes.

b. Velocity 1000 to 1500 fpm:

1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

c. Velocity 1500 fpm or Higher:

1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

   a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
   b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
   c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."

   a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

      1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
      2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
      3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.

   b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
   c. Round Elbows, 14 Inches and Larger in Diameter: Welded.

E. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."

   a. Rectangular Main to Rectangular Branch: 45-degree entry.
   b. Rectangular Main to Round Branch: Spin in.

2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.

   a. Velocity 1000 fpm or Lower: 90-degree tap.
   b. Velocity 1000 to 1500 fpm: Conical tap.
   c. Velocity 1500 fpm or Higher: 45-degree lateral.

**END OF SECTION**

# SECTION 23 33 00 - 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. Manual volume dampers.
2. Fire dampers.
3. Combination fire and smoke dampers.
4. Flange connectors.
5. Turning vanes.
6. Duct-mounted access doors.
7. Flexible connectors.
8. Flexible ducts.
9. Duct accessory hardware.

B. Related Section Includes:

1. Section 28 31 11 – Digital, Addressable Fire-Alarm System for duct-mounted fire and smoke detectors.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:

a. Fire-damper, combination fire- and smoke-damper including sleeves; and duct-mounted access doors and remote damper operators.
b. Manual volume damper installations.
c. Control-damper installations.
d. Wiring Diagrams: For power, signal, and control wiring.

## 1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

## 1.5 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.

# PART 2 - PRODUCTS

## 2.1 ASSEMBLY DESCRIPTION

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

## 2.2 MATERIALS

A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90.
2. Exposed-Surface Finish: Mill phosphatized.

B. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

C. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

## 2.3 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

1. Standard leakage rating, with linkage outside airstream.
2. Suitable for horizontal or vertical applications.
3. Frames:

    a. Frame: Hat-shaped, 0.094-inch-thick, galvanized sheet steel.
    b. Mitered and welded corners.
    c. Flanges for attaching to walls and flangeless frames for installing in ducts.

4. Blades:

    a. Multiple or single blade.
    b. Parallel- or opposed-blade design.
    c. Stiffen damper blades for stability.
    d. Galvanized-steel, 0.064 inch thick.

5. Blade Axles: Galvanized steel.
6. Bearings:

    a. Molded synthetic.
    b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

7. Tie Bars and Brackets: Galvanized steel.

## 2.4 FIRE DAMPERS

A. Type: Dynamic; rated and labeled according to UL 555 by an NRTL.

B. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.

C. Fire Rating: 1-1/2 hours.

D. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.

E. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.

1. Minimum Thickness: 0.138 inch thick, as indicated, and of length to suit application.
2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.

F. Mounting Orientation: Vertical or horizontal as indicated.

G. Blades: Roll-formed, interlocking, 0.024-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch-thick, galvanized-steel blade connectors.

H. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

I. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

## 2.5 COMBINATION FIRE AND SMOKE DAMPERS

A. Type: Dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL.

B. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.

C. Fire Rating: 1-1/2 hours.

D. Frame: Hat-shaped, 0.094-inch-thick, galvanized sheet steel, with welded interlocking, gusseted or mechanically attached corners and mounting flange.

E. Heat-Responsive Device: Electric resettable device and switch package, factory installed, rated.

F. Smoke Detector: Integral, factory wired for single-point connection.

G. Blades: Roll-formed, horizontal, interlocking, 0.063-inch-thick, galvanized sheet steel.

H. Leakage: Class I.

I. Rated pressure and velocity to exceed design airflow conditions.

J. Mounting Sleeve: Factory-installed, 0.05-inch-thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone calking.

K. Damper Motors: two-position action.

L. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 23 05 13 "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section 23 09 00 “Instrumentation and Control for HVAC."
3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
5. Non-spring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
6. Electrical Connection: 115 V, single phase, 60 Hz.

M. Accessories:

1. Auxiliary switches for signaling or position indication.
2. Test and reset switches, damper mounted.

## 2.6 FLANGE CONNECTORS

A. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

B. Material: Galvanized steel.

C. Gage and Shape: Match connecting ductwork.

## 2.7 TURNING VANES

A. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

B. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."

C. Vane Construction: Single wall.

## 2.8 DUCT-MOUNTED ACCESS DOORS

A. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."

1. Door:

    a. Double wall, rectangular.
    b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
    c. Vision panel.
    d. Hinges and Latches: 1-by-1-inchbutt or piano hinge and cam latches.
    e. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Number of Hinges and Locks:

    a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
    b. Access Doors up to 18 Inches Square: Continuous and two sash locks.
    c. Access Doors up to 24 by 48 Inches: Continuous and two compression latches.

## 2.9 FLEXIBLE CONNECTORS

A. Materials: Flame-retardant or noncombustible fabrics.

B. Coatings and Adhesives: Comply with UL 181, Class 1.

C. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch-wide, 0.028-inch-thick, galvanized sheet steel or 0.032-inch-thick aluminum sheets. Provide metal compatible with connected ducts.

D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd..
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F.

E. Insulated, Flexible Duct: UL 181, Class 1, multiple layers of aluminum laminate supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.

1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 20 to plus 210 deg F.

F. Flexible Duct Connectors:

1. Clamps: Nylon strap in sizes 3 through 18 inches, to suit duct size.
2. Non-Clamp Connectors: Liquid adhesive plus tape.

## 2.10 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

# PART 3 - EXECUTION

## 3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts.

1. Install steel volume dampers in steel ducts.

D. Set dampers to fully open position before testing, adjusting, and balancing.

E. Install test holes at fan inlets and outlets and elsewhere as indicated.

F. Install fire and combination fire smoke dampers according to UL listing.

G. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. At outdoor-air intakes.
2. At outdoor-air intakes and mixed-air plenums.
3. Downstream from manual volume dampers.
4. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
5. Elsewhere as indicated.

H. Install access doors with swing against duct static pressure.

I. Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches.
2. Two-Hand Access: 12 by 6 inches.
3. Head and Hand Access: 18 by 10 inches.
4. Head and Shoulders Access: 21 by 14 inches.
5. Body Access: 25 by 14 inches.
6. Body plus Ladder Access: 25 by 17 inches.

J. Label access doors according to Section 23 05 53 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

K. Install flexible connectors to connect ducts to equipment.

L. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

M. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.

N. Connect diffusers to ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place. Connect flexible ducts to metal ducts with liquid adhesive plus tape and draw bands.

O. Install duct test holes where required for testing and balancing purposes.

## 3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. 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**

# SECTION 23 34 23 - HVAC POWER VENTILATORS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Centrifugal roof ventilators.

### 1.2 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base fan-performance ratings on sea level.

B. Operating Limits: Classify according to AMCA 99.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Also include the following:

1. Certified fan performance curves with system operating conditions indicated.
2. Certified fan sound-power ratings.
3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
4. Material thickness and finishes, including color charts.
5. Dampers, including housings, linkages, and operators.
6. Roof curbs.
7. Fan speed controllers.

### 1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

### 1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and 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. Belts: One set(s) for each belt-driven unit.

## 1.7 QUALITY ASSURANCE

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

B. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.

C. UL Standards: Power ventilators shall comply with UL 705.

## 1.8 COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

# PART 2 - PRODUCTS

## 2.1 CENTRIFUGAL ROOF VENTILATORS

A. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.

1. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.

B. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

C. Accessories:

1. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
2. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.

D. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch-thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to suit roof opening and fan base.

1. Configuration: Built-in cant and mounting flange.
2. Overall Height: 12 inches above finished roof level.
3. Metal Liner: Galvanized steel.

E. Capacities and Characteristics:

1. Refer to schedule on design drawings.

## 2.2 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 23 05 13 "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

B. Enclosure Type: Totally enclosed, fan cooled.

## 2.3 SOURCE QUALITY CONTROL

A. Certify sound-power level ratings according to 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. Certify fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating." Label fans with the AMCA-Certified Ratings Seal.

# PART 3 - EXECUTION

## 3.1 INSTALLATION

A. Install power ventilators level and plumb.

B. Equipment Mounting:

1. Comply with requirements for vibration isolation devices specified in Section 23 05 48.13 "Vibration Controls for HVAC."

C. Secure roof-mounted fans to roof curbs with stainless steel hardware.

D. Install units with clearances for service and maintenance.

E. Label units according to requirements specified in Section 23 05 53 "Identification for HVAC Piping and Equipment."

## 3.2 CONNECTIONS

A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 23 33 00 "Air Duct Accessories."

B. Install ducts adjacent to power ventilators to allow service and maintenance.

C. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Section 26 05 19 “Building Wire and Cable."

## 3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Prepare test and inspection reports.

## 3.4 ADJUSTING

A. Adjust damper linkages for proper damper operation. Adjust belt tension.

B. Comply with requirements in Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.

C. Replace fan and motor pulleys as required to achieve design airflow. Lubricate bearings.

**END OF SECTION**

# SECTION 23 36 00 - 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 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section Includes: Shutoff, single-duct air terminal units.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of air terminal unit.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for air terminal units.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

### 1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Factory-authorized service representative start-up report.

### 1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:

a. Instructions for resetting minimum and maximum air volumes.
b. Instructions for adjusting software set points.

## PART 2 - PRODUCTS

### 2.1 SYSTEM DESCRIPTION

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

### 2.2 SHUTOFF, SINGLE-DUCT AIR TERMINAL UNITS

A. Refer to schedule on drawings for performance, physical characteristics and accessories.

### 2.3 SOURCE QUALITY CONTROL

A. Factory Tests: Test assembled air terminal units according to AHRI 880. Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and AHRI certification seal.

## PART 3 - EXECUTION

### 3.1 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 5, "Hangers and Supports" and with Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached. Use powder-actuated concrete fasteners for standard-weight aggregate concretes and for slabs more than 4 inches thick. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes and for slabs less than 4 inches thick.

C. Hangers Exposed to View: Threaded rod and angle or channel supports.

D. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

### 3.2 TERMINAL UNIT INSTALLATION

A. Insofar as possible, install air terminal units located above door swings to assure maintenance clearances from below.

B. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

C. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.

## 3.3 CONNECTIONS

A. Where installing piping adjacent to air terminal unit, allow space for service and maintenance.

B. Hot-Water Piping: Comply with requirements in Section 23 21 13 "Hydronic Piping" and Section 23 21 16 "Hydronic Piping Specialties," and 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. Comply with requirements in Section 23 31 13 "Metal Ducts" for connecting ducts to air terminal units.

D. Make connections to air terminal units with flexible connectors complying with requirements in Section 23 33 00 "Air Duct Accessories."

## 3.4 IDENTIFICATION

A. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Section 23 05 53 "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

## 3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
2. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Air terminal unit will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

## 3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
3. Verify that controls and control enclosure are accessible.
4. Verify that control connections are complete.
5. Verify that nameplate and identification tag are visible.
6. Verify that controls respond to inputs as specified.

## 3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air terminal units.

**END OF SECTION**

# SECTION 23 37 13 - DIFFUSERS, REGISTERS, AND GRILLES

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Diffusers, registers, and grilles.

B. Related Sections:

1. Section 08 90 00 "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
2. Section 23 33 00 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

## PART 2 - PRODUCTS

### 2.1 DIFFUSERS, REGISTERS, AND GRILLES

A. Refer to schedule on design drawings for further information.

### 2.2 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

### 3.2 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

**END OF SECTION**

# SECTION 23 41 00 - PARTICULATE AIR FILTRATION

## 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. Pleated panel filters.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include dimensions; operating characteristics; required clearances and access; rated flow capacity, including initial and final pressure drop at rated airflow; efficiency and test method; fire classification; furnished specialties; and accessories for each model indicated.

### 1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of filter to include in emergency, operation, and maintenance manuals.

### 1.5 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. Provide two complete set(s) of filters for each filter bank.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

A. ASHRAE Compliance:

1. Comply with applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality"; Section 5 - "Systems and Equipment"; and Section 7 - "Construction and Startup."
2. Comply with ASHRAE 52.2 for MERV for methods of testing and rating air-filter units.

B. Comply with NFPA 90A and NFPA 90B.

## 2.2 PLEATED PANEL FILTERS

A. Description: Factory-fabricated, self-supported, extended-surface, pleated, panel-type, disposable air filters with holding frames.

B. Filter Unit Class: UL 900, Class 1.

C. Media: Interlaced glass or synthetic fibers coated with nonflammable adhesive.

1. Media shall be coated with an antimicrobial agent.
2. Separators shall be bonded to the media to maintain pleat configuration.
3. Welded-wire grid shall be on downstream side to maintain pleat.
4. Media shall be bonded to frame to prevent air bypass.
5. Support members on upstream and downstream sides to maintain pleat spacing.

D. Filter-Media Frame: Cardboard frame with perforated metal retainer sealed or bonded to the media.

E. Capacities and Characteristics: MERV Rating: 8 and 13 when tested according to ASHRAE 52.2.

# PART 3 - EXECUTION

## 3.1 INSTALLATION

A. Install filters in position to prevent passage of unfiltered air. Install filter gage for each filter bank.

B. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing with new, clean filters.

C. Coordinate filter installations with duct and air-handling-unit installations.

## 3.2 FIELD QUALITY CONTROL

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

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Test for leakage of unfiltered air while system is operating.

C. Air filter will be considered defective if it does not pass tests and inspections. Prepare test and inspection reports.

## 3.3 CLEANING

A. After completing system installation and testing, adjusting, and balancing of air-handling and air-distribution systems, clean filter housings and install new filter media.

**END OF SECTION**

# SECTION 23 52 16 - CONDENSING BOILERS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section includes gas-fired, fire-tube condensing boilers, trim, and accessories for generating hot water.

### 1.2 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 boilers.
2. Include rated capacities, operating characteristics, and furnished specialties and accessories.

B. Shop Drawings: For boilers, boiler trim, and accessories.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

### 1.3 INFORMATIONAL SUBMITTALS

A. Source quality-control reports.

B. Field quality-control reports.

C. Sample Warranty: For special warranty.

### 1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For boilers to include in emergency, operation, and maintenance manuals.

### 1.5 WARRANTY

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

1. Warranty Period for Fire-Tube Condensing Boilers:

    a. Leakage and Materials: 10 years from date of Substantial Completion.
    b. Heat Exchanger Damaged by Thermal Stress and Corrosion: Nonprorated for five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 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. ASME Compliance: Fabricate and label boilers to comply with 2010 ASME Boiler and Pressure Vessel Code.

C. UL Compliance: Test boilers for compliance with UL 795. Boilers shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.

D. Mounting Base: For securing boiler to concrete base.

### 2.2 FORCED-DRAFT, FIRE-TUBE CONDENSING BOILERS

A. Description: Factory-fabricated, -assembled, and -tested, fire-tube condensing boiler with heat exchanger sealed pressure tight, built on a steel base, including insulated jacket; flue-gas vent; combustion-air intake connections; water supply, return, and condensate drain connections; and controls. Water-heating service only.

B. Heat Exchanger: Nonferrous, corrosion-resistant combustion chamber.

C. Pressure Vessel: Carbon steel with welded heads and tube connections.

D. Burner: Natural gas, forced draft.

E. Blower: Centrifugal fan to operate during each burner firing sequence and to prepurge and postpurge the combustion chamber.

F. Gas Train: Combination gas valve with manual shutoff and pressure regulator.

G. Ignition: Spark ignition with 100 percent main-valve shutoff with electronic flame supervision.

H. Casing:

1. Jacket: Sheet metal, with snap-in or interlocking closures.
2. Control Compartment Enclosures: NEMA 250, Type 1A.
3. Finish: Baked-enamel protective finish.

4. Insulation: Minimum 2-inch-thick, insulation surrounding the heat exchanger.
5. Combustion-Air Connections: Inlet and vent duct collars.

I. Capacities and Characteristics:

1. Refer to schedule on design drawings.

## 2.3 TRIM

A. Include devices sized to comply with ASME B31.9.

B. Aquastat Controllers: Operating, firing rate, and high limit.

C. Safety Relief Valve: ASME rated.

D. Pressure and Temperature Gage: Minimum 3-1/2-inch-diameter, combination water-pressure and -temperature gage. Gages shall have operating-pressure and -temperature ranges, so normal operating range is about 50 percent of full range.

E. Boiler Air Vent: Automatic.

F. Drain Valve: Minimum NPS 3/4 hose-end gate valve.

G. Circulation Pump: Nonoverloading, in-line pump with split-capacitor motor having thermal-overload protection and lubricated bearings; designed to operate at specified boiler pressures and temperatures.

## 2.4 CONTROLS

A. Boiler operating controls shall include the following devices and features:

1. Control transformer.
2. Set-Point Adjust: Set points shall be adjustable.
3. Sequence of Operation: Electric, factory-fabricated and field-installed panel to control burner firing rate to reset supply-water temperature inversely with outside-air temperature. At 0 deg F outside-air temperature, set supply-water temperature at 130 deg F; at 60 deg F outside-air temperature, set supply-water temperature at 110 deg F.

    a. Include automatic, alternating-firing sequence for multiple boilers to ensure maximum system efficiency throughout the load range and to provide equal runtime for boilers.

B. Burner Operating Controls: To maintain safe operating conditions, burner safety controls limit burner operation.

1. High Cutoff: Manual reset stops burner if operating conditions rise above maximum boiler design temperature.

2. Low-Water Cutoff Switch: Electronic probe shall prevent burner operation on low water. Cutoff switch shall be manual-reset type.
3. Blocked Inlet Safety Switch: Manual-reset pressure switch field mounted on boiler combustion-air inlet.
4. Audible Alarm: Factory mounted on control panel with silence switch; shall sound alarm for above conditions.

C. Building Automation System Interface: Factory install hardware and software to enable building automation system to monitor, control, and display boiler status and alarms.

1. Hardwired Points:

a. Monitoring: On/off status, common trouble alarm.
b. Control: On/off operation, hot-water-supply temperature set-point adjustment.

## 2.5 ELECTRICAL POWER

A. Single-Point Field Power Connection: Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to boiler.

1. House in NEMA 250, Type 1 enclosure.
2. Wiring shall be numbered and color coded to match wiring diagram.
3. Install factory wiring outside of an enclosure in a raceway.
4. Provide branch power circuit to each motor and to controls.
5. Provide each motor with overcurrent protection.

## 2.6 VENTING

A. CPVC per manufacturer’s recommendations.

## 2.7 SOURCE QUALITY CONTROL

A. Burner and Hydrostatic Test: Factory adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency; perform hydrostatic test.

B. Test and inspect factory-assembled boilers, before shipping, according to 2010 ASME Boiler and Pressure Vessel Code.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and piping and electrical connections to verify actual locations, sizes, and other conditions affecting performance of the Work.

1. Final boiler locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.

B. Examine mechanical spaces for suitable conditions where boilers will be installed.

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

### 3.2 BOILER INSTALLATION

A. Equipment Mounting:

1. Install boilers on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 03 30 00 "Cast-in-Place Concrete."
2. Comply with requirements for vibration isolation devices specified in Section 23 05 48.13 "Vibration Controls for HVAC."

B. Install gas-fired boilers according to NFPA 54.

C. Assemble and install boiler trim.

D. Install electrical devices furnished with boiler but not specified to be factory mounted.

E. Install control wiring to field-mounted electrical devices.

### 3.3 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to boiler to allow service and maintenance.

C. Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection. Provide an isolation valve if required.

D. Connect piping to boilers, except safety relief valve connections, with flexible connectors of materials suitable for service. Flexible connectors and their installation are specified in Section 23 21 16 "Hydronic Piping Specialties."

E. Connect gas piping to boiler gas-train inlet with union. Piping shall be at least full size of gas-train connection. Provide a reducer if required.

F. Connect hot-water piping to supply- and return-boiler tappings with shutoff valve and union or flange at each connection.

G. Install piping from safety relief valves to nearest floor drain.

H. Boiler Venting:

1. Install flue venting kit and combustion-air intake.

I. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

J. Connect wiring according to Section 26 05 19 “Building Wire and Cable."

## 3.4 FIELD QUALITY CONTROL

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

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Boiler will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

F. Performance Tests:

1. Engage a factory-authorized service representative to inspect component assemblies and equipment installations, including connections, and to conduct performance testing.
2. Boilers shall comply with performance requirements indicated, as determined by field performance tests. Adjust, modify, or replace equipment to comply.
3. Perform field performance tests to determine capacity and efficiency of boilers.

    a. Test for full capacity.
    b. Test for boiler efficiency at low fire 20, 40, 60, 80, 100, 80, 60, 40, and 20 percent of full capacity. Determine efficiency at each test point.

4. Repeat tests until results comply with requirements indicated.
5. Provide analysis equipment required to determine performance.

6. Provide temporary equipment and system modifications necessary to dissipate the heat produced during tests if building systems are inadequate.
7. Notify Architect 24 hours minimum in advance of test dates.
8. Document test results in a report and submit to Architect.

## 3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain boilers. Refer to Section 01 79 00 "Demonstration and Training."

**END OF SECTION**

# SECTION 23 74 16.13 - PACKAGED, LARGE-CAPACITY, ROOFTOP AIR-CONDITIONING UNITS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section includes packaged, large-capacity, rooftop air conditioning units (RTUs) with the following components and accessories:

1. Casings.
2. Fans.
3. Motors.
4. Coils.
5. Refrigerant circuit components.
6. Air filtration.
7. Dampers.
8. Electrical power connections.
9. Controls.
10. Accessories
11. Roof curbs.

### 1.2 DEFINITIONS

A. DDC: Direct-digital controls.

B. ECM: Electronically commutated motor.

C. Outdoor-Air Refrigerant Coil: Refrigerant coil in the outdoor-air stream to reject heat during cooling operations and to absorb heat during heating operations. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.

D. RTU: Rooftop unit. As used in this Section, this abbreviation means packaged, large-capacity, rooftop air-conditioning units. This abbreviation is used regardless of whether the unit is mounted on the roof or on a concrete base on ground.

E. Supply-Air Fan: The fan providing supply air to conditioned space. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

F. Supply-Air Refrigerant Coil: Refrigerant coil in the supply-air stream to absorb heat (provide cooling) during cooling operations and to reject heat (provide heating) during heating operations. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

## 1.3 ACTION SUBMITTALS

A. Product Data: Include manufacturer's technical data for each RTU, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.

B. Shop Drawings:

1. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Include diagrams for power, signal, and control wiring.

C. Delegated-Design Submittal: For RTU supports indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.
2. Detail mounting, securing, and flashing of roof curb to roof structure. Indicate coordinating requirements with roof membrane system.

## 1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Sample Warranty: For special warranty.

## 1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For RTUs to include in emergency, operation, and maintenance manuals.

## 1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fan Belts: One set(s) for each belt-driven fan.
2. Filters: One set(s) of filters for each unit.

## 1.7 WARRANTY

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

1. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from date of Substantial Completion.
2. Warranty Period for Control Boards: Manufacturer's standard, but not less than three years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 SYSTEM DESCRIPTION

A. AHRI Compliance:

1. Comply with AHRI 340/360 for testing and rating energy efficiencies for RTUs.
2. Comply with AHRI 270 for testing and rating sound performance for RTUs.

B. AMCA Compliance:

1. Comply with AMCA 11 and bear the AMCA-Certified Ratings Seal for air and sound performance according to AMCA 211 and AMCA 311.
2. Damper leakage tested in accordance with AMCA 500-D.
3. Operating Limits: Classify according to AMCA 99.

C. ASHRAE Compliance:

1. Comply with ASHRAE 15 for refrigeration system safety.
2. Comply with ASHRAE 33 for methods of testing cooling and heating coils.
3. Comply with applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

D. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

E. NFPA Compliance: Comply with NFPA 90A or NFPA 90B.

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

### 2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design mounting for RTUs, including comprehensive engineering analysis.

1. Design RTU supports to comply with wind performance requirements.

B. Wind-Restraint Performance:

1. Basic Wind Speed: 102 MPH.

2. Building Classification Category: II.
3. Minimum 10 lb/sq. ft. multiplied by the maximum area of the mechanical component projected on a vertical plane that is normal to the wind direction, and 45 degrees either side of normal.

## 2.3 CAPACITIES AND CHARACTERISTICS

A. Refer to schedule on design drawings.

## 2.4 CASINGS

A. General Fabrication Requirements for Casings: Formed and reinforced double-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.

B. Double-Wall Construction: Fill space between walls with 1 inch fiber insulation and seal moisture tight for R-4.1 performance.

C. Exterior Casing Material: Galvanized steel with factory-painted finish, with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.

D. Inner Casing Fabrication Requirements:

1. Inside Casing: G-90-coated galvanized steel, 0.034 inch thick.

E. Corrosion-Resistant Coating: Apply a corrosion-resistant coating capable of withstanding a 672-hour salt-spray test according to ASTM B 117.

1. Standards:

a. ASTM B-117 for salt spray.
b. ASTM D-2794 for minimum impact resistance of 100 in-lb
c. ASTM B-3359 for cross-hatch adhesion of 5B.

2. Application: Spray.

F. Condensate Drain Pans: Fabricated using stainless 0.025 inch thick steel sheet, a minimum of 2 inches deep, and complying with ASHRAE 62.1 for design and construction of drain pans.

1. Double-Wall Construction: Fill space between walls with foam insulation and seal moisture tight.
2. Drain Connections: Threaded nipple.

G. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

## 2.5 FANS

A. Supply-Air Fans: Aluminum or painted-steel wheels, and galvanized- or painted-steel fan scrolls.

1. Belt-Driven Supply-Air Fans: Motors shall be installed on an adjustable fan base resiliently mounted in the casing.

B. Condenser-Coil Fan: propeller, mounted on shaft of permanently lubricated ECM motors.

C. Return Fan: Forward curved, shaft mounted on permanently lubricated motor.

## 2.6 MOTORS

A. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

B. Service Factor: 1.15.

C. Motor Bearings: 200,000 hours average life.

D. Efficiency: Premium efficient.

## 2.7 COILS

A. Supply-Air Refrigerant Coil:

1. Aluminum-plate fin and seamless internally grooved copper tube in steel casing with equalizing-type vertical distributor.
2. Coil Split: Interlaced.
3. Condensate Drain Pan: Stainless steel formed with pitch and drain connections complying with ASHRAE 62.1.

B. Supply-Air Hydronic Heating Coil:

1. One-row aluminum-plate fin and seamless internally grooved copper tube in steel casing with equalizing-type vertical distributor and with air vent and drain.

C. Outdoor-Air Refrigerant Coil:

1. Aluminum-plate fin and seamless internally grooved copper tube in steel casing with equalizing-type vertical distributor.

## 2.8 REFRIGERANT CIRCUIT COMPONENTS

A. Number of Refrigerant Circuits: Three.

B. Compressor: Hermetic, variable speed scroll, mounted on vibration isolators; with internal overcurrent and high-temperature protection, internal pressure relief.

C. Refrigeration Specialties:

1. Refrigerant: R-410A.
2. Expansion valve with replaceable thermostatic element.
3. Refrigerant filter/dryer.
4. Manual-reset high-pressure safety switch.
5. Automatic-reset low-pressure safety switch.
6. Minimum off-time relay.
7. Automatic-reset compressor motor thermal overload.
8. Brass service valves installed in compressor suction and liquid lines.

## 2.9 AIR FILTRATION

A. Minimum arrestance and a minimum efficiency reporting value according to ASHRAE 52.2.

B. Pleated Panel Filters:

1. Description: Factory-fabricated, self-supported, extended-surface, pleated, panel-type, disposable air filters with holding frames. High efficiency throw-away filters. Filters shall be U.L. Class 2, 2.0" nominal thickness, pleated media type, with a MERV rating of 8.

## 2.10 DAMPERS

A. Outdoor- and Return-Air Mixing Dampers: Parallel- or opposed blade galvanized-steel dampers mechanically fastened to cadmium plated for galvanized-steel operating rod in reinforced cabinet. Connect operating rods with common linkage or gears and interconnect so dampers operate simultaneously.

1. Leakage Rate: Dampers shall have a leakage rate of 1% at 1.0 in WC pressure differential.
2. Damper Motor: Modulating with adjustable minimum position.
3. Relief-Air Damper: Gravity actuated or motorized, as required by ASHRAE/IES 90.1, with bird screen and hood.

## 2.11 ELECTRICAL POWER CONNECTIONS

A. RTU shall have a single connection of power to unit with control-circuit transformer with built-in overcurrent protection.

## 2.12 CONTROLS

A. DDC Controller:

1. Controller shall have volatile-memory backup.
2. Terminal-Unit Relays:

    a. Provide heating- and cooling-mode changeover relays compatible with terminal control system required in Section 23 36 00 "Air Terminal Units" and Section 23 09 00 “Instrumentation and Control for HVAC."

B. Interface Requirements for HVAC Instrumentation and Control System:

1. Interface relay for scheduled operation.
2. Interface relay to provide indication of fault at the central workstation and diagnostic code storage.
3. Provide BACnet compatible interface for central HVAC control workstation for the following:

    a. Adjusting set points.
    b. Monitoring supply fan start, stop, and operation.
    c. Inquiring data to include outdoor-air damper position, supply- and room-air temperature.
    d. Monitoring occupied and unoccupied operations.
    e. Monitoring constant and variable motor loads.
    f. Monitoring variable-frequency drive operation.
    g. Monitoring cooling load.
    h. Monitoring economizer cycles.
    i. Monitoring air-distribution static pressure and ventilation air volume.

## 2.13 ACCESSORIES

A. Refer to schedule on design drawings.

## 2.14 ROOF CURBS

A. Roof curbs shall be provided by the unit’s supplier. Curbs shall be vibration isolation type custom made from 12 gauge or heavier as required galvanized steel with welded one-piece construction and insulated with 1-1/2” thick rigid insulation. Curb height shall be minimum of 14” high above the finished roof height. Secure curb to roof structure and unit to curb per manufacturer’s recommendations for site’s wind zone loading. Curbs shall have structural cross members.

# 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 RTUs.

B. Examine roughing-in for RTUs to verify actual locations of piping and duct connections before equipment installation.

C. Examine roofs for suitable conditions where RTUs will be installed.

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

## 3.2 INSTALLATION

A. Roof Curb: Install on roof structure, level and secure, according to NRCA's "NRCA Roofing Manual: Membrane Roof Systems." Install RTUs on curbs and coordinate roof penetrations and flashing with roof construction specified in Section 07 62 00 “Sheet Metal Flashing and Trim.” Secure RTUs to upper curb rail, and secure curb base to roof framing with anchor bolts.

## 3.3 CONNECTIONS

A. Install condensate drain, minimum connection size, with trap and indirect connection to nearest roof drain.

B. Install piping adjacent to RTUs to allow service and maintenance.

C. Duct installation requirements are specified in other HVAC Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:

1. Install ducts to termination at top of roof curb.
2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
3. Connect supply ducts to RTUs with flexible duct connectors specified in Section 23 33 00 "Air Duct Accessories."
4. Install return-air duct continuously through roof structure.

D. Connect electrical wiring according to Section 26 05 19 “Building Wire and Cable."

E. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

F. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

1. Nameplate shall be laminated acrylic or melamine plastic signs as layers of black with engraved white letters at least 1/2 inch high.
2. Locate nameplate where easily visible.

## 3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. RTU will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

## 3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Complete installation and startup checks according to manufacturer's written instructions.

1. Inspect for visible damage to unit casing.
2. Inspect for visible damage to furnace combustion chamber.
3. Inspect for visible damage to compressor, coils, and fans.
4. Inspect internal insulation.
5. Verify that labels are clearly visible.
6. Verify that clearances have been provided for servicing.
7. Verify that controls are connected and operable.
8. Verify that filters are installed.
9. Clean condenser coil and inspect for construction debris.
10. Remove packing from vibration isolators.
11. Verify lubrication on fan and motor bearings.
12. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
13. Adjust fan belts to proper alignment and tension.
14. Start unit according to manufacturer's written instructions.

    a. Start refrigeration system.
    b. Do not operate below recommended low-ambient temperature.
    c. Complete startup sheets and attach copy with Contractor's startup report.

15. Inspect and record performance of interlocks and protective devices; verify sequences.
16. Operate unit for an initial period as recommended or required by manufacturer.
17. Adjust and inspect high-temperature limits.
18. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
19. Start refrigeration system and measure and record the following when ambient is a minimum of 15 deg F above return-air temperature:

    a. Coil leaving-air, dry- and wet-bulb temperatures.
    b. Coil entering-air, dry- and wet-bulb temperatures.
    c. Outdoor-air, dry-bulb temperature.
    d. Outdoor-air-coil, discharge-air, dry-bulb temperature.

20. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
21. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.

    a. Supply-air volume.
    b. Return-air volume.
    c. Relief-air volume.
    d. Outdoor-air intake volume.

22. Simulate maximum cooling demand and inspect the following:

    a. Compressor refrigerant suction and hot-gas pressures.
    b. Short circuiting of air through condenser coil or from condenser fans to outdoor-air intake.

23. Verify operation of remote panel including pilot-light operation and failure modes. Inspect the following:

    a. High-temperature limit on gas-fired heat exchanger.
    b. Low-temperature safety operation.
    c. Filter high-pressure differential alarm.
    d. Economizer to minimum outdoor-air changeover.
    e. Relief-air fan operation.
    f. Smoke and firestat alarms.

24. After startup and performance testing and prior to Substantial Completion, replace existing filters with new filters.

## 3.6 CLEANING AND ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

B. After completing system installation and testing, adjusting, and balancing RTU and air-distribution systems, clean filter housings and install new filters.

## 3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain RTUs.

**END OF SECTION**

# SECTION 23 82 39.16 - PROPELLER UNIT HEATERS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section includes propeller unit heaters with electric-resistance heating coils.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, furnished specialties, and accessories.

### 1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For propeller unit heaters to include in emergency, operation, and maintenance manuals.

## PART 2 - PRODUCTS

### 2.1 DESCRIPTION

A. Assembly including casing, coil, fan, and motor in horizontal discharge configuration with adjustable discharge louvers.

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 UL 2021.

### 2.2 HOUSINGS

A. Finish: Manufacturer's standard baked enamel applied to factory-assembled and -tested propeller unit heaters before shipping.

B. Discharge Louver: Adjustable fin diffuser for horizontal units and conical diffuser for vertical units.

## 2.3 COILS

A. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in steel or corrosion-resistant metallic sheath with fins no closer than 0.16 inch. Element ends shall be enclosed in terminal box. Fin surface temperature shall not exceed 550 deg F at any point during normal operation.

1. Circuit Protection: One-time fuses in terminal box for overcurrent protection and limit controls for high-temperature protection of heaters.
2. Wiring Terminations: Stainless-steel or corrosion-resistant material.

## 2.4 FAN AND MOTOR

A. Fan: Propeller type with aluminum wheel directly mounted on motor shaft in the fan venturi.

B. Motor: Permanently lubricated.

## 2.5 CONTROLS

A. Control Devices:

1. Unit-mounted thermostat.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. Examine areas to receive propeller unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for electrical connections to verify actual locations before unit-heater installation.

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

## 3.2 INSTALLATION

A. Install propeller unit heaters to comply with NFPA 90A.

B. Install propeller unit heaters level and plumb.

C. Suspend propeller unit heaters from structure with unit manufacturer wall bracket.

## 3.3 CONNECTIONS

A. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Section 26 05 19 “Building Wire and Cable."

## 3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

B. Units will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

## 3.5 ADJUSTING

A. Adjust initial temperature set points.

**END OF SECTION**

# SECTION 26 05 00 - GENERAL ELECTRICAL

## PART 1 - GENERAL

### 1.1 SCOPE OF WORK

A. The Instructions to Bidders, General Conditions of the Contract, Supplementary General Conditions and Division 1 bound herewith are a component part of this Division of the specifications and shall apply to this Division with equal force and shall be consulted in detail for instructions pertaining to the work.

B. Requirements generally applicable to all electrical Work on the Project, including but not limited to Work specified in Divisions 26, 27, and 28.

C. Furnish all labor, materials and equipment and incidentals required to make ready for use complete electrical systems as shown on the Drawings and specified herein.

D. It is the intent of these Specifications that the electrical systems shall be suitable in every way for the service required. All material and all work which may be reasonably implied as being incidental to the work of this Division shall be furnished at no extra cost.

E. The work shall include, but not be limited to, furnishing, coordinating, and installing the following:

1. Electrical service from utility company transformer to service equipment.
2. Electrical distribution system for power, lighting, receptacles and miscellaneous power as shown on the contract drawings.
3. Electrical lighting systems as shown on the contract drawings, complete with indicated switching, circuiting, etc.
4. Electrical receptacle systems as shown on the contract drawings.
5. Exit and emergency lighting systems.
6. Power supplies for equipment furnished by others as detailed in Specification Section 26 05 80.
7. Fire Detection and Alarm System.
8. Standby Emergency Power System.
9. Raceway and outlet systems for data and other special systems.
10. Grounding.
11. Seismic restraint systems.
12. Other special requirements and/or systems where shown.

F. The work shall include complete testing of all equipment and wiring at the completion of work and making any minor correction changes or adjustments necessary for all the proper functioning of the system and equipment. All work shall be of the highest quality; substandard work will be rejected.

## 1.2 SUBMITTALS

A. Shop drawings shall be submitted for all equipment, apparatus, and other items as required by the Architect/Engineer. Submit under provisions of relevant sections of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Conduct and submit results of power system studies before submitting product data and Shop Drawings for electrical equipment.

C. Submittals are required for all materials shown in the individual specifications sections.

D. Submittals are required for materials and specific methods used for penetrations of rated assemblies and for seismic restraints.

E. All shop drawings and submittals shall be submitted at the same time. Partial shop drawing and submittals will be rejected and not processed. Materials and equipment with long lead times or other materials and equipment requiring special handling, if identified and requested by the contractor, will be processed separately.

F. Proposed equipment and/or materials substitutions shall be clearly indicated in shop drawings. All deviations from the specified quality, functionality, appearance or performance of the proposed equipment and/or materials shall be clearly summarized in the preface of each submittal. If none are disclosed, and the deviation specifically approved, the Contractor is responsible for providing the specified materials regardless of submittal approval.

G. The project shall be bid based on the equipment listed in these specifications and on the drawings. After award of the Electrical Contract the Contractor may wish to substitute equipment other than that specified, subject to approval. The Electrical Contractor shall bear the “burden of proof” for demonstrating substitute equipment equivalency and suitability.

H. The Electrical Contractor shall be required to replace installed “equivalent” equipment if the operation of this equipment does not meet the full design intent of the specified system.

I. Physical size of equipment used in the design layout are those of reputable equipment manufacturers. The Contractor is responsible for providing equipment which will fit the space provided. If the Contractor elects to use other manufacturer’s equipment, any resulting conflicts with space clearance or codes shall be the responsibility of the Contractor to correct at the Contractor’s expense.

J. The Contractor assumes all responsibility for providing code clearances. Submit a scale drawing of each electrical equipment room showing exact size and location of all proposed electrical equipment with code clearances and working space clearly indicated.

## 1.3 COORDINATION OF WORK

A. It is understood and agreed that the Contractor is, by careful examination, satisfied as to the nature and location of the work, the conformation of the ground, the character, quality and quantity of the materials to be encountered, the general and local conditions and all other matters which can and may affect the work under this contract. The Contractor shall be held responsible for thoroughly familiarizing himself with the any contractual requirements as may be set forth in the other Divisions of these Specifications. No extras will be considered because of additional work necessitated by obvious job conditions that are not indicated on the drawings.

B. The Contractor shall compare the electrical drawings and specifications with the drawings and specifications for other trades, and shall report any discrepancies between them to the Architect/Engineer and obtain written instructions for changes necessary in the electrical work. The electrical work shall be installed in cooperation with other trades installing interrelated work. Before installation, the Contractor shall make proper provisions to avoid interferences in a manner approved by the Architect/Engineer. All changes required in the work of the Contractor caused by neglect to do so shall be made at the expense of the Contractor.

C. Location of electrical raceways, switches, panels, equipment, fixtures, etc., shall be adjusted to accommodate the work to interferences anticipated and encountered. The Contractor shall determine the exact route and location of each electrical raceway prior to make up and assembly.

1. Right of Way: Lines which pitch shall have the right of way over those which do not pitch. For example, steam, condensate and plumbing drains shall normally have right of way. Lines whose elevations cannot be changed shall have the right of way over lines whose elevations can be changed.
2. Offsets and changes in direction of electrical raceways shall be made as required to maintain proper headroom and to clear pitched lines whether or not indicated on the drawings. The Contractor shall furnish and install elbows, pull boxes, etc., as required to affect these offsets, transitions, and changes in directions. Conflicts between electrical raceways, fixtures, etc., and ductwork or piping which cannot be resolved otherwise, will be resolved by the Architect/Engineer.

D. Installation and Arrangements: The Contractor shall install all electrical work to permit removal (without damage to other parts) of any equipment requiring periodic replacement or maintenance. The Contractor shall arrange electrical raceways and equipment to permit ready access to valves, cocks, traps, starters, motors, control components, etc., and to clear the opening of swinging and overhead doors and of access panels.

## 1.4 EQUIPMENT AND MATERIALS (GENERAL)

A. In compliance with North Carolina General Statute 133.3, the Architect/Engineer has, wherever possible, specified the required performance and design characteristics of all materials utilized in this construction. In some cases it is impossible to specify the required performance and design characteristics and when this occurs the

Architect/Engineer has specified three or more examples of equal design or equivalent design, establishing an acceptable range for items of equal or equivalent design. Cited examples are used only to denote the quality standard of product desired and do not restrict bidders to a specific brand, make, manufacturer or specific name and are used only to set forth and convey to bidders the general style, type, character and quality of product desired. Equivalent products will be acceptable.

B. Substitution of materials, items, or equipment of equal or equivalent design shall be submitted to the Architect/Engineer for approval or disapproval. Equal or equivalent shall be interpreted to mean an item of material or equipment, similar to that named and which is suitable for the same use and capable of performing the same functions as that named, the Architect/Engineer being the judge of equality.

C. The materials used in all systems shall be new, unused and as hereinafter specified and shall bear the manufacturer's name, trade name and third party testing agency label in every case where a standard has been established for the particular material. Equipment furnished under this specification shall be essentially the standard product of manufacturers regularly engaged in the production of the required type of equipment, and shall be the manufacturer's latest approved design. All materials where not specified shall be of the very best of their respective kinds. Samples of materials or manufacturer's specifications shall be submitted for approval as required by the Architect/Engineer.

D. Electrical distribution equipment including switchboards, panelboards, disconnect switches, enclosed circuit breakers, surge protection devices, etc. shall be furnished by the same manufacturer.

E. Protection: Electrical equipment shall at all times during construction be adequately protected against damage Equipment shall be tightly covered and protected against dirt, water and chemical or mechanical injury and theft. Electrical equipment shall not be stored out of doors. Electrical equipment shall be stored in dry, permanent shelters. If an apparatus has been damaged, such damage shall be repaired at no additional cost. If any apparatus has been subject to possible injury by water, it shall be replaced at no additional cost to the Owner. At the completion of the work, fixtures, equipment, and materials shall be cleaned and polished thoroughly and turned over to the Owner in a condition satisfactory to the Architect/Engineer. Damage or defects, developing before acceptance of the work shall be made good at the Contractor's expense.

F. Any damage to factory applied paint finish shall be repaired using touch up paint furnished by the equipment manufacturer. The entire damaged panel or section shall be repainted per the field painting specifications in Division 9, at no additional cost to the Owner.

G. Where materials such as wiring devices and plates, fire alarm equipment, paging system components, etc. are specified to match existing, provide materials to match existing equipment in finish, color, capacity, ratings, operating characteristics, performance, etc.

H. Delivery and Storage: Equipment and materials shall be delivered to the site and stored in original containers, suitably sheltered from the elements, but readily accessible for inspection by the Architect/Engineer until installed.

I. Equipment and materials of the same general type shall be of the same make throughout the work to provide uniform appearance, operation and maintenance.

J. Manufacturer's directions shall be followed completely in the delivery, storage, protection, and installation of all equipment and materials. The Contractor shall promptly notify the Architect/Engineer, in writing, of any conflicts between any requirements of the Contract Documents and the manufacturer's directions and shall obtain the Architect/Engineer's written instructions before proceeding with the work. Should the Contractor perform any work that does not comply with the manufacturer's direction or such written instructions from the Architect/Engineer, the Contractor shall bear all costs arising in correcting the deficiencies.

## 1.5 OPERATION AND MAINTENANCE MANUALS

A. Submit under relevant sections of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. The Contractor shall provide electronic manuals, for each manufactured item of equipment used in the electrical work. These shall be presented to the Architect/Engineer for transmittal to the Owner before the final inspection is made. Data shall include printed installation, operation and maintenance instructions for each item, indexed by product with dividers and tabs. All warranties shall be included with each item. Each manufacturer's name, address and telephone number shall be clearly indicated.

C. Shop drawings with Architect/Engineer's "as noted" markings are not acceptable for the above. "Approved" shop drawings are acceptable if adequate information is contained therein. Generally, shop drawings alone are not adequate.

D. Installation information packed with lighting fixtures, devices and equipment shall be retained for inclusion in the operations and maintenance manuals.

E. Operation and Maintenance Data:

1. Provide emergency operation, normal operation, and preventive maintenance manuals for each system, equipment, and device.

2. Include the following information:

    a. Manufacturer's operating specifications.
    b. User's guides for software and hardware.
    c. Schedule of maintenance material items recommended to be stored at the Project site.
    d. Detailed instructions covering operation under both normal and abnormal conditions.

e. Time-current curves for overcurrent protective devices and manufacturer's written instructions for testing and adjusting their settings.
f. List of load-current and overload-relay heaters with related motor nameplate data.
g. List of lamp types and photoelectric relays used on the Project, with ANSI and manufacturers' codes.
h. Manufacturer's instructions for setting field-adjustable components.
i. Manufacturer's instructions for testing, adjusting, and reprogramming microprocessor controls.
j. EPSS: Manufacturer's system checklists, maintenance schedule, and maintenance log sheets in accordance with NFPA 110.

## 1.6 PAINTING

A. All painting will be performed by the General Contractor for the project, unless specifically indicated otherwise.

B. The Electrical Contractor shall clean all exposed electrical work for painting. Should the Electrical Contractor delay in installing exposed conduit and outlets until the General Contractor has begun painting, the Electrical Contractor shall be required to paint all exposed electrical work at the Electrical Contractor’s own expense. Such painting will be accomplished in accordance with the detailed specifications for the Project.

C. Conductors exposed in boxes and cabinets shall be protected against painting. Devices, cover plates, trims, etc., for panel boards and cabinets shall not be installed until painting has been completed.

D. The Electrical Contractor shall be responsible for touch up painting that may be required for electrical material or apparatus furnished with factory applied finish.

## 1.7 LOCATIONS AND MEASUREMENTS

A. Outlets and appliances are shown and located on the drawings as accurately as possible. All measurements shall be verified on the project and in all cases the work shall suit the surrounding trim, finishes and/or construction. The locations of outlets for special appliances shall be installed so that when extended, they are flush with the finished wall or ceiling and permit the proper installation of fixtures and/or devices. Heights of all outlets shown on the drawings are approximate only. Slight relocations of outlets, devices and equipment shall be made by the Contractor as required or as directed by the Architect/Engineer at no additional cost to the Owner.

## 1.8 QUALITY OF WORK

A. All work shall be executed as required by this specifications and the accompanying drawings and shall be done by skilled mechanics, and shall present a neat, trim, and mechanical appearance when completed. All work shall be performed as required by the progress of the job.

## 1.9 SUPERVISION

A. The Contractor shall personally, or through an authorized and competent representative, constantly supervise the work from the beginning to completion and final acceptance. So far as possible, the Contractor shall keep the same foreman and mechanics throughout the project duration.

B. During the progress of the work it shall be subject to inspection by representatives of the Architect/Engineer, the Owner, and local inspection authorities, at which time the Contractor shall furnish such required information and data on the project as requested.

C. The Electrical Contractor shall coordinate the electrical work with other Contractors and cooperate in the preparation and maintenance of a master schedule for the completion of the project.

## 1.10 EXCAVATION, TRENCHING AND BACKFILLING

A. The Electrical Contractor shall do all excavating, trenching and backfilling in connection with this contract. All such excavation shall be done in a manner as not to endanger or damage existing utility lines and other structures. If damage occurs, the Contractor shall pay for and repair damage to the satisfaction of the Architect/Engineer.

B. It shall be the responsibility of the Contractor to investigate conditions before excavation and to exercise care during the excavation to avoid any utilities or other objects which may not be shown. Whether or not utilities, etc., are shown on the drawings shall not relieve the Contractor from the responsibility to repair any damage caused by this work. Location of all ditching shall be laid out at grade and shall be approved by the Architect/Engineer before excavating and no work shall be done until such approval has been obtained.

C. All surplus earth shall be removed by the Contractor from the site and disposed of at the Contractor’s expense.

D. All excavation, trenching and shoring shall be in accordance with rules and regulations set forth in Article XXI, Bulletin 1 “Trenching” as published in a separate bulletin by the North Carolina Department of Labor, Division of Standards and Inspection Construction Bureau.

E. Backfilling shall be in 6” layers with each layer tamped. No boulders or debris shall be used for backfill material. Where trenching passes through areas designated as streets, driveways, walkways, or parking areas, backfill shall be tamped with power tamps to 95 percent compaction.

F. Excavation shall be bid unclassified with no extra payment for removal of rock.

## 1.11 CLOSING IN WORK

A. Work shall not be covered up or enclosed until it has been inspected, tested and approved by the authorities having jurisdiction over this work. Should any of the work be enclosed or covered up before such inspection and test, the Contractor shall uncover the work at the Contractor's expense; after it has been inspected, tested and approved, the Contractor shall restore the work to its original condition.

## 1.12 REFERENCE STANDARDS

A. All electrical equipment, materials, and installation shall be in accordance with the latest edition of the following codes and standards:

1. American Association of Edison Illuminating Companies (AEIC)
2. American National Standards Institute (ANSI)
3. American Society for Testing and Materials (ASTM)
4. Building Officials Code Administrators (BOCA)
5. Energy Code 90.1 (ASHRAE/IES)
6. Institute of Electrical and Electronic Engineers (IEEE)
7. Insulated Cable Engineers Association (ICEA)
8. International Code Council (ICC)
9. International Conference of Building Officials (ICBO)
10. National Electrical Code (NEC) 2020 edition
11. National Electrical Contractor's Association (NECA)
12. National Electrical Installation Standards (NEIS)
13. National Electrical Manufacturer's Association (NEMA)
14. National Electrical Safety Code (NESC)
15. National Fire Protection Association (NFPA)
16. North Carolina State Building Code (NCSBC)
17. Occupational Safety and Health Act (OSHA)
18. Requirements of the Americans with Disabilities Act (ADA), latest edition.
19. Underwriters Laboratories Inc (U.L.)
20. Southern Building Code Congress International (SBCCI)
21. Toxicity Characteristics Leaching Procedure (TCLP)

B. All electrical equipment and material shall be listed by a qualified third party testing agency. Acceptable qualified third party testing laboratories/agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment. Equipment and materials shall bear the appropriate testing agency's listing mark or classification marking. Equipment, materials, etc. utilized not bearing a third party testing agency certification shall be field or factory third party testing agency certified prior to equipment acceptance and use.

C. Where reference is made to one of the above standards, the revision in effect at the time of the bid opening shall apply.

## 1.13 ENCLOSURE TYPES

A. Unless otherwise specified herein or shown on the Drawings, electrical enclosures shall have the following ratings:

1. NEMA 1 for dry, indoor locations.
2. NEMA 3R for outdoor locations, rooms below grade (including basements and buried vaults), “DAMP” and “WET” locations.
3. NEMA 4X for locations subject to corrosion when specifically noted.

## 1.14 CODES, INSPECTION AND FEES

A. All equipment, materials and installation shall be in accordance with the requirements of the local authority having jurisdiction.

B. The Electrical Contractor shall obtain all necessary permits and pay all fees required for permits and inspections of electrical work.

C. The Electrical Contractor shall contact Code Officials to schedule any and all required inspections.

## 1.15 TESTS AND SETTINGS

A. Test all systems furnished under Division 26, 27 & 28 and repair or replace all defective work. Make all necessary adjustments to the systems and instruct the Owner’s personnel in the proper operation of the systems.

B. See other Sections for specific testing and acceptance requirements.

C. Make the following minimum tests and checks prior to energizing electrical equipment:

1. Mechanical inspection, testing and settings of all circuit breakers, disconnect switches, motor starters, control equipment, etc., for proper operation.
2. Check all wire and cable terminations. Verify to the Architect/Engineer that connections meet the equipment torque requirements.
3. Check rotation of motors, obtain permission from other contractors to start motor, and proceed to check for proper rotation. If the motor rotates in the wrong direction, correct it. Take all necessary precautions not to damage any equipment.
4. Provide all instruments and equipment for the tests specified herein.

D. All testing shall be scheduled and coordinated by the Contractor. Notify the Owner at least two (2) weeks in advance of conducting tests. The Contractor shall have qualified personnel present during all testing.

E. All tests shall be completely documented with the time of day, date, temperature, and all other pertinent test information. All required documentation of readings indicated shall be submitted to the Architect/Engineer prior to, and as one of the prerequisites for, final acceptance of the project.

F. Electrical Distribution System Tests: All current carrying phase conductors and neutrals shall be tested as installed, and before load connections are made, for insulation resistance and accidental grounds. This shall be done with a 500 volt megger. The following procedures shall be as follows:

1. Minimum readings shall be one million (1,000,000) ohms or more for #6 AWG wire and smaller; 250,000 ohms or more for #4 AWG wire or larger. Measurement to be taken between conductors and between conductor and the grounded metal raceway.
2. After all fixtures, devices and equipment are installed and all connections completed to each panel, the Contractor shall disconnect the neutral feeder conductor from the neutral bar and take a megger reading between the neutral bar and grounded enclosure. If this reading is less than 250,000 ohms, the Contractor shall disconnect the branch circuit neutral wires from this neutral bar. The Contractor shall then test each one separately to the panel until the low reading ones are found. The Contractor shall correct troubles, reconnect and retest until at least 250,000 ohms from the neutral bar to the grounded panel can be achieved with only the neutral feeder disconnected.
3. The Contractor shall send a letter to the Architect/Engineer certifying that the above has been done and tabulating the megger readings for each panel. This shall be done at least four (4) days prior to final inspection.
4. At inspection, the Contractor shall furnish a megger and show Architect/Engineer's representative that the panels comply with the above requirements. The Contractor shall also furnish a clamp type ammeter and a voltmeter and take current and voltage readings as directed by the representatives.
5. At inspection, the Contractor shall furnish ladders, required tools, and mechanics to open fixtures, boxes, panels, or any other equipment to enable the Architect/Engineer's representatives to see into any parts of the installation that may be requested.

G. Electrical Grounding System Tests: Provide documentation showing values of earth ground impedance for the system ground. See Specifications Section 26 05 26 for testing requirements.

H. Patient Environment Electrical Grounding System Tests: Provide documentation showing values of impedance and equipotential voltage for each grounded point in a patient care area and showing the value of current leakage (with grounds in place and lifted) of each piece of fixed electrical equipment (see NFPA 99, Section 3 5.2.). Grounding systems shall be tested TO THE EXTENT REQUIRED by the NEC, the Division of Health Services Regulation, North Carolina Department of Human Resources (DHSR) and all local codes and ordinances. Provide written certification of tests and results in triplicate to the Owner, DHSR and the Architect/Engineer prior to final inspection. All testing shall be accomplished by competent personnel appropriately certified, accredited and accepted by the State of North Carolina to perform the required testing. Provide testing personnel credentials to the Architect/Engineer for approval prior to commencing tests. All tests shall be performed in the presence of the Owner and Architect/Engineer.

## 1.16 SLEEVES AND FORMS FOR OPENINGS

A. Anchor bolts, sleeves, inserts, supports, etc., that may be required for electrical work shall be furnished, located and installed by the Electrical Contractor. The Electrical Contractor shall give sufficient information (marked and located) to the General Contractor in time for proper placement in the construction schedule. Should the Electrical Contractor delay or fail to provide sufficient information in time, then the Electrical Contractor shall cut and patch construction as necessary and required to install electrical work. Such cutting and patching will be done by the General Contractor but paid for by the Electrical Contractor.

B. Provide and place all sleeves for conduits penetrating floors, walls, partitions, etc. Locate all necessary slots for electrical work and form before concrete is poured.

C. Where exact locations are required by equipment for stubbing up and terminating conduit concealed in floor slabs, request shop drawings, equipment location drawings, foundation drawings, and any other data required to locate the concealed conduit before the floor slab is poured.

D. Where such data is not available in time to avoid delay in scheduled floor slab pours, the Architect/Engineer may elect to allow the installations of such conduits to be exposed. No additional compensation for such change will be allowed and written approval must be obtained from the Architect/Engineer.

E. Seal all openings, sleeves, penetration, and slots as specified and as shown on the Contract Drawings.

## 1.17 CUTTING AND PATCHING

A. For the purposes of the Electrical Contract, “cutting and patching” shall be defined as that work required to introduce new electrical work into existing construction. Work required to install or fit electrical boxes, conduit, enclosures, equipment, etc. into new construction is not “cutting and patching”.

B. The Electrical Contractor shall perform all cutting and patching necessary to install all equipment as required under his contract and shall re-establish all finishes to their original condition where cutting and patching occur.

C. All cutting and patching shall be done in a thoroughly workmanlike manner.

D. Core drill holes in existing concrete floors and walls as required.

E. Install work at such time as to require the minimum amount of cutting and patching.

F. Do not cut joists, beams, girders, columns or any other structural members without first obtaining written permission from the Architect/Engineer.

G. Cut opening only large enough to allow easy installation of the conduit.

H. Patching is to be of the same kind of material as was removed.

I. The completed patching work shall restore the surface to its original appearance.

J. Patching of waterproofed surfaces shall render the area of the patching completely waterproofed.

K. Remove rubble and excess patching materials from the premises.

L. Raceways and ducts penetrating rated floor, ceiling or wall assemblies shall be properly sealed in accordance with the corresponding Underwriters Laboratories approved method utilizing approved and listed materials.

## 1.18 INTERPRETATION OF DRAWINGS

A. The Electrical drawings and specifications are complementary each to the other and what may be called for by one shall be as binding as if called for by both. The drawings are diagrammatic and indicate generally the location of outlets, devices, equipment, wiring, etc. Drawings shall be followed as closely as possible; however, all work shall suit the finished surroundings and/or trim.

B. Do not scale electrical drawings. Refer to the architectural drawings for dimensions.

C. Where the words “furnish and install” or “provide” are used, it is intended that this contractor shall purchase and install completely any and/or all material necessary and required for this particular item, system, equipment, etc.

D. Where the words “the Contractor” or “this Contractor” appear in either the Electrical Drawings or Division 26 Specifications, it shall mean the Electrical Contractor.

E. Any omission from either the drawings or these specifications are unintentional, and it shall be the responsibility of this Contractor to call to the attention of the Architect/Engineer any pertinent omissions before submitting a bid. Complete and working systems are required, whether every small item of material is shown and specified or not.

F. Where no specific material or equipment type is mentioned, a high quality product of a reputable manufacturer may be used provided it conforms to the requirements of these specifications. These materials shall be listed or labeled by a Third Party Testing Agency accredited by the NCBCC to label electrical equipment.

G. The electrical drawings show the general arrangement of raceways, equipment, fixtures, and appurtenances and shall be followed as closely as actual building construction and the work of other trades will permit. Some adjustment of routings and installation of conduit, cable tray and devices should be expected. The electrical work shall conform to the requirements shown on all of the drawings. General and Structural drawings shall take precedence over Electrical Drawings. Because of small scale of the electrical drawings, it is not possible to indicate offsets, fittings and accessories which may be required. The Contractor shall investigate the structural and finish conditions affecting the work and shall arrange his work accordingly, providing such fittings and accessories as may be required to meet such conditions, without additional cost to the Owner and as directed by the Architect/Engineer.

H. Each 3 phase circuit shall be run in a separate conduit unless otherwise shown on the Drawings.

I. Unless otherwise approved by the Architect/Engineer, conduit shown exposed shall be installed exposed; conduit shown concealed shall be installed concealed.

J. Where circuits are shown as “home runs” all necessary fittings and boxes shall be provided for a complete raceway installation.

K. Verify with the Architect/Engineer the exact locations and mounting heights of lighting fixtures, switches and receptacles prior to installation.

L. Any work installed contrary to or without approval by the Architect/Engineer shall be subject to change as directed by the Architect/Engineer, and no extra compensation will be allowed for making these changes.

M. The locations of equipment, fixtures, outlets, and similar devices shown on the Drawings are approximate only. Exact locations shall be as approved by the Architect/Engineer during construction. Obtain in the field all information relevant to the placing of electrical work and in case of any interference with other work, proceed as directed by the Architect/Engineer and furnish all labor and materials necessary to complete the work in an approved manner.

N. Surface mounted panel boxes, junction boxes, conduit, etc., shall be supported by spacers to provide a clearance between wall and equipment.

O. Circuit layouts are not intended to show the number of fittings, or other installation details. Furnish all labor and materials necessary to install and place in satisfactory operation all power, lighting, and other electrical systems shown. Additional circuits shall be installed wherever needed to conform to the specific requirements of equipment.

P. All connections to the equipment shall be made as required, and in accordance with the approved shop and setting drawings.

Q. Redesign of electrical work, which is required due to the Contractor’s use of an alternate item, arrangement of equipment and/or layout other than specified herein, shall be done by the Contractor at the Contractor’s expense. Redesign and detailed plans shall be submitted to the Architect/Engineer for approval. No additional compensation will be provided for changes in the work, either the Electrical Contractor’s or others, caused by such redesign.

R. All floor mounted electrical equipment shall be placed on 4 inch thick concrete housekeeping pads. Edges shall be chamfered.

## 1.19 SIZE OF EQUIPMENT

A. Investigate each space in the structure through which equipment must pass to reach its final location. If necessary, the manufacturer shall be required to ship his materials in sections sized to permit passing through such restricted areas in the structure.

B. The equipment shall be kept upright at all times. When equipment has to be tilted for ease of passage through restricted areas during transportation, the manufacturer shall be required to suitably brace the equipment, to insure that the tilting does not impair the functional integrity of the equipment.

## 1.20 RECORD DRAWINGS

A. As the work progresses, legibly record all field changes on one set of project contract drawings, herein after called the “record drawings”.

B. Record drawings shall accurately show the installed condition of the following items:

1. Power distribution one line diagram(s).
2. Panel schedule(s).
3. Control wiring diagram(s).
4. Lighting fixture schedule(s).
5. Service, feeder, branch circuit conduit and conductor sizes.
6. Lighting fixture, receptacle, and switch outlets, interconnections and homeruns with circuit identification.
7. Underground raceway routing.
8. Plan view, sizes and locations of switchboards, panelboards, automatic transfer switches, etc.
9. Standy Power System.
10. Fire Detection and Alarm System.
11. Telecommunications System.

## 1.21 CORROSION PROTECTION

A. All equipment, raceways, hardware, etc., furnished under the electrical contract shall be protected from corrosion by factory applied coatings, paint and galvanizing, or shall be fabricated of high quality 300 series stainless steel. All exposed hardware shall be hot dip galvanized. The requirements of preceding section entitled “Delivery and Storage” shall be strictly followed. Touch up any scratched metallic surfaces immediately to prevent corrosion. Apply cold galvanizing compound to all galvanized surfaces damaged during installation, i.e., cutting, etc. Rusted or corroded materials shall be replaced before final acceptance of the work.

## 1.22 SEISMIC REQUIREMENTS

A. All equipment furnished under the electrical contract shall be installed in a manner to be fully compliant with the seismic restraint requirements of the North Carolina State Building Code (NCSBC). The Contractor shall provide any and all seismic restraint details and calculations that may be required by the NCSBC and/or the Authority Having Jurisdiction.

B. Requirements for restraints are detailed in the NCSBC. All tables and references shall conform to building’s location. Restraints shall be per Seismic Performance Category stated on Architectural and/or Structural Drawings.

C. The Contractor shall retain the services of a Professional Engineer registered in the State of North Carolina to design seismic restraint elements required for this project. The Engineer's calculations, bearing his professional seal, shall accompany shop drawings and shall demonstrate Code compliance including certification that the seismic system components comply with the testing requirements of NCSBC Section 17 08 .5. Calculations and shop drawings shall be submitted for review prior to the purchasing of materials, equipment, systems and assemblies. Internal seismic restraint elements of manufactured equipment shall be certified by a professional engineer retained by the manufacturer. Such certificate applies only to internal elements of the equipment. All equipment anchorage requirements shall be coordinated with the building structure and shall be compatible thereto. All such anchorages shall be subject to the review and approval of the project's structural engineer.

D. The Professional Engineer retained for seismic restraint calculations shall visit the job site upon completion of the seismic restraint installation to comply with the Special Inspections requirement of the Code. This engineer shall provide written verification of compliance of the installation with the approved seismic submittal. This verification shall be submitted as a Special Inspections Report and shall bear the Engineer's professional seal. Job site inspections by other than this engineer are not acceptable.

E. Review of the seismic design computations and shop drawings by the Architect/Engineer or his agent shall not relieve the Contractor of his responsibility to comply with the seismic or any other requirements of the North Carolina State Building Code.

## 1.23 GUARANTEE

A. The Contractor shall guarantee the materials and workmanship covered by these drawings and specifications for a period of one year from the date of acceptance by the Owner. The Contractor shall repair and/or replace any parts of any system that may prove to be defective at no additional cost to the Owner within the guarantee period. All equipment warranties shall be as specified and included in the Contract Documents.

## 1.24 PHASING OF THE WORK

A. The Electrical Contractor shall schedule his work as described in the relevant sections of the General and Supplemental General Conditions and Division 1 Specifications Sections.

## 1.25 ALTERNATE BIDS

A. Alternate bid items are described in relevant sections of the General and Supplemental General Conditions and Division 1 Specifications Sections.

**PART 2 - PRODUCTS Not Used**

**PART 3 - EXECUTION Not Used**

**END OF SECTION**

# SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Building wires and cables rated 600 V and less.
2. Metal-clad cable, Type MC, rated 600 V or less.
3. Lighting Control Cables.
4. Connectors, splices, and terminations rated 600 V and less.

B. Related Requirements:

1. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
2. Section 26 05 33 “Raceway and Boxes for Electrical Systems”.
3. Section 26 05 53 “Identification for Electrical Systems” specifies electrical equipment labels and warning signs installed by this Section.

C. References:

1. ANSI/NFPA 70 National Electrical Code.
2. NECA Standard of Installation (National Electrical Contractors Association).

### 1.2 ACTION SUBMITTALS

A. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Product Data: Provide manufacturer’s catalog information showing dimensions, ratings, colors, and configurations.

C. Test Reports: Indicate procedures and values obtained.

D. Manufacturer’s Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements.

### 1.3 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years documented experience.

## 1.4 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.

B. Furnish products listed and classified by testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

## 1.5 PROJECT CONDITIONS

A. All wire and cable shall be installed in conduit, except where MC Cable and/or free run lighting control, data, and fire alarm cable is specifically permitted concealed above accessible ceilings. Cabling, connectors, tape and insulating materials above ceilings in plenums, must be UL 2043 listed for use in air-handling spaces. This includes all power wiring, emergency systems control conductors, and other electrical systems required by Codes to be installed raceways.

B. Verify that field measurements are as shown on Drawings.

C. Conductor sizes are based on 75° C. copper.

D. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required to meet Project Conditions.

E. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.

## 1.6 COORDINATION

A. Coordinate Work under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

# PART 2 - PRODUCTS

## 2.1 CONDUCTORS AND CABLES

A. Description: Single conductor insulated building wire.

B. Conductor: Copper. Solid and stranded as specified below. Minimum #12 AWG, maximum 500 KCMil, unless noted otherwise.

C. Insulation/Voltage Rating: 600 volts.

D. Insulation: Dual-rated THHN/THWN or XHHW.

Color Coding: 120/240 volts 480/277 volts

and 208/120 volts

| | | |
|---|---|---|
| Phase A - | Black | Brown |
| Phase B - | Red | Orange |
| Phase C - | Blue | Yellow |
| Neutral - | White* | Grey* |
| Ground - | Green | Green |

*Provide branch circuit neutral conductors with factory color coded markings or stripes identified for their associated phase conductor (white-black, white-blue, white-red, gray-brown, gray-orange, gray-yellow) where individual neutral conductors are required.

## 2.2 METAL CLAD (MC) CABLE

A. Description: Metal clad (MC) cable with aluminum interlocked armor, copper conductors and an internal green insulated equipment grounding conductor may be used for branch circuits 30 amperes and less, where approved by the AHJ. MC Cable must be health care rated where used in patient care areas as defined by the NEC and the AHJ. Use cable with individual neutral conductors where specified and/or required. Cable with individual neutral per phase design neutral conductors shall be provided with factory color coded neutral markings or stripes identified for their associated phase conductor (white-black, white-red, white-blue, gray-brown, gray-orange, gray-yellow).

B. Conductors: Copper. Solid and stranded as specified below. Minimum #12 AWG, maximum #10 AWG.

C. Insulation/Voltage Rating: 600 volts.

D. Insulation: Dual-rated THHN/THWN or XHHW.

E. Conductor Color Coding: Same as Building Wire above.

F. Interlocked armor color coding: Consistent with Section 26 05 53 requirements for raceways.

G. MC cable with integral power and low voltage cable for lighting control is permitted.

H. Power-Limited Fire-Alarm Circuits, complying with UL 1424 are permitted.

I. Connectors shall be zinc plated malleable iron or steel body with locknut, dual cable gripping saddle design with set screw and insulated throat. Pressure cast (pot metal) connectors are not permitted.

## 2.3 LIGHTING CONTROL CABLE

A. Lighting control cable for dimming and occupancy sensor control shall be provided as required. Lighting control cable may be provided integral to MC cable, or discrete, as

approved by the lighting controls manufacturer and as required by NEC Article 725. If discrete, cable shall be NEC Type CMP, in raceway from the switch outlet box to the accessible ceiling cavity, then free run to follow the lighting power system raceways to the fixtures controlled, be secured to the structure to the plane of the lighting power raceway system, then supported by the lighting power raceway system using NEC approved cable ties installed on no more than six foot intervals, or less if required by Codes and the AHJ. Lighting control cable shall be plenum rated and be approved by the lighting controls manufacturer. It shall consist of a 2#18 AWG solid, violet and gray insulated conductors minimum with an outer jacket rating of 300V minimum. Cable outer jacket shall not be red. Cable shall be daisy chain connected to lighting fixtures or be taped in junction boxes installed at the same plane of the lighting power raceway system. Do not support cable with ceiling grid supports wires. Do not drape cable over ceilings, lighting fixtures, conduit, ductwork, piping or equipment. Daisy chaining cable at the ceiling level is not permitted.

## 2.4 FIRE-ALARM WIRE AND CABLE

A. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.NFPA 70 permits wire sizes down to No. 16 AWG.

B. Signaling Line Circuits: Twisted, shielded pair, not less than No. 18 AWG, size as recommended by system manufacturer.

1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire-alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a two-hour rating.

C. Non-Power-Limited Circuits: Solid-copper conductors with 600 V rated, 75 deg C, color-coded insulation, and complying with requirements in UL 2196 for a two-hour rating.

1. Low-Voltage Circuits: No. 16 AWG, minimum, in pathway.
2. Line-Voltage Circuits: No. 12 AWG, minimum, in pathway.
3. Multiconductor Armored Cable: NFPA 70, Type MC, copper conductors, Type TFN/THHN conductor insulation, copper drain wire, copper armor with outer jacket with red identifier stripe, NTRL listed for fire-alarm and cable tray installation, plenum rated.

## 2.5 WIRING CONNECTORS AND CONNECTIONS

A. Conductors shall be installed continuous from outlet to outlet with no splicing except within outlet or junction boxes, troughs and gutters. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise. In plenum spaces, all wiring methods, including boxes and connectors, shall be plenum-rated and comply with UL 2043 for low smoke production.

B. Use mechanical connectors for copper conductor splices and taps, 8 AWG and larger, except main grounding conductors, which shall be terminated with compression lugs. Tape un-insulated conductors and connector with electrical tape to 150 percent of insulation rating of conductor or use third party testing agency-approved insulating

covers. In plenum spaces, only tape and insulating materials listed for plenum use (UL 2043 compliant) shall be used.

C. Use insulated spring wire connectors with plastic caps for copper conductors, 10 AWG and smaller, splices and taps in junction boxes, outlet boxes and lighting fixtures, Ideal "Wire-Nut" or "Wing-Nut", 3M Company "Scotchlock" series or NSI "Easy-Twist". "Push wire" type connectors are not acceptable. In plenum spaces, only connectors that are UL 2043-rated for use in air plenums shall be permitted.

D. "Sta-Kon" or other permanent type crimp connectors shall not be used for branch circuit connections.

E. Joints in stranded conductors shall be spliced by approved mechanical connectors and insulated with vinyl mastic tape and covered with vinyl electrical tape, 3M Scotch Vinyl Mastic Tape 2210 and Scotch Vinyl Electrical Tape Super 88, respectively, or approved equal. In plenum spaces, use only UL 2043-listed insulating materials or factory-applied UL-listed insulators on connectors. Solderless mechanical connectors for splices and taps, provided with U.L approved insulating covers, may be used instead of mechanical connectors plus tape.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Verify that interior of building has been protected from weather.

B. Verify that mechanical work likely to damage wire has been completed.

C. Verify that raceway installation is complete and supported.

### 3.2 PREPARATION

A. Completely and thoroughly swab raceway before installing wire.

### 3.3 WIRING METHODS

A. Service: Use building wire in raceway.

B. Panelboard and Equipment Feeders: Use building wire in raceway.

C. Exposed Branch Circuits in Unfinished Dry Interior Locations: Use building wire in raceway. Use rigid metallic conduit for Life Safety and EOC distribution feeders.

D. Branch Circuits in Wet or Damp Interior Locations: Use building wire in raceway.

E. Underground Installations: Use building wire in non-metallic raceway. Provide concrete encasement where shown and where required by relevant Codes.

F. Under Accessible Floor Installations:
   1. Cables must be securely supported, not resting directly on floor.
      a. Utilize pedestal brackets that attach to the raised floor pedestals to elevate and support MC cable.
      b. Do not attach cables directly to removable floor panels.
      c. Allow for separation of MC cables from low-voltage cables.

G. Branch Circuits in Concealed Dry Interior Locations:

   1. Use building wire in metallic raceway or metal clad cable.
   2. MC cable may be used exposed in electrical equipment rooms where branch circuits originate at panelboards, but cable shall be supported and neatly arranged above panelboards on steel ladder rack, width as required. Cable shall be strapped to ladder rack using approved, UV resistant plastic cable ties. Alternately, MC cable shall be transitioned to building wire and metallic raceway outside of the electrical equipment rooms in a junction box or wiring trough concealed above an accessible ceiling. If this method is utilized to convert MC cable to building wire and metallic raceway, provide screw connection, feed-through, modular type DIN rail terminal blocks for termination and extension of circuit conductors. Terminal blocks shall be rated 30A, 300VAC minimum, and higher as required by circuit ampacity and voltage, quantity as required for phase, neutral and equipment ground conductors. Wirenut and similar terminations are not permitted in splice boxes or panelboard interiors. All splices shall be clearly labeled and neatly trained as judged acceptable by the Engineer.

H. Above Accessible Ceilings: Use building wire in metallic raceway or health care rated metal clad cable in patient care areas. Cabling and materials above ceilings must be plenum rated.

I. Wet or Damp Interior Locations: Use building wire in metallic raceway.

J. Exterior Locations: Use building wire in metallic raceway.

## 3.4 INSTALLATION

A. Install products in accordance with manufacturer’s instructions.

B. Route wire and cable as required to meet Project Conditions.

C. Install cable in accordance with the NECA “Standard of Installation”.

D. If a continuous raceway system is not shown on the Drawings, all concealed cabling not shown in raceway shall be supported with a cable support structure.

   1. Cabling shall be installed in straight paths and exit pathways at ninety degree angles. Diagonal, beeline and or non-supported cabling are unacceptable. Cabling shall be routed as high as possible and above other building facilities in the path with the least obstructions in the ceiling space while maintaining the separation requirements of the equipment manufacturer and NFPA 70 (NEC). Cables shall not be strapped to electrical conduits, piping, ductwork, etc.

2. The cable support structure shall utilize approved cable supports and be sized to accommodate change. J hook type cable supports shall be securely fastened to the building structure and be spaced at a maximum distance of four (4) feet so that sag between supports does not exceed 12 inches. J hooks shall be sized as follows: two inch J hooks rated for 75 cables and shall be used to support cable paths of 50 or less cables, four inch J hooks rated for 150 cables and shall be used to support cable paths of 51 to 100 cables. All cable paths shall be sized with 20% spare capacity. All attachment hardware shall be approved for the type of installation and maximum load rating of the products to be installed.
3. All penetrations through walls and ceilings shall be sleeved. All sleeves shall have permanently attached bushings. Sleeves shall be sized to accept 50% growth. All sleeves shall be fire-stopped using UL® approved methods and shall maintain assembly fire ratings.
4. Cables of different systems shall be separately bundled on 2 foot intervals using hook and loop cable ties. Plastic cable ties are not permitted.
5. All cable shall be installed in a complete, neat, and orderly fashion. Install cable with sufficient bending radius as not to kink, shear, or damage binders. Bend radius shall meet manufacturer's specifications.

E. Use solid conductor for feeders and branch circuits 10 AWG and smaller, and Class B stranded for larger conductors.

F. Use conductor not smaller than 12 AWG for power and lighting circuits.

G. Use conductor not smaller than 14 AWG for fire alarm and control circuits.

H. Pull all conductors into raceway at same time.

I. Use suitable wire pulling lubricant for building wire 4 AWG and larger.

J. Neatly train and lace wiring inside boxes, equipment, and panelboards. Do not tightly bundle conductors.

K. Clean conductor surfaces before installing lugs and connectors.

L. Identify wire and cable under provisions of Section 26 05 53.

M. Identify each conductor with its circuit number or other designation indicated on Drawings.

N. Common neutral multiwire lighting and receptacle branch circuits are not permitted. Provide separate, individual neutral conductors for receptacle circuits.

O. Do not bundle metal clad cable in a manner that requires the conductors be derated.

P. MC cable shall be supported in straight lines using approved supporting means and in compliance with the NEC. Dedicated support wires may be used above finished ceilings and shall be painted red prior to installation. Do not support cable with ceiling grid supports wires. Do not drape cable over ceilings, lighting fixtures, conduit, ductwork, piping or equipment. Do not "daisy-chain" connect lighting fixtures with MC cable.

## 3.5 FIELD QUALITY CONTROL

A. Perform field inspection and testing under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Inspect wire for physical damage and proper connection.

C. Measure tightness of bolted connections and compare torque measurements with manufacturer's recommended values.

D. Verify continuity of each branch circuit conductor

E. Prior to energizing, feeders, sub-feeders and service conductor cables shall be tested for electrical continuity and short circuits. See Section 26 05 00. A copy of these tests shall be sent to the Architect/Engineer.

**END OF SECTION**

# SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section includes:

1. Grounding electrodes and conductors.
2. Equipment grounding conductors.
3. Grounding well components.
4. Grounding Busbars.

B. Related Requirements:

1. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
2. Section 26 05 33 “Raceway and Boxes for Electrical Systems”.
3. Section 26 05 53 “Identification for Electrical Systems” specifies electrical equipment labels and warning signs installed by this Section.
4. Section 26 41 13 “Lightning Protection for Structures”.

C. REFERENCES

1. IEEE 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
2. Grounding and Bonding: NECA NEIS 331 and Article 250 of NFPA 70.
3. Communications Work: BICSI N1.
4. Work in Health Care Facilities: NFPA 99 and Article 517 of NFPA 70.
5. Emergency and Standby Power Work: NFPA 110, NFPA 111, and NECA NEIS 416.
6. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

### 1.2 GROUNDING SYSTEM DESCRIPTION

A. The neutral of each secondary electrical distribution system shall be grounded at one point only which shall be at the main disconnecting device. From the main disconnecting device, a copper grounding conductor sized in accordance with the NEC shall be extended to the earth electrode. Main grounding conductors #8 AWG through and including #4 AWG shall be insulated and identified by a green colored insulation.

All grounding conductors shall be installed in conduit sized in accordance with the NEC. Conduit carrying a grounding conductor shall also be grounded at the earth electrode.

B. The earth electrode shall be:

1. The metallic domestic water piping system of the building. Connection of the grounding conductor shall be made by an approved grounding clamp. The point of connection to the water system shall be within 6 inches of the entrance of the pipe inside the building or structure. Where dielectric unions are used in the water piping system, the grounding connection shall be made on the “street side” of the first such union in the system. A bonding jumper the same wire size as the grounding conductor shall be installed across the water piping connection such that the water meter may be removed without interrupting the grounding system continuity. Where no metallic domestic water piping system exists, the earth electrode shall be a ground rod with supplemental ground electrodes as defined below.
2. Ground Rods: Size as specified below driven 11 feet into the earth where shown on the contract drawings or as required. The rods shall be connected to the system ground point as shown on the Drawings by an insulated, green copper jumper in conduit. The connection at the rod shall be brazed or exothermically welded. The points of connection to the earth electrode system shall be visible and accessible upon completion of construction. Sectional rods of the same size and length shall be used in multiple rod installations, if required by soil conditions.
3. The building steel and slab reinforcing steel as shown and as required by the NEC. Connection points shall be as directed by the Architect/Engineer.
4. Other systems as required by the NEC or the AHJ.

## 1.3 PERFORMANCE REQUIREMENTS

A. The ground resistance of the earth electrode shall not exceed 5 ohms. The Electrical Contractor shall test the earth electrode using a standard three point ground resistance tester and shall advise the Architect/Engineer of the results of such tests in writing. Where tests show the resistance to ground exceeds 5 ohms, appropriate action shall be taken to reduce the resistance to 5 ohms, or less, by driving additional ground rods or other approved methods. Compliance shall be demonstrated by retesting.

## 1.4 ACTION SUBMITTALS

A. Submittals: Procedures for submittals. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Product Data: Provide for each type of product.

1. Product Listing: Include copy of unexpired approval letter, on letterhead of qualified electrical testing agency, certifying product's compliance with specified listing criteria.

    a. If listed manufacturer differs from selling manufacturer, indicate relationship between entities on submittal. Clearly indicate which entity warrants product performance and fitness for purpose.
    b. Listing criteria identified in approval letter must match specified listing criteria. UL label indicating approval of equipment's enclosure is not considered approval of equipment for intended application.
    c. Product identification in approval letter must match product branding and model numbers in submittal. Approval letters for discontinued or superseded products are unacceptable for submitted product.

C. Shop Drawings: Prepare and submit the following:

1. Plans showing dimensioned locations of grounding features described in "Field Quality Control for Grounding and Bonding" Article, including the following:

    a. Grounding electrode access enclosures.
    b. Grounding electrodes.
    c. Grounding arrangements and connections for separately derived systems.

## 1.5 INFORMATIONAL SUBMITTALS

A. Submittals: Submittals for information. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Test Reports: Indicates overall resistance to ground and resistance of each electrode.

C. Manufacturer’s Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

## 1.6 CLOSEOUT SUBMITTALS

A. Contract Closeout: Procedures for submittals as required under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Project Record Documents: Record actual locations of components and grounding electrodes.

C. Certificate of Compliance: Indicate approval of installation by authority having jurisdiction.

D. Test Reports: Indicates overall resistance to ground and resistance of each electrode.

## 1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience, and with service facilities within 100 miles of Project.

## 1.8 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.

B. Products: Listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

# PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

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. Burndy; Part of Hubbell Electrical Systems.
2. ERICO International Corporation.
3. O-Z/Gedney; a brand of Emerson Industrial Automation.

## 2.2 SYSTEM DESCRIPTION

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

B. Comply with UL 467 for grounding and bonding materials and equipment.

## 2.3 ROD ELECTRODES

A. Material: Copper-clad steel with a minimum of 10 mils of copper cladding.

B. Diameter: 3/4 inch (19mm)

C. Length: 10 feet (3000 mm).

## 2.4 CONNECTORS

A. Listed and labeled by an approved third party testing agency acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, cast bronze, brass, or plain malleable iron, pressure type with at least two bolts.

1. Pipe Connectors: Clamp type, sized for pipe.
2. Ground clamps shall not be fabricated from aluminum or any aluminum alloy.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

D. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless exothermic-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

E. Signal Reference Grid Grounding and Bonding: Combination of compression wire connectors, access floor grounding clamps, bronze U-bolt grounding clamps, and copper split-bolt connectors, designed for the purpose.

## 2.5 WIRE

A. Material: Insulated copper. Use solid conductor for 10 AWG and smaller, and Class B stranded for larger conductors, all sized per NEC requirements. Conductors shall be tinned bare copper for direct buried installations.

## 2.6 BONDING BUSHINGS

A. Bonding bushings shall be steel or malleable iron, insulated, threaded type, zinc plated for interior use and galvanized for exterior use. Provide with dual rated tin plated saddle for use with bonding conductors and resilient plastic insulation throat liner with 150°C rating molded on over the metallic stop. All bushings shall be third party testing agency approved and listed. Die cast zinc bushings are not acceptable.

## 2.7 GROUND ROD INSPECTION WELLS

A. Pedestrian Traffic Rated

1. Well Housing: 9 inch diameter High Density Polyethylene (HDPE), 10” minimum length. Static vertical load rating of 300 PSF minimum. Two knock out mouse holes for conductor entrance. Harger GAW910, nVent Erico T416B or approved equal.
2. Well cover: HDPE twist lock with locking bolt and the legend “GROUND” embossed on cover.

B. Vehicle Traffic Rated

1. Well Housing: 10 inch diameter reinforced concrete, 12" minimum length. Static vertical load rating of 20,000 PSF minimum. Two knock out mouse holes for conductor entrance.
2. Well cover: Bolt down cast iron with the legend "GROUND" embossed on cover.

## 2.8 GROUNDING BUSBARS

A. Electrical Power Grounding Busbars: Third party testing agency listed and labelled. Grounding busbars shall be provided for single point termination of power distribution system grounding and bonding conductors as shown on the Drawings. Grounding busbars shall be tin plated solid copper factory drilled with a NEMA hole size and spacing pattern for termination of two hole lugs, quantity as required with 25% spare, and be of the minimum dimensions shown on the Drawings. Provide with 600V standoff insulators, stainless steel mounting brackets and stainless steel hardware. Provide clear Lexan cover over connections.

B. Telecommunications Grounding Busbars: Comply with TIA-607-C and BISCI Standards. Grounding busbars shall be provided for single point termination of telecommunications system grounding and bonding conductors as shown on the Drawings. Grounding busbars shall be tin plated solid copper factory drilled with a BISCI hole size and spacing pattern for termination of two hole lugs, quantity as required with 25% spare, and be of the minimum dimensions shown on the Drawings. Provide with 600V standoff insulators, stainless steel mounting brackets and stainless steel hardware. Provide clear Lexan cover over connections.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. Coordination and Meetings: Verify existing conditions prior to beginning work as required under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

## 3.2 INSTALLATION

A. Quality Control: Manufacturer's instructions shall be followed as required under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Provide bonding to meet Regulatory Requirements.

C. Provide separate, insulated conductor within each feeder and branch circuit raceway.

D. Equipment Grounding Conductor: The raceway system shall not be relied on for ground continuity. A green grounding conductor, properly sized per the NEC shall be run in all raceways. Terminate each end on suitable lug, bus, or bushing. Exceptions are as follows:

1. Raceways for telecommunications.
2. Raceways for data.
3. Raceways for audio conductors.
4. Services.

E. Equipment grounding continuity shall be maintained through flexible conduit as required in previous sections.

F. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

G. All connections to ground conductors shall be accessible for inspection and made with approved solderless connectors, brazed or bolted to the equipment or structure to be grounded. All contact surfaces shall be thoroughly cleaned before connections are made to insure good metal to metal contact.

H. All equipment housings and/or enclosures, and all non-current carrying metallic parts of electrical equipment, raceway systems, etc., shall be effectively and adequately bonded to ground.

I. Grounding type insulated bonding bushings and jumpers shall be provided where concentric, eccentric or over-sized knockouts are encountered. The jumpers shall be sized per NEC Table 250-66 for services and per Table 250-122 for branch circuits.

J. All metallic raceways entering or leaving panelboards (branch circuits less than 30 amperes in lighting and appliance branch circuit panelboards excepted), switchboards, transfer switches, enclosed circuit breakers, safety switches, transformers, etc. shall be provided with insulated grounding and bonding bushings and each separate piece of raceway shall be individually bonded to the equipment ground bus or metallic enclosure, as applicable, by means of copper conductor sized in accordance with the National Electrical Code, Tables 250-66 for services and 250-122 for other circuits.

K. Bond the above ground portion of the gas piping system upstream from equipment shutoff valve to the building electrical service ground. The bonding jumper shall be sized per the NEC.

L. An equipment ground bus shall be installed in each panelboard for terminating equipment grounding conductors.

M. All wiring devices equipped with grounding connections shall be permanently and securely connected to the enclosure in which they are mounted with a copper grounding jumper.

N. The frame of all lighting fixtures shall be securely grounded to the equipment ground system with grounding conductors.

O. Provide grounding electrode conductor and connect to reinforcing steel in foundation footing where indicated. Bond reinforcing steel together.

P. Install rod electrodes at locations indicated. Install additional rod electrodes as required to achieve specified resistance to ground.

Q. Provide ground rod inspection well with cover at each rod location. Install well top flush with finished grade.

R. Special Requirements for Roof-Mounted Towers:
   1. Roof Ring: Meet requirements for ring electrode except conductors must comply with NFPA 780.
   2. Bond tower base footings steel, SBB in equipment room, and antenna support guys to roof ring.
   3. Connect roof ring to perimeter conductors of lightning protection system.

## 3.3 LABELING

A. Comply with requirements in Section 26 05 53 "Identification for Electrical Systems" for instruction signs. The label or its text shall be green.

B. Install labels at the telecommunications bonding conductor and grounding equalizer.

   1. Label Text: "If this connector or cable is loose or if it must be removed for any reason, notify the facility manager."

## 3.4 FIELD QUALITY CONTROL

A. Quality Assurance: Field inspection, testing and adjusting as required under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

**END OF SECTION**

# SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Conduit and equipment supports.
2. Anchors and fasteners.

B. Related Requirements:

1. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
2. Section 03 30 00 "Cast-in-Place Concrete" specifies concrete materials, reinforcement, and placement requirements referenced by this Section.
3. Section 26 05 00 "General Electrical" specifies additional requirements applicable to coordinating, scheduling, and sequencing of the Work specified in this Section.
4. Section 26 05 33 “Raceway and Boxes for Electrical Systems.”
5. Section 26 24 13 “Switchboards.”
6. Section 26 24 16 “Panelboards.”
7. Section 26 27 26 “Wiring Devices.”
8. Section 26 28 16 “Enclosed Switches.”
9. Section 26 28 17 “Enclosed Circuit Breakers.”
10. Section 26 32 13 “Packaged Engine-Generator System.”
11. Section 26 36 00 “Automatic Transfer Switches.”
12. Section 26 37 00 “Temporary Generator Docking Station.”
13. Section 26 43 13 “Surge Suppression Devices for Low-Voltage Electrical Power Circuits.”
14. Section 26 51 00 “Interior Luminaires.”
15. Section 26 52 00 “Emergency and Exit Lighting.”
16. Section 27 05 10 “Telecommunications Pathway.”
17. Section 28 31 11 “Fire Detection and Alarm System.”

C. References:

1. NECA - National Electrical Contractors Association.
2. ANSI/NFPA 70 - National Electrical Code.

### 1.2 ACTION SUBMITTALS

A. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Product Data: Provide for each type of product.

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

a. Slotted support systems, hardware, and accessories.
b. Clamps.
c. Hangers.
d. Fasteners.
e. Anchors.
f. Saddles.
g. Brackets.

2. Include rated capacities and furnished specialties and accessories.

C. Shop Drawings: For fabrication and installation details for electrical hangers and support systems.

1. Hangers. Include product data for components.
2. Slotted support systems.
3. Equipment supports.
4. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

## 1.3 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.

B. Furnish products listed and classified by testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

# PART 2 - PRODUCTS

## 2.1 PRODUCT REQUIREMENTS

A. Materials and Finishes: Provide adequate corrosion resistance.

B. Provide materials, sizes, and types of anchors, fasteners and supports to carry the loads of equipment and conduit. Consider weight of wire in conduit when selecting products.

C. Steel Slotted Support Systems:
   1. Standard Features: Preformed steel channels and angles with minimum 13/32 inch diameter holes at a maximum of 8 inch on center in at least one surface.

      a. Referenced Standard: MFMA-4 factory-fabricated components for field assembly.
      b. Material for Channel, Fittings, and Accessories: Galvanized steel.
      c. Channel Width: Selected for applicable load criteria.
      d. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
      e. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
      f. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
      g. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

D. Conduit and Cable Support Devices:

   1. Standard Features: **Steel and malleable-iron** hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

E. Support for Conductors in Vertical Conduit:

   1. Standard Features: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs must have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body must be made of malleable iron.

F. Anchors and Fasteners:

   1. Concrete Structural Elements: Use expansion anchors.
   2. Steel Structural Elements: Use beam clamps.
   3. Concrete Surfaces: Use self drilling anchors and expansion anchors.
   4. Hollow Masonry, Plaster, and Gypsum Board Partitions: Use toggle bolts.
   5. Solid Masonry Walls: Use expansion anchors.
   6. Sheet Metal: Use sheet metal screws or bolts
   7. Wood Elements: Use wood screws.

## PART 3 - EXECUTION

### 3.1 SELECTION OF HANGERS AND SUPPORTS

A. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as scheduled in NECA NEIS 1, where its Table 1

lists maximum spacings that are less than those stated in NFPA 70. Minimum rod size must be 1/4 inch in diameter.

B. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with two-bolt conduit clamps.

C. 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 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Do not fasten supports to pipes, ducts, mechanical equipment, and conduit.

C. Do not use powder-actuated anchors.

D. Obtain permission from Architect/Engineer before drilling or cutting structural members.

E. Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.

F. Install surface mounted cabinets and panelboards with minimum of four anchors.

G. 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 by means that comply with seismic-restraint strength and anchorage requirements.

H. In wet and damp locations use steel channel supports to stand cabinets and panelboards one inch (25 mm) off wall.

I. Conduits installed on the interior of exterior building walls shall be spaced away from the wall surface a minimum of 1/4 inch (65mm) using "clamp-backs" or struts.

J. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.

K. Installation of Concrete Bases:
1. Provide concrete bases of not less than 4 inch larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
2. Use 3000 psi, 28-day compressive-strength concrete.
3. Anchor equipment to concrete base as follows:

a. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
b. Install anchor bolts to elevations required for proper attachment to supported equipment.
c. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

**END OF SECTION**

# SECTION 26 05 33 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Metal conduit, tubing, and fittings.
2. Flexible metal conduit.
3. Liquidtight flexible metal conduit.
4. Electrical metallic tubing.
5. Nonmetallic conduit.
6. Wall and ceiling outlet boxes.
7. Pull and junction boxes.

B. Related Sections:

1. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
2. Division 7: Fire Stopping.
3. Division 7: Roofing penetrations.
4. Division 8: Access Doors.
5. Section 26 05 26 “Grounding and Bonding”.
6. Section 26 05 29 “Supporting Devices”.
7. Section 26 05 53 “Identification for Electrical Systems” specifies electrical equipment labels and warning signs installed by this Section.
8. Section 26 27 26 “Wiring Devices”

C. References:

1. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
2. ANSI C80.3 - Electrical Metallic Tubing, Zinc Coated.
3. ANSI/NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
4. ANSI/NFPA 70 - National Electrical Code.
5. NECA “Standard of Installation”.
6. NEMA FB 1 - Fittings and Supports for Conduit and Cable Assemblies.
7. NEMA OS 1 - Sheet steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
8. NEMA TC2 - Schedule 40 PVC
9. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.
10. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
11. NFPA 70 - National Electrical Code.

## 1.2 DESIGN REQUIREMENTS

A. Conduit Size: ANSI/NFPA 70.

## 1.3 ACTION SUBMITTALS

A. Submit under provisions of relevant sections of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Product Data: Provide for metallic conduit, flexible metal conduit, liquidtight flexible metal conduit, metallic tubing, nonmetallic conduit, fittings and conduit bodies.

C. Product Data: Fore each product, provide manufacturer's catalog information showing dimensions and configurations.

1. For concrete and steel used in precast concrete handholes, also include product certificates as required by ASTM C858.

D.

E. Shop Drawings: Prepare and submit the following:

1. Shop Drawings for Floor Boxes: Show that floor boxes are located to avoid interferences and are structurally allowable. Indicate floor thickness where boxes are embedded in concrete floors and underfloor clearances where boxes are installed in raised floors.

## 1.4 SUBMITTALS FOR CLOSEOUT

A. Contract Closeout: Submittals for Project closeout. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Accurately record actual routing of conduits larger than 2 inches.

C. Record actual locations and mounting heights of outlet, pull, and junction boxes on project record documents.

## 1.5 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.

B. Provide Products listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

## 1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle Products to site under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Accept conduit and boxes on site. Inspect for damage.

C. Protect conduit and boxes from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

D. Protect PVC conduit from sunlight.

## 1.7 PROJECT CONDITIONS

A. Verify that field measurements are as shown on Drawings.

B. Verify routing and termination locations of conduit prior to rough-in.

C. Conduit routing is shown on Drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

# PART 2 - PRODUCTS

## 2.1 CONDUIT REQUIREMENTS

A. Size: Conduit shall be sized in accordance with the latest edition of the NEC unless shown otherwise, with minimum conduit size of ½ inch, except homeruns minimum size shall be 3/4". Flexible metal and watertight ("sealtite") conduit in size ½ inch and larger are acceptable for motor, appliance and fixture connections provided green ground wire is installed (see Section 26 05 26) and NEC is followed.

B. Underground Installations:

1. More than Five Feet from Foundation Wall: Use thickwall nonmetallic conduit or thinwall nonmetallic conduit.
2. Within Five Feet from Foundation Wall: Use thickwall nonmetallic conduit.
3. In or Under Slab on Grade: Use thickwall nonmetallic conduit.
4. Minimum Size: 2 inch (25 mm).

C. Outdoor Locations, Above Grade: Use rigid steel conduit.

D. In Slab Above Grade:

1. Use rigid steel conduit, intermediate metal conduit, electrical metallic tubing.
2. Maximum Size Conduit in Slab: 3/4 inch (19mm)

E. Wet and Damp Locations: Use rigid steel conduit.

F. Dry Locations:

1. Concealed: Use rigid steel conduit, intermediate metal conduit or electrical metallic tubing. EMT may be utilized as permitted by the NEC, with the following restrictions. EMT shall not be installed:

   a. For LS and EOC distribution branch panelboard and equipment feeders.

   b. Where tubing, couplings, elbows and fittings would be in direct contact with the earth.
   c. Underground (in/below slab-on-grade or in earth).
   d. Any location outdoors where the tubing, etc., would be subjected to the elements.
   e. Where subject to severe corrosive influence.
   f. Where subject to severe physical damage.

## 2.2 METAL CONDUIT

A. Rigid Steel Conduit: ANSI C80.1.

B. Plastic-Coated Rigid Steel Conduit: ANSI C80.1, 40 mil PVC coating.

C. Intermediate Metal Conduit (IMC): Rigid steel.

D. Fittings and Conduit Bodies: ANSI/NEMA FB 1; material to match conduit with all steel fittings.

## 2.3 FLEXIBLE METAL CONDUIT

A. Description: Interlocked steel construction.

B. Fittings: ANSI/NEMA FB 1, steel.

## 2.4 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

A. Description: Interlocked steel construction with PVC jacket.

B. Fittings: ANSI/NEMA FB 1, steel or nonmetallic type.

## 2.5 ELECTRICAL METALLIC TUBING (EMT)

A. Description: ANSI C80.3; galvanized tubing.

B. Fittings and Conduit Bodies: ANSI/NEMA FB 1; steel or malleable iron, compression type, insulated throat.

## 2.6 NONMETALLIC CONDUIT

A. Description: NEMA TC 2; Schedule 40 and 80 PVC.

B. Fittings and Conduit Bodies: NEMA TC 3.

## 2.7 OUTLET BOXES

A. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.

1. Junction, switch, receptacle and outlet boxes for interior use in dry locations shall be zinc coated or cadmium plated sheet steel, 5” square and minimum 2 1/8” deep, unless otherwise indicated on the contract drawings. Smaller and shallower outlet boxes will be permitted only by special permission of the Architect/Engineer where such boxes are necessary due to structural conditions encountered. Where larger junction boxes are required, they shall be fabricated from No. 10, 12, 14 or 16 gauge sheet steel as required by the Underwriters Laboratories, Inc., and galvanized after fabrication. All junction boxes shall have screw fastened covers. Outlet boxes shall be provided with extension plaster rings where required by structural and finish conditions. Sheet steel boxes shall be as manufactured by Appleton, Raco, Steel City or Spring City.
2. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 1/2 inch male fixture studs where required.
3. Concrete Ceiling Boxes: Concrete type.

B. Cast Boxes: NEMA FB 1, Type FD, cast feralloy. Provide gasketed cover by box manufacturer. Provide threaded hubs. Cast boxes shall be by Crouse-Hinds, Appleton, O. Z. Gedney or Killark.

C. Metallic Conduit Bodies, Device Boxes, and Extension Rings:
1. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
   a. UL CCN QCIT; including UL 514A.

2. Standard Features: Means for providing access to interior of conduit or tubing system through one or more removable covers at junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.

D. Metallic Floor Boxes and Floor Box Covers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB, Electrification Business.
   b. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
   c. Wiremold; Legrand North America, LLC.

2. Floor Boxes: NEMA OS 1, fully adjustable, oversize, reach-in, concealed service, multi-compartment, two and three gang type (one and two duplex receptacles and one telecommunications outlet as shown), 3-3/4 inches deep, minimum. See Drawings for raceway connection requirements.
3. Standard Features: Box mounted in floor with floor box cover and other components to complete floor box enclosure, shape rectangular, material cast metal.
4. Boxes shall be as specified on the Drawings.

E. Metallic Concrete Boxes and Covers:
1. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
a. UL CCN QCIT; including UL 514A.

2. Standard Features: Box intended for use in poured concrete.

F. Wall Plates for Finished Areas: As specified in Section 26 27 26.

G. Hood for Outlet Boxes:
1. Retractable or Reattachable Hoods for Outlet Boxes: Receptacle, Hood, Cover Plate, Gaskets, and Seals: UL 498.
2. Mounts to box using fasteners different from wiring device.
3. Marked "Extra-Duty" in accordance with UL 514D.
4. Provide white, weatherproof, "while-in-use" cover.

## 2.8 PULL AND JUNCTION BOXES

A. Indoor Sheet Metal Junction and Pull Boxes:
1. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
a. UL CCN BGUZ; including UL 50 and UL 50E.

2. Standard Features:
a. Sheet Metal Boxes: NEMA OS 1, galvanized steel.
b. Box with a blank cover that serves the purpose of joining different runs of raceway or cable.

B. Outdoor Sheet Metal Junction and Pull Boxes:
1. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
a. UL CCN BGUZ; including UL 50 and UL 50E.

2. Standard Features:
a. Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
b. Degree of Protection: Type 3R.

C. Polymer Concrete Handholes and Boxes with Polymer Concrete Cover:

1. Description: Molded of sand, concrete, and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or combination.First option in "Configuration" Subparagraph below facilitates bottom raceway entry. Second option may be provided by separate slab placed in excavation under open-bottom enclosure; third option is obtained by molding or fabricating bottom integrally with body of unit.
2. Configuration: Units must be designed for flush burial and have open bottom unless otherwise indicated.
3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and installed location.

    a. Cover Finish: Nonskid finish must have minimum coefficient of friction of 0.50.
    b. Cover Legend: Molded lettering, "ELECTRIC" or as indicated for each service.

4. Conduit Entrance Provisions: Conduit-terminating fittings must mate with entering raceways for secure, fixed installation in enclosure wall.
5. Handholes Size as required for proper bending radius.
6. Options:

    a. Color: Gray.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Verify locations of outlets prior to rough-in.

1. Outdoors:

    a. Type 3R unless otherwise indicated.
    b. Locations Subject to Potential Flooding: Type 6P.

2. Indoors:

    a. Type 1 unless otherwise indicated.

B. Exposed Boxes Installed Less Than 2.5 m (8 ft) Above Floor:

1. Provide cast-metal boxes.

C. Provide exposed cover. Flat covers with angled mounting slots or knockouts are prohibited.

## 3.2 INSTALLATION

A. Circuiting is shown schematically. Exact routing of branch circuits may be varied to suit building construction; however, the combination of circuits within raceways and panelboard connections shall not be changed from those shown on the drawings. Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures.

B. Raceways shall be installed concealed in finished areas. Where construction does not permit concealed raceways and where indicated on the drawings, raceways shall be run exposed. Exposed raceways shall be run parallel to, or at a right angle with the building walls. Route conduit installed above accessible ceilings parallel and perpendicular to walls.

C. Where any run of rigid conduit may change to a run of EMT or vice-versa, each change shall be made in a junction or outlet box with each conduit terminated separately therein. Rigid conduit to EMT (or vice-versa) adapters shall not be permitted.

D. Install conduit and boxes in accordance with NECA “Standard of Installation”.

E. Arrange conduit to maintain headroom and present neat appearance.

F. Maintain adequate clearance between conduit and piping. Keep conduits at least 6 inch (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal conduit runs above water and steam piping.

G. Maintain 12 inch (300 mm) clearance between conduit and surfaces with temperatures exceeding 104 degrees F (40 degrees C).

H. Cut conduit square using saw or pipecutter and de-burr cut ends.

I. Bring conduit to shoulder of fittings and fasten securely.

J. Use conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.

K. Install no more than equivalent of three 90-degree bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Use factory elbows, or hydraulic one-shot bender, to fabricate bends in metal conduit larger than 2 inch size.

L. Make conduit bends using large-radius preformed ells except for parallel bends. Field bending must be in accordance with NFPA 70 minimum radii requirements. Provide only equipment specifically designed for material and size involved.

M. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.

N. Provide suitable fittings to accommodate expansion and deflection where conduit crosses, control and expansion joints.

O. Provide suitable pull string in each empty conduit except sleeves and nipples.

P. Use suitable caps to protect installed conduit against entrance of dirt and moisture.

Q. The raceway system shall not be relied on for grounding continuity. Ground and bond conduit under provisions of Section 26 05 26.

R. Identify conduit under provisions of Section 26 05 53.

S. The use of “LB’s” shall be limited where possible. Where necessary to use “LB’s” sized above 2 inch, mogul units shall be installed.

T. Where concentric, eccentric or over-sized knockouts are encountered, a grounding type insulated bushing shall be provided.

U. Fasten conduit supports to building structure and surfaces under provisions of Section 26 05 29. Support conduit within 12 inch (300 mm) of enclosures to which attached. Do not install conduits within 2 inch (50 mm) of the bottom side of a metal deck roof.

V. Arrange supports to prevent misalignment during wiring installation.

W. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.

X. Group related conduits; support using conduit rack. Construct rack using steel channel; provide space on each for 25 percent additional conduits.

Y. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.

Z. Do not attach conduit to ceiling support wires.

AA. All metallic raceways entering or leaving panelboards (branch circuits less than 30 amperes in lighting and appliance branch circuit panelboards excepted), switchboards, transfer switches, enclosed circuit breakers, safety switches, transformers, etc. shall be provided with insulated grounding and bonding bushings and each separate piece of raceway shall be individually bonded to the equipment ground bus or metallic enclosure, as applicable, by means of copper conductor sized in accordance with the National Electrical Code.

BB. The term “fittings” includes couplings, connectors, offsets, LBs, etc.

CC. No pressure cast (pot metal) fittings or conduit bodies shall be allowed.

DD. Outlets, junction, taps, etc., on exposed rigid metal conduit shall be cast metal conduit fittings or cast metal boxes of the type and size appropriate for the location. Sheet steel outlet boxes shall not be permitted on exposed raceway runs except at or near a ceiling for interior construction.

1. Interior exposed raceway junction, switch, receptacle and outlet boxes installed at or below 8 feet AFF/AFG shall be cast malleable type with hubs and cast, gasketed plates.

2. Exterior exposed raceway junction, switch, receptacle and outlet boxes shall be cast malleable type with hubs and cast, gasketed plates.
3. Locate boxes so that cover or plate will not span different building finishes.
4. Support boxes in recessed ceilings independent of ceiling tiles and ceiling grid.

EE. Boxes and Enclosures in Areas or Walls with Acoustical Requirements:
1. Seal openings and knockouts in back and sides of boxes and enclosures with acoustically rated putty.
2. Provide gaskets for cover plates and covers.

FF. Set metal floor boxes level and flush with finished floor surface.

GG. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

HH. EMT couplings and terminations shall be made utilizing steel-plated hexagonal compression connectors. No set screw or indented type fittings shall be utilized.

II. EMT couplings and terminations shall be “concrete tight” where buried in masonry or concrete. EMT fittings, where installed in damp locations, shall be of the “raintight” type.

JJ. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box, whether installed indoors or outdoors.

KK. Install nonmetallic conduit in accordance with manufacturer’s instructions.

LL. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.

MM. PVC schedule 40 shall not be used exposed or concealed in gypsum walls, but may be used in CMU walls.

NN. IMC and GRC shall terminate with either a double locknut / bushing set, or in a threaded hub.

OO. Conduit couplings for IMC, GRC and PVC shall be in accordance with the NEC.

PP. The placement of conduit in floor slabs shall be thoroughly coordinated with the General Contractor to avoid conflicts with steel reinforcing bars, reductions in net concrete sections and floor penetrations.

QQ. Route conduit in and under slab from point-to-point.

RR. Do not cross conduits in slab.

SS. Schedule 40 PVC may be used in elevated floor slabs and in foundation slabs. Minimum concrete cover shall be 3/4 inch at finished or formed surface and shall be 3

inches at concrete surface cast against earth or for slabs placed on-grade. Greater amounts of concrete cover shall be used in areas subject to damage.

TT. Service entrance raceways run inside building foundation walls shall be buried at least eighteen (18) inches below grade or encased with a minimum of three (3) inches of concrete on all sides. Concrete encasement shall extend to the service equipment for raceways exposed above grade in crawl spaces.

UU. Encased raceways shall be of a type approved by the NEC as “suitable for concrete encasement.”

VV. Encased raceways shall have a minimum cover of eighteen (18) inches, except for raceways containing circuits with voltages above 600 volts, which shall have a minimum cover of thirty (30) inches.

WW. Branch circuit raceways run underground external to building foundation walls shall be run in raceways installed in accordance with the NEC, and shall be of a type approved by the NEC as “suitable for direct burial.” Minimum raceway size shall be 1 inch.

XX. Raceways run underground, internal to building foundation walls shall be of a type, and installed by a method approved by the NEC.

YY. Raceways that penetrate outside walls, ceilings from conditioned space or other similar condition shall be effectively sealed to prevent condensation from infiltrating humid air.

ZZ. Where raceways pass through a below grade wall, from a conditioned interior building space, the raceway shall be sealed utilizing fittings similar and equal to OZ/GEDNEY type “FSK” thru-wall fitting with “FSKA” membrane clamp adapter if required.

AAA. All underground raceways shall be identified by underground line marking tape within the provisions of Section 26 05 53. The tape to be located directly above the raceway and 6 to 8 inches below finished grade.

BBB. Provide stub-ups through floors with coupling threaded inside for plugs, set flush with finished floor. Plug coupling until conduit is extended above floor to final destination or a minimum of 2 ft (0.6 m) above finished floor.

CCC. Install in locations as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections and compliance with regulatory requirements.

DDD. Set wall mounted boxes at elevations to accommodate mounting heights indicated and specified in section for outlet device. Boxes are shown on Drawings in approximate locations unless dimensioned. Adjust box location up to 10 feet if required to accommodate intended purpose. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only. Install boxes to preserve fire resistance rating of partitions and other elements, using approved materials and methods. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes. Use flush mounting outlet box in finished areas. Use Erico Caddy RBS series, Raco 9001 or Cooper B-Line BB8-16 box mounting brackets to support flush mounting outlet boxes between studs.

## 3.3 INTERFACE WITH OTHER PRODUCTS

A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods under the provisions of Division 7.

B. Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket. Coordinate location with roofing installation specified under Division 7.

## 3.4 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

## 3.5 ADJUSTING

A. Contract Closeout: Adjust installed work under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Adjust floor box flush with finish flooring material.

C. Adjust flush mounting outlets to make front flush with finished wall material.

D. Install knockout closures in unused box openings

## 3.6 CLEANING

A. Contract Closeout: Clean installed work under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Clean interior of boxes to remove dust, debris, and other material.

C. Clean exposed surfaces and restore finish.

**END OF SECTION**

# SECTION 26 05 44 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Round sleeves.
2. Rectangular sleeves.
3. Sleeve-seal systems.
4. Sleeve-seal fittings.
5. Grout.
6. Pourable sealants.
7. Foam sealants.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

## PART 2 - PRODUCTS

### 2.1 ROUND SLEEVES

A. Steel Wall Sleeves:

1. General Characteristics: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, plain ends and integral waterstop.

B. Cast-Iron Wall Sleeves:

1. General Characteristics: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop.

C. PVC Pipe Sleeves:

1. General Characteristics: ASTM D1785, Schedule 40.

D. PVC Molded Sleeves:

1. General Characteristics: With nailing flange for attaching to wooden forms.

E. PE or PP Molded Sleeves:

1. General Characteristics: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

F. Round, Galvanized-Steel, Sheet Metal Sleeves:

1. General Characteristics: Galvanized-steel sheet; thickness not less than 0.0239 inch; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

## 2.2 RECTANGULAR SLEEVES

A. Rectangular, Galvanized-Steel, Sheet Metal Sleeves:

1. General Characteristics:

a. Material: Galvanized sheet steel.
b. Minimum Metal Thickness:

1) For sleeve cross-section rectangle perimeter less than 50 inch and with no side larger than 16 inch, thickness must be 0.052 inch.
2) For sleeve cross-section rectangle perimeter not less than 50 inch or with one or more sides larger than 16 inch, thickness must be 0.138 inch.

## 2.3 SLEEVE-SEAL SYSTEMS

A. General Characteristics: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable or between raceway and cable.

B. Options:

1. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Stainless steel.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

## 2.4 SLEEVE-SEAL FITTINGS

A. General Characteristics: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit must have plastic or rubber waterstop collar with center opening to match piping OD.

## 2.5 GROUT

A. General Characteristics: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

1. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
2. Design Mix: 5000 psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

## 2.6 POURABLE SEALANTS

A. Performance Criteria:

1. General Characteristics: Single-component, neutral-curing elastomeric sealants of grade indicated below.

a. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

## 2.7 FOAM SEALANTS

A. Performance Criteria:

1. General Characteristics: Multicomponent, liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam. Foam expansion must not damage cables or crack penetrated structure.

# PART 3 - EXECUTION

## 3.1 INSTALLATION OF SLEEVES FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Sleeves for Conduits Penetrating Above-Grade, Non-Fire-Rated, Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:

a. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall or floor so no voids remain. Tool exposed surfaces smooth; protect material while curing.
b. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 07 92 00 "Joint Sealants."

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide 1/4 inch annular clear space between sleeve and raceway or cable, unless sleeve-seal system is to be installed or seismic criteria require different clearance.
4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inch above finished floor level. Install sleeves during erection of floors.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Wall Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for wall assemblies.

C. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

D. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve-seal systems. Size sleeves to allow for 1 inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

E. Underground, Exterior-Wall and Floor Penetrations:

1. Install steel pipe sleeves with integral waterstops. Size sleeves to allow for 1 inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system. Install sleeve during construction of floor or wall.
2. Install steel pipe sleeves. Size sleeves to allow for 1 inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system. Grout sleeve into wall or floor opening.

## 3.2 INSTALLATION OF RECTANGULAR SLEEVES AND SLEEVE SEALS

A. Install sleeves in existing walls without compromising structural integrity of walls. Do not cut structural elements without reinforcing the wall to maintain the designed weight bearing and wall stiffness.

B. Install conduits and cable with no crossings within the sleeve.

C. Fill opening around conduits and cables with expanding foam without leaving voids.

D. Provide metal sheet covering at both wall surfaces and finish to match surrounding surfaces. Metal sheet must be same material as sleeve.

## 3.3 INSTALLATION OF SLEEVE-SEAL SYSTEMS

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

**END OF SECTION**

# SECTION 26 05 48 - VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Vibration controls.
2. Seismic and wind controls.

B. Related Requirements:
1. Section 26 05 29 "Hangers and Supports for Electrical Systems" specifies hangers and supports referenced by this Section.

### 1.2 DEFINITIONS

A. Designated Seismic System: An architectural, electrical, or mechanical system and its components for which the component importance factor is greater than 1.0.

### 1.3 DELEGATED DESIGN SERVICES

A. Delegated Design Professionals: Engage qualified structural professional engineer to design seismic and wind controls.

### 1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Prepare and submit catalog cuts, brochures, diagrams, schedules, and performance data illustrating size, physical appearance, and other characteristics of product.

    a. Include rated load capacity for each seismic- and wind-restraint device.
    b. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic- and wind-restraint component used.
    c. Annotate types and sizes of seismic restraints and accessories, complete with listing markings or report numbers and load rating in tension and compression as evaluated by an agency acceptable to authorities having jurisdiction.
    d. Annotate to indicate application of each product submitted and compliance with requirements.

B. Shop Drawings:

1. Detail fabrication and assembly of equipment bases.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
3. Show coordination of seismic and wind bracing for components with other systems and equipment in the vicinity, including other supports and seismic restraints.

C. Delegated Design Submittals:

1. For each seismic-restraint device, including restraint - rigid and cable type, restraint accessory, and concrete anchor and insert that is required by this Section or is indicated on the Drawings, submit the following:

    a. Seismic Restraints: Select seismic restraints complying with performance requirements, design criteria, and analysis data.
    b. Post-Installed Concrete Anchors and Inserts: Include calculations showing anticipated seismic criteria. Include certification that device is approved by qualified testing laboratory for seismic reinforcement use.
    c. Seismic Design Calculations: Submit input data and loading calculations.

2. For each wind-restraint device, including restraint - rigid and cable type, restraint accessory, and concrete anchor and insert that is required by this Section or is indicated on the Drawings, submit the following:

    a. Wind Restraint: Select wind restraints complying with performance requirements, design criteria, and analysis data.
    b. Post-Installed Concrete Anchors and Inserts: Include calculations showing anticipated wind criteria. Include certification that device is approved by qualified testing laboratory for reinforcement use.
    c. Wind Design Calculations: Submit static and dynamic loading calculations.

3. Seismic- and Wind-Restraint Detail Drawings:

    a. Design Analysis: To support selection and arrangement of seismic and wind restraints. Include calculations of combined tensile and shear loads.
    b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
    c. Coordinate seismic-restraint details with wind details required for equipment mounted outdoors.

4. Product Listing, Preapproval, and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

D. Field quality-control reports.

## 1.5 REGULATORY AGENCY APPROVALS

A. Delegated design submittals and shop drawings requiring approval by authorities having jurisdiction must be signed by qualified structural professional engineer responsible for their preparation.

# PART 2 - PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

A. Prepare design calculations in accordance with criteria specified in Section 26 00 10 "Supplemental Requirements for Electrical".

B. Seismic and Wind Restraint Device Ratings: Devices must be tested and rated in accordance with applicable code requirements and authorities having jurisdiction. Devices must be listed by a nationally recognized third party that requires periodic follow-up inspections and has a listing directory available to the public. Provide third-party listing by one or more of the following: an agency acceptable to authorities having jurisdiction.

C. Consequential Damage: Provide additional seismic and wind restraints for suspended components or anchorage of floor-, roof-, or wall-mounted components so that failure of a non-essential or essential component will not cause failure of any other essential building component.

D. Fire/Smoke Resistance: Seismic- and wind-restraint devices that are not constructed of ferrous metals must have a maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested by qualified testing laboratory in accordance with ASTM E84 or UL 723, and be so labeled.

E. Component Supports:

1. Load ratings, features, and applications of reinforcement components must be based on testing standards of qualified testing laboratory.

## 2.2 VIBRATION CONTROLS

A. Elastomeric Isolation Pads:

1. Standard Features:

a. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
b. Size: Factory or field cut to match requirements of supported equipment.

c. Pad Material: Oil and water resistant with elastomeric properties. Neoprene rubber, silicone rubber, or other elastomeric material.
d. Surface Pattern: Smooth, ribbed, or waffle pattern.
e. Infused nonwoven cotton or synthetic fibers.
f. Load-bearing metal plates adhered to pads.
g. Sandwich-Core Material: Resilient and elastomeric.

1) Surface Pattern: Smooth, ribbed, or waffle pattern.
2) Infused nonwoven cotton or synthetic fibers.

## 2.3 SEISMIC AND WIND CONTROLS

A. Restraints - Rigid Type:

1. Standard Features: Shop- or field-fabricated bracing assembly made of ANSI/AISI S110-07-S1 slotted steel channels, ANSI/ASTM A53/A53M steel pipe, or other rigid steel brace member. Includes accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

B. Restraints - Cable Type:

1. Standard Features:

a. Seismic- and Wind-Restraint Cables: ASTM A492 stainless steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for seismic-restraining cable service; with fittings attached by means of poured socket, swaged socket, or mechanical (Flemish eye) loop.
b. Restraint cable assembly and cable fittings must comply with ASCE/SEI 19. Cable fittings and complete cable assembly must maintain the minimum cable breaking force. U-shaped cable clips and wedge-type end fittings do not comply and are unacceptable.

C. Restraint Accessories:

1. Standard Features:

a. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections and/or reinforcing steel angle clamped to hanger rod. Non-metallic stiffeners are unacceptable.
b. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.
c. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

d. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.
e. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

D. Mechanical Anchor Bolts:

1. Standard Features:

a. Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength for anchor and as tested according to ASTM E488/E488M.
b. Prequalify post-installed anchors in concrete in accordance with ACI 355.2 or other approved qualification testing procedures.
c. Prequalify post-installed anchors in masonry in accordance with approved qualification procedures.

E. Adhesive Anchor Bolts:

1. Standard Features

a. Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488/E488M.
b. Prequalify post-installed anchors in concrete in accordance with ACI 355.2 or other approved qualification testing procedures.
c. Prequalify post-installed anchors in masonry in accordance with approved qualification procedures.

F. Concrete Inserts:

1. Standard Features:

a. Provide preset concrete inserts that are seismically prequalified in accordance with ICC-ES AC446 testing.
b. Comply with MSS SP-58.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine areas and equipment to receive seismic and wind control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for reinforcement and cast-in-place anchors to verify actual locations before installation.

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

### 3.2 SELECTION OF VIBRATION AND SEISMIC CONTROLS

A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

B. Hanger-Rod Stiffeners: Install where indicated or scheduled on the Drawings to receive them and where required to prevent buckling of hanger rods caused by seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry static, wind, and seismic loads within specified loading limits.

### 3.3 INSTALLATION OF SEISMIC AND WIND CONTROLS

A. Provide seismic and wind control devices for systems and equipment where indicated in Equipment Schedules or Seismic and Wind Controls Schedule, where indicated on the Drawings, where the Specifications indicate they must be installed on specific equipment and systems, and where required by applicable codes.

1. Install equipment and devices to withstand the effects of earthquake motions and high wind events.

B. Coordinate location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 03 30 00 "Cast-in-Place Concrete."

C. Installation of seismic and wind restraints must not cause any stresses, misalignment, or change of position of equipment or conduits.

D. Equipment Restraints:

1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.

2. Install seismic-restraint and wind-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.

E. Raceway, Cable, Wireway, Cable Tray, and Busway Support and Hanger Restraints:

1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
2. Install seismic-restraint and wind-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.
3. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
4. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

F. Install cables so they do not bend across edges of adjacent equipment or building structure.

G. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

H. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

I. Post-Installed Concrete Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Mechanical-Type Anchor Bolts: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors must be installed with sleeve fully engaged in the structural element to which anchor will be fastened.
4. Adhesive-Type Anchor Bolts: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque using a torque wrench.
6. Install stainless-steel anchors for interior and exterior applications.

J. Accommodation of Differential Seismic Motion: Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints,

where adjacent sections or branches are supported by different structural elements, and where connection is terminated to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

## 3.4 FIELD QUALITY CONTROL

A. Field tests must be witnessed by Architect.

B. Special Structural Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless post connection testing has been approved), and with at least seven days' advance notice.
3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test no fewer than four of each type and size of installed anchors and fasteners selected by Architect.
5. Test to 90 percent of rated proof load of device.

C. Nonconforming Work:

1. Seismic controls will be considered defective if they do not pass tests and inspections.
2. Remove and replace malfunctioning units and retest as specified above.

D. Field Quality-Control Reports: Collect, assemble, and submit test and inspection reports.

**END OF SECTION**

# SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Nameplates and Labels.
2. Wire and cable markers.
3. Conduit markers.
4. Wiring device plates marking.
5. Underground warning tape.

B. Related Requirements:

1. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
2. Section 26 05 00 "General Electrical" specifies additional coordination, scheduling, sequencing, submittal, and installation requirements applicable to the Work for electrical, communications, and electronic safety and security systems on the Project, including wiring methods.
3. Division 9: FINISHES – Painting.

C. References:

ANSI/NFPA 70 - National Electrical Code.

### 1.2 ACTION SUBMITTALS

A. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Product Data: Provide catalog data for nameplates, labels, and markers.

C. Identification Schedule: For each piece of electrical equipment and electrical system components to be index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

D. Manufacturer’s Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under regulatory requirements. Include instructions for storage, handling, protection, examination, preparation and installation of Product.

## 1.3 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.

B. Furnish products listed and classified by testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

# PART 2 - PRODUCTS

## 2.1 NAMEPLATES AND LABELS

A. Nameplates: Engraved three-layer laminated plastic as follows:

B. Furnish and install engraved laminated phenolic nameplates for all electrical equipment supplied under this contract for identification of system, equipment controlled or served, phase, voltage, ampacity, fault current, etc. Nameplates shall be securely attached to equipment with stainless steel screws, and shall identify by name the equipment controlled, attached, etc. Embossed, self-adhesive plastic tape is not acceptable for marking equipment. Nameplate material colors shall be:

1. Black surface with white core for all 120/208 volt normal (utility source) equipment.
2. Black surface with yellow core for all 277/480 volt normal (utility source) equipment.
3. Yellow surface with black core for all equipment related to the life safety branch system.
4. Bright red surface with white core for all equipment related to fire alarm system.

C. Locations:

1. Each electrical distribution and control equipment enclosure (safety switches, panelboards, transformers, etc.)
2. Communication cabinets.
3. Pull and splice boxes.
4. Fire alarm system cabinets, NAC power supplies, pull boxes, terminal boxes, etc.

D. Letter Size: Letters shall be a minimum of 1/2 inch (13 mm) high.

E. See details on the Drawings for additional requirements.

## 2.2 WIRE MARKERS

A. Description: Split sleeve type wire markers or approved equivalent.

B. Locations: Each conductor at panelboard gutters, pull boxes, outlet and junction boxes, and each load connection.

C. Legend:

1. Power and Lighting Circuits: Branch circuit or feeder number as indicated on drawings.
2. Control Circuits: Control wire number as indicated on schematic and interconnection diagrams on drawings.

## 2.3 CONDUIT, RACEWAY AND BOX MARKING

A. Paint visible surfaces of exposed junction and outlet boxes and covers of raceway systems above lay-in and other accessible ceilings. Paint all boxes and covers before installation. Legibly mark conduits at junction boxes above accessible ceilings with the panelboard and circuit numbers of the circuits contained in the raceway using a permanent black, bold marking pen.

## 2.4 WIRING DEVICE PLATES MARKING

A. Description: Adhesive backed, laminated plastic receptacle device plate labels identifying the circuit feeding the device. Labels shall be label machine printed, black lettering on a clear background, to indicate panel and circuit number and shall be Casio, Brother, T&B or approved equal.

B. Locations: Each receptacle device plate. Apply centered on the lower portion below the receptacle, parallel to the lower surface.

C. Legend: Typed labels to indicate panel and circuit number feeding the device (i.e., RPA-24).

## 2.5 UNDERGROUND WARNING TAPE

A. 6 inch wide, 4 mils thick, minimum, permanent plastic tape compounded for direct burial, detectable type, colored bright yellow with suitable continuous warning legend describing buried electrical lines.

# PART 3 - EXECUTION

## 3.1 PREPARATION

A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

## 3.2 APPLICATION

A. Install nameplate parallel to equipment lines.

B. Secure nameplate to equipment front using stainless steel rivets or stainless steel machine screws, lockwashers and acorn nuts as shown on the Drawings. Stainless

steel screws and nylon locknuts may be used in lieu of lockwashers and acorn nuts if the screw threads are not exposed.

C. Secure nameplate to inside surface of door on panelboard that is recessed in finished locations.

D. Install receptacle circuit identification labels.

E. Identify conduit using field painting under provisions of Division 9.

F. All empty conduit runs and conduit with conductors for future use shall be identified for use and shall indicate where they terminate. Identification shall be by tags with string or wire attached to conduit or outlet.

G. Identify underground conduits using one underground warning tape per trench at 6 - 8 inches below finished grade.

H. Install adhesive backed labels only when ambient temperature and humidity conditions for adhesive use are within range recommended by manufacturer.

**END OF SECTION**

# SECTION 26 05 73 - POWER SYSTEM STUDIES

## PART 1 - GENERAL

### 1.1 SUMMARY

A. The Work of this Section Includes:

1. Short-circuit study.
2. Overcurrent protective device coordination study.
3. Load-flow and voltage-drop study.
4. Arc-flash hazard study.

### 1.2 ACTION SUBMITTALS

A. Product Data: For power system analysis software to be used for studies.

1. Product Certificates: For power system study software applications, include certificate stating compliance with specified requirements, signed by software manufacturer.

B. Power System Study Reports:

1. Submit reports after approval of system protective devices submittals. Submittal may be in digital form.
2. Submit short-circuit study input data, including completed computer-program input data sheets.
3. Submit coordination study input data, including completed computer-program input data sheets.

    a. Submit load-flow, and voltage-drop data with coordination study.

4. Submit arc-flash study input data, including completed computer-program input data sheets.
5. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.
6. Submit revised one-line diagram, reflecting field investigation results and results of short-circuit study.

C. Data files for studies in format compatible with Owner's power system analysis software.

## 1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For coordination-study specialist.

B. Product Certificates: For coordination study and fault current study computer software programs, certifying compliance with IEEE 399.

## 1.4 QUALITY ASSURANCE

A. Submittals for power system studies must be signed and sealed by qualified electrical professional engineer responsible for their preparation.

B. Studies must be performed using commercially developed and distributed software designed specifically for power system analysis.

C. Software algorithms must comply with requirements of standards and guides specified in this Section.

D. Manual calculations are unacceptable.

# PART 2 - PRODUCTS

## 2.1 POWER SYSTEM ANALYSIS SOFTWARE

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

1. EDSA Micro Corporation.
2. EasyPower; brand of Bentley Systems, Inc.
3. Power Tools for Windows (PTW); brand of SKM Systems Analysis, Inc.

B. Standard Features:

1. Power System Analysis:

   a. Power-systems-analysis software applications must have analytical capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 3002 series standards.
   b. Computer software application must be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program must report device settings and ratings of overcurrent protective devices and must demonstrate selective coordination by computer-generated, time-current coordination plots.
   c. Computer software application must be designed to perform arc-flash analysis or have function, component, or add-on module designed to perform arc-flash analysis.

2. Analysis Standards:

a. Short-Circuit Current Analysis: In accordance with IEEE 3002.3.
b. Device Coordination Analysis: In accordance with IEEE 3004.3 and IEEE 3004.5.
c. Load-Flow Analysis: In accordance with IEEE 3002.2.
d. Harmonic Analysis: In accordance with IEEE 3002.8.
e. Transient Stability Analysis: In accordance with IEEE P3002.9.
f. Arc-Flash Hazard Analysis: In accordance with IEEE 1584.

3. Capable of printing arc-flash hazard warnings for equipment on vinyl, weather- and UV-resistant, pressure-sensitive adhesive labels complying with NFPA 70E.

a. Label must have orange header with wording, "WARNING, ARC-FLASH HAZARD," and must include the following information taken directly from arc-flash hazard study:

1) Equipment designation.
2) Nominal voltage.
3) Protection boundaries.

a) Arc-flash boundary.
b) Restricted approach boundary.
c) Limited approach boundary.

4) Arc-flash PPE category.
5) Required minimum arc rating of PPE in Cal/cm squared.
6) Available incident energy.
7) Working distance.
8) Engineering report number, revision number, and issue date.

C. Other Available Features Required by the Project:

1. Simultaneous faults.
2. Explicit negative sequence.
3. Mutual coupling in zero sequence.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Collect and analyze data for power system studies.

1. Verify completeness of data supplied in one-line diagram on Drawings. Call discrepancies to Architect's attention.
2. For equipment included as Work on the Project, use characteristics submitted under provisions of action submittals and information submittals for the Project.
3. For relocated equipment and equipment that is existing to remain, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers in accordance with NFPA 70E.

4. Gather and tabulate required input data to support power system studies. Comply with requirements in Section 01 78 39 "Project Record Documents" for recording circuit protective device characteristics. Record data on Record Document copy of one-line diagram. Comply with recommendations in IEEE 3002 series standards as to amount of detail that is required to be acquired in field. Field data gathering must be by, or under supervision of, qualified electrical professional engineer. Data include, but are not limited to, the following:

    a. Product data for the Project's overcurrent protective devices involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
    b. Electrical power utility impedance at service.
    c. Power sources and ties.
    d. Short-circuit current at each system bus (three phase and line to ground).
    e. Full-load current of loads.
    f. Voltage level at each bus.
    g. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
    h. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
    i. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
    j. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
    k. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
    l. Maximum demands from service meters.
    m. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
    n. Motor horsepower and NEMA MG 1 code letter designation.
    o. Low-voltage cable sizes, lengths, number, conductor material, and conduit material (magnetic or nonmagnetic).
    p. Medium-voltage cable sizes, lengths, conductor material, cable construction, metallic shield performance parameters, and conduit material (magnetic or nonmagnetic).
    q. Derating factors.

## 3.2 PREPARATION

A. Preparation of Data for Short-Circuit Study:

1. Verify completeness of data supplied on one-line diagram. Call discrepancies to Architect's attention.
2. For equipment included as Work on the Project, use characteristics submitted under provisions of action submittals and information submittals for the Project.
3. Prepare one-line diagram of modeled power system, showing the following:

a. Protective device designations and ampere ratings.
b. Conductor types, sizes, and lengths.
c. Transformer kVA and voltage ratings.
d. Motor and generator designations and kVA ratings.
e. Switchboard, motor-control center, and panelboard designations and ratings.
f. Derating factors and environmental conditions.
g. Revisions to electrical equipment required by study.

B. Preparation of Data for Overcurrent Protective Device Coordination Study:

1. Prepare data sheets to supplement electrical distribution system one-line diagram, cross-referenced with tag numbers on diagram, indicating the following:

   a. Special load considerations, including starting inrush currents and frequent starting and stopping.
   b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
   c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
   d. Generator thermal-damage curve.
   e. Ratings, types, and settings of utility company's overcurrent protective devices.
   f. Special overcurrent protective device settings or types stipulated by utility company.
   g. Time-current-characteristic curves of devices indicated to be coordinated.
   h. Manufacturer, frame size, interrupting rating in amperes root mean square (rms) symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
   i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
   j. Switchboards, motor-control centers, and panelboards ampacity, and SCCR in amperes rms symmetrical.
   k. Identify series-rated interrupting devices for condition where available fault current is greater than interrupting rating of downstream equipment. Obtain device data details to allow verification that series application of these devices complies with NFPA 70 and UL 489 requirements.

2. Examine the Project's overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance of the Work. Devices to be coordinated are indicated on Drawings.
3. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

C. Preparation of Data for Arc-Flash Hazard Study:

1. Assemble data from short-circuit study and overcurrent protective device coordination study.
2. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

## 3.3 SHORT-CIRCUIT STUDY

A. Base study on device characteristics supplied by device manufacturer.

B. Extent of electrical power system to be studied is indicated on Drawings.

C. Study the electrical distribution system, beginning at the utility transformer, from normal and alternate power sources throughout electrical distribution system for the Project. Study cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

D. Include AC fault-current decay from induction motors, synchronous motors, and asynchronous generators and apply to low- and medium-voltage, three-phase AC systems. Also account for fault-current DC decrement to address asymmetrical requirements of interrupting equipment.

E. Calculate short-circuit momentary and interrupting duties for three-phase bolted fault and single line-to-ground fault at equipment indicated on one-line diagram.

1. For grounded systems, provide bolted line-to-ground fault-current study for areas as defined for three-phase bolted fault short-circuit study.

F. Include in report identification of protective device applied outside its capacity.

## 3.4 OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

A. Base study on device characteristics supplied by device manufacturer.

B. Study the electrical distribution system, beginning at the utility transformer, from normal and alternate power sources throughout electrical distribution system for the Project. Study cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

C. See the Evaluations for discussion of what data should be indicated on one-line diagram, where the study should stop, and what data should be obtained and verified by Contractor.

D. Transformer Primary Overcurrent Protective Devices:

1. Device must not operate in response to the following:

a. Inrush current when first energized.

b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
c. Permissible transformer overloads in accordance with IEEE C57.96 if required by unusual loading or emergency conditions.

2. Device settings must protect transformers in accordance with IEEE C57.12.00, for fault currents.

E. Motor Protection:

1. Select protection for low-voltage motors in accordance with IEEE 3004.8 and NFPA 70.
2. Select protection for motors served at voltages more than 600 V in accordance with IEEE 620.

F. Conductor Protection: Protect cables against damage from fault currents in accordance with ICEA P-32-382, ICEA P-45-482, and protection recommendations in IEEE 3004.7. Demonstrate that equipment withstands maximum short-circuit current for time equivalent to tripping time of primary relay protection or total clearing time of fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

G. Generator Protection: Select protection in accordance with manufacturer's published instructions and IEEE C37.102.

H. Include AC fault-current decay from induction motors, synchronous motors, and asynchronous generators and apply to low- and medium-voltage, three-phase AC systems. Also account for fault-current DC decrement, to address asymmetrical requirements of interrupting equipment.

I. Include coordination of ground-fault protection devices.

J. Calculate short-circuit momentary and interrupting duties for three-phase bolted fault and single line-to-ground fault at equipment indicated on one-line diagram.

1. For grounded systems, provide bolted line-to-ground fault-current study for areas as defined for three-phase bolted fault short-circuit study.

K. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to short-circuit ratings.
2. Adequacy of switchboards, motor-control centers, and panelboard bus bars to withstand short-circuit stresses.
3. Application of series-rated devices must be recertified, complying with requirements in NFPA 70.
4. Include in report identification of protective device applied outside its capacity.

## 3.5 LOAD-FLOW AND VOLTAGE-DROP STUDY

A. Perform load-flow and voltage-drop study to determine steady-state loading profile of system. Analyze power system performance two times as follows:

1. Determine load flow and voltage drop based on full-load currents.
2. Determine load flow and voltage drop based on 80 percent of design capacity of load buses.
3. Prepare load-flow and voltage-drop analysis and report to show power system components that are overloaded, or might become overloaded; show bus voltages that are less than as prescribed by NFPA 70.

## 3.6 ARC-FLASH HAZARD STUDY

A. Comply with NFPA 70E, including Annex D, for arc-flash hazard study.

B. Preparatory Studies: Obtain short-circuit study and overcurrent protective device coordination study results prior to starting arc-flash hazard study.

C. Calculate maximum and minimum contributions of fault-current size.

1. Maximum calculation must assume maximum contribution from utility and must assume motors to be operating under full-load conditions.
2. Calculate arc-flash energy at 85 percent of maximum short-circuit current in accordance with IEEE 1584 recommendations.
3. Calculate arc-flash energy at 38 percent of maximum short-circuit current in accordance with NFPA 70E recommendations.
4. Calculate arc-flash energy with utility contribution at minimum and assume no motor contribution.

D. Calculate arc-flash protection boundary and incident energy at locations in electrical distribution system where personnel could perform work on energized parts.

E. Include low-voltage equipment locations.

F. Calculate limited, restricted, and prohibited approach boundaries for each location.

G. Incident energy calculations must consider accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations must account for changing current contributions, as sources are interrupted or decremented with time. Fault contribution from motors and generators must be decremented as follows:

1. Fault contribution from induction motors must not be considered beyond three to five cycles.
2. Fault contribution from synchronous motors and generators must be decayed to match actual decrement of each as closely as possible (for example, contributions from permanent magnet generators will typically decay from 10 p.u. to 3 p.u. after 10 cycles).

H. Arc-flash energy must generally be reported for maximum of line or load side of circuit breaker. However, arc-flash computation must be performed and reported for both line and load side of circuit breaker as follows:

1. When circuit breaker is in separate enclosure.
2. When line terminals of circuit breaker are separate from work location.

I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

## 3.7 POWER SYSTEM STUDY REPORTS

A. Preparation of Power System Study Reports: Prepare and submit the following:

1. Short-Circuit Study Report Contents:

a. Executive summary of study findings.
b. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.
c. One-line diagram of modeled power system, showing the following:

1) Protective device designations and ampere ratings.
2) Conductor types, sizes, and lengths.
3) Transformer kVA and voltage ratings.
4) Motor and generator designations and kVA ratings.
5) Switchboard, motor-control center, and panelboard designations and ratings.
6) Derating factors and environmental conditions.
7) Revisions to electrical equipment required by study.

d. Comments and recommendations for system improvements or revisions in written document, separate from one-line diagram.
e. Short-Circuit Study Input Data:

1) One-line diagram of system being studied.
2) Power sources available.
3) Manufacturer, model, and interrupting rating of protective devices.
4) Conductors.
5) Transformer data.

f. Protective Device Evaluation:

1) Evaluate equipment and protective devices and compare to available short-circuit currents. Verify that equipment withstand ratings exceed available short-circuit current at equipment installation locations.
2) Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties.
3) For 600 V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

4) For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in standards to 1/2-cycle symmetrical fault current.
5) Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

g. Short-Circuit Study Output Reports:

1) Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

a) Voltage.
b) Calculated fault-current magnitude and angle.
c) Fault-point X/R ratio.
d) Equivalent impedance.

2) Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

a) Voltage.
b) Calculated symmetrical fault-current magnitude and angle.
c) Fault-point X/R ratio.
d) Calculated asymmetrical fault currents based on fault-point X/R ratio; based on calculated symmetrical value multiplied by 1.6; and based on calculated symmetrical value multiplied by 2.7.

3) Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

a) Voltage.
b) Calculated symmetrical fault-current magnitude and angle.
c) Fault-point X/R ratio.
d) No AC Decrement (NACD) ratio.
e) Equivalent impedance.
f) Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on symmetrical basis.
g) Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on total basis.

2. Overcurrent Protection Device Coordination Study Report Contents:

a. Executive summary of study findings.
b. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.

c. One-line diagram of modeled power system, showing the following:

1) Protective device designations and ampere ratings.
2) Conductor types, sizes, and lengths.
3) Transformer kVA and voltage ratings.
4) Motor and generator designations and kVA ratings.
5) Switchboard, motor-control center, and panelboard designations.
6) Revisions to electrical equipment required by study.

d. Report recommended settings of protective devices, ready to be applied in field. Use manufacturer's data sheets for recording recommended setting of overcurrent protective devices when available.

1) Phase and Ground Relays:

a) Device tag.
b) Relay current transformer ratio and tap, time dial, and instantaneous pickup value.
c) Recommendations on improved relaying systems, if applicable.

2) Circuit Breakers:

a) Adjustable pickups and time delays (long time, short time, and ground).
b) Adjustable time-current characteristic.
c) Adjustable instantaneous pickup.
d) Recommendations on improved trip systems, if applicable.

3) Fuses: Show current rating, voltage, and class.

e. Time-Current Coordination Curves: Determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for switching schemes and for emergency periods where power source is local generation. Show the following information:

1) Device tag and title, one-line diagram with legend identifying portion of system covered.
2) Terminate device characteristic curves at point reflecting maximum symmetrical or asymmetrical fault current to which device is exposed.
3) Identify device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
4) Plot the following listed characteristic curves, as applicable:

a) Power utility's overcurrent protective device.
b) Medium-voltage equipment overcurrent relays.
c) Medium- and low-voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.

d) Low-voltage equipment circuit-breaker trip devices, including manufacturer's tolerance bands.
e) Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.
f) Cables and conductors damage curves.
g) Ground-fault protective devices.
h) Motor-starting characteristics and motor damage points.
i) Generator short-circuit decrement curve and generator damage point.
j) Largest feeder circuit breaker in each motor-control center and panelboard.

5) Maintain selectivity for tripping currents caused by overloads.
6) Maintain maximum achievable selectivity for tripping currents caused by overloads on series-rated devices.
7) Provide adequate time margins between device characteristics such that selective operation is achieved.
8) Comments and recommendations for system improvements.

3. Arc-Flash Hazard Study Report Contents:

a. Executive summary of study findings.
b. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.
c. One-line diagram, showing the following:

1) Protective device designations and ampere ratings.
2) Conductor types, sizes, and lengths.
3) Transformer kVA and voltage ratings, including derating factors and environmental conditions.
4) Motor and generator designations and kVA ratings.
5) Switchboard, motor-control center, panelboard designations, and ratings.

d. Short-circuit study output data.
e. Overcurrent protective device coordination study report contents.
f. Arc-Flash Study Output Reports:

1) Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each equipment location included in report:

a) Voltage.
b) Calculated symmetrical fault-current magnitude and angle.
c) Fault-point X/R ratio.
d) No AC Decrement (NACD) ratio.
e) Equivalent impedance.
f) Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on symmetrical basis.

g) Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on total basis.

g. Incident Energy and Flash Protection Boundary Calculations:

1) Arcing fault magnitude.
2) Protective device clearing time.
3) Duration of arc.
4) Arc-flash boundary.
5) Restricted approach boundary.
6) Limited approach boundary.
7) Working distance.
8) Incident energy.
9) Hazard risk category.
10) Recommendations for arc-flash energy reduction.

h. Fault study input data, case descriptions, and fault-current calculations including definition of terms and guide for interpretation of computer printout.

## 3.8 FIELD ADJUSTMENT FOR DEVICE COORDINATION

A. Adjust relay and protective device settings in accordance with recommended settings provided by coordination study. Field adjustments must be completed by engineering service division of equipment manufacturer under "Startup and Acceptance Testing" contract portion.

B. Make minor modifications to equipment as required to accomplish compliance with short-circuit and protective device coordination studies.

C. Testing and adjusting must be by qualified low-voltage electrical testing and inspecting agency.

1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters. Perform NETA tests and inspections for adjustable overcurrent protective devices.

## 3.9 WARNING LABELING OF ARC-FLASH HAZARDS

A. Apply arc-flash label on front cover of each section of equipment for each equipment included in study, including each piece of equipment listed below:

1. Switchboards.
2. Panelboards.
3. Motor Control Centers.
4. Low voltage transformers.
5. Automatic Transfer Switches.
6. Safety switches.
7. Control panels.

8. Motor starters.

B. Base arc-flash label data on highest values calculated at each location.

C. Machine print warning labels with no handwritten or field-applied markings.

D. Install arc-flash warning labels under direct supervision and control of qualified electrical professional engineer.

E. Indicate on record Drawings location of equipment where personnel could be exposed to arc-flash hazard during their work.

1. Indicate arc-flash energy.
2. Indicate protection level required.

**END OF SECTION**

# SECTION 26 05 80 – EQUIPMENT WIRING SYSTEMS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. The Work of this Section Includes:

Electrical power supply for, and connections to, equipment specified under other Divisions and/or provided by the Owner or Owner's vendors.

B. Related Requirements:

C. NOTE: Work specified to be accomplished by Division 26 in Related Divisions and Sections shall be as binding as work specified in Division 26.

1. Division 1: Owner-furnished equipment.
2. Division 11: Equipment
3. Division 13: Special Construction.
4. Division 14: Conveying Systems.
5. Division 21: Fire Protection.
6. Division 22: Plumbing.
7. Division 23: Heating, Ventilation and Air Conditioning.
8. Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables".
9. Section 26 05 26 "Grounding and Bonding for Electrical Systems".
10. Section 26 05 29 "Hangers and Supports for Electrical Systems"
11. Section 26 05 33 "Raceway and Boxes for Electrical Systems".
12. Section 26 05 53 "Identification for Electrical Systems".

D. References:

1. NEMA WD 1 - General Purpose Wiring Devices.
2. NEMA WD 6 - Wiring Device Configurations.
3. ANSI/NFPA 70 - National Electrical Code.

### 1.2 ACTION SUBMITTALS

A. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Product Data: Provide wiring device manufacturer's catalog information showing dimensions, configurations, and construction.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements.

Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

## 1.3 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.

B. Furnish products listed and classified by testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

C. Where electrical wiring is required by trades other than covered by Division 26, specifications for that section shall refer to same wiring materials and methods as specified under Division 26.

## 1.4 COORDINATION

A. Coordinate work under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Obtain and review shop drawings, product data, and manufacturer's instructions for equipment furnished under other sections.

C. Determine connection locations and requirements.

D. Sequence rough-in of electrical connections to coordinate with installation schedule for equipment.

E. Sequence electrical connections to coordinate with start-up schedule for equipment.

# PART 2 - PRODUCTS

## 2.1 CORDS AND CAPS

A. Attachment Plug Construction: Conform to NEMA WD 1.

B. Configuration: NEMA WD 6; match receptacle configuration at outlet provided for equipment.

C. Cord Construction: ANSI/NFPA 70, Type SO multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.

D. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Verify conditions under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Verify that equipment is ready for electrical connection, wiring, and energization.

### 3.2 ELECTRICAL WORK IN CONNECTION WITH OTHERS

A. Provide a source of power, and final connections, for mechanical, plumbing, sprinkler, fire protection, General Contractor-furnished and Owner-furnished equipment shown on the Drawings. Provide pigtails, flexible connections, conductors, raceways, circuit breakers, disconnect switches, receptacles, junction boxes, panelboards, wiring troughs, etc. as detailed in this section and/or as shown on the Drawings.

B. The locations of disconnect (safety) switches and other electrical equipment and devices shown on the Electrical Drawings are approximate only and some adjustment of their locations should be anticipated. Coordinate exact locations with the entity (contractor or Owner) providing the equipment. See other specifications divisions for further explanation of contractor responsibility. Do not apply power to equipment without the permission of the entity providing the equipment.

C. Coordinate with the mechanical, plumbing, fire protection, contractors, and the General Contractor and Owner, prior to ordering or installation of any equipment, to verify equipment requirements are provided in the electrical design. Coordinate and verify all electrical requirements, final connections, phasing and rotation, overcurrent and overload protective device sizes with the entity providing the equipment. The contractor will not be compensated for costs associated with changing the electrical systems to match utilization equipment, even if the electrical work is installed per the electrical drawings.

D. Division 23 (Mechanical) Equipment.

1. Furnish and install power wiring up to a defined disconnecting means (see Contract Drawings) consisting of a panelboard, built-in disconnect or fused safety switch for each item of equipment specified in the Mechanical Contract.
2. Make final connections from the disconnecting means to the equipment.
3. HVAC Control Panels, Control Equipment and Computers:

    a. Provide and install power wiring to the control panel(s) terminals or to a receptacle, as required. Provide sufficient electrical circuits from the fire alarm control panel to allow all required mechanical equipment operations during fire mode. See Division 23 Specifications for further definition of the required fire alarm/mechanical control system interface and operation sequence.

b. HVAC Control and Miscellaneous Power: Provide branch circuit power sources (designated “HVAC Control Power” 20A circuit breakers in selected branch circuit panelboards) as indicated in the panel schedules on the Drawings. The HVAC Contractor shall extend power from these circuit breakers as required for control power, damper power, and power for unscheduled HVAC equipment. If additional circuits are required, the contractor may use circuit breakers designated as “Spare”.

c. All equipment less than 120VAC, all relays, actuators, timers, seven-day clocks, alternators, pressure, vacuum, float, flow, pneumatic-electric, and low voltage thermostats, thermals, remote selector switches, remote pushbutton stations, emergency break-glass stations, interlocking, safety switches beyond the Division 26 Contractor termination point and other appurtenances associated with equipment in Division 23, shall be furnished, installed and wired under Division 23. All wiring required for controls and instrumentation, not indicated on the Drawings, shall be furnished and installed by the Mechanical Contractor.

4. Duct Mounted Smoke Detectors: Duct mounted smoke detectors shall be provided and wired by the Division 26 Contractor, but installed by the Mechanical Contractor. Fire Alarm Air Handling Units (AHU) shut down circuits shall be wired, by Division 26 Contractor, from the fire alarm control panel to a termination point, adjacent to the AHU control. The Division 26 Contractor shall leave sufficient marked conductor tails in a junction box adjacent to each unit for final connection by the Mechanical Contractor to the equipment to be furnished and installed by the Mechanical Contractor. Duct mounted smoke detectors are shown on the mechanical floor plans only.
5. Smoke Dampers: The Division 26 Contractor shall provide 120VAC power for smoke dampers provided by the Mechanical Contractor. Circuits are not shown on the Electrical Drawings. The Division 26 Contractor shall extend power circuits to dampers from circuit breakers designated as “HVAC Control Power”. Leave sufficient marked conductor tails in a junction box adjacent to each damper for final connection by the HVAC Contractor. Smoke dampers are shown on the mechanical floor plans only. The branch circuit breaker(s) supplying smoke dampers shall be physically protected by a panelboard lock and circuit breaker handle lock and each circuit breaker shall be identified with a 1/4" permanent red dot applied to its handle.
6. Refer to Division 23 for additional detail concerning electrical connections to Division 23 equipment.

E. Division 22 (Plumbing) Equipment:

1. Furnish and install a properly sized fused safety switch, or snap switch, as shown, and make final power connections for each item of equipment specified in the Plumbing Contract and as listed below.
2. All equipment less than 120VAC, all relays, actuators, timers, seven-day clocks, alternators, pressure, vacuum, float, flow, pneumatic-electric, and low voltage thermostats, thermals, remote selector switches, remote pushbutton stations, emergency break-glass stations, interlocking, safety switches beyond the Division 26 Contractor termination point and other appurtenances associated with equipment in Division 22, shall be furnished, installed and wired under

Division 22. All wiring required for controls and instrumentation, not indicated on the drawings, shall be furnished and installed by the Plumbing Contractor.

3. Electric and Gas-Fired Water Heaters: Furnish and install a fused safety switch or snap switch, as shown, adjacent to each water heater. Make power connections to the line side of the disconnect switch terminals as well as wiring from the switch to the water heater.
4. Hot Water Circulation Pump: The Plumbing Contractor will provide VFD (VFC) for the pump. The Division 26 Contractor shall install and wire the system complete.
5. Electric Water Coolers: Provide grounding type 120VAC GFCI receptacle(s), quantity as required by the equipment, for 120VAC power supply at each electric water cooler and shall consult the Plumbing Contractor and determine the exact location and type service required for each type installed before roughing in. All outlets and cords shall be concealed within the cabinet.
6. Sump Pump: Provide a weatherproof, ground fault interrupting type duplex receptacles for sump pumps. See electrical drawings for locations and confirm exact locations and termination requirements with the Plumbing Contractor.
7. Refer to Division 22 for additional detail concerning electrical connections to Division 22 equipment.

F. Division 14 (Elevator) Equipment:

1. Provide a power source for all elevator equipment including elevator controllers and elevator cab lighting. Furnish and install a properly sized fusible safety switch, adjacent to the respective equipment or in locations as required by the elevator manufacturer, and make final power connections for each item of equipment specified in Division 14 and as shown on the Drawings. Provide connections as required and coordinate exact locations and configurations with the General Contractor and the elevator vendor.
2. Provide raceways for telephone connections, and telephone cable to the telephone backboard if specified, to each elevator controller.
3. The electrical design for the elevator(s) is based on the elevator specified in Division 14. Modifications to the electrical requirements shall be provided by the Contractor at no additional cost to the Owner.
4. Provide fire alarm system connections to the elevator controllers and provide appropriate signals to the controllers during fire mode, including recall and fire hat signals. Coordinate requirements with the Division 14. See Specs Section 28 31 11 for additional requirements.
5. Provide power for elevator sump pumps, control panels and alarm systems as required. Provide connections as required and coordinate exact locations and configurations with the General Contractor and Division 14.
6. Provide accessory power and lighting as required by Division 14.
7. Provide shunt trip accessory for all feeder circuit breakers supplying elevator controllers, if required. Coordinate shut trip coil voltage. Provide electrical supervision for shunt trip circuits as indicated and as required by Codes. See Drawings and Specifications Section 28 31 11 for control requirements and details.

G. Division 21 (Fire Protection) System: Connect fire alarm system conductors to sprinkler flow and tamper switches, provided and installed by Division 21. Final connections shall be made by Division 26 under the direct supervision of Division 21. See Fire Alarm System Drawings and Specifications Section 28 31 11 for interface requirements and details.

H. Food Service Equipment: The Division 26 Contractor shall provide a power source adjacent to equipment provided by the Food Service Equipment Vendor and make final electrical connections to the equipment. See Food Service Equipment Drawings, Specifications and Food Service Equipment Electrical Notes on the Drawings for additional details and requirements. Coordinate exact locations and requirements with the Food Service Equipment Vendor and the General Contractor. Do not apply power to equipment without the permission of the Food Service Equipment Vendor.

I. General Contractor Provided Equipment: The Division 26 Contractor shall provide a power source adjacent to equipment provided by the General Contractor. Final connections to this equipment shall be provided by the Division 26 Contractor. Coordinate exact locations and requirements with the General Contractor.

1. Door Hold-Open Devices: The Division 26 Contractor shall furnish and install electrical connections from the fire alarm system to each door hold-open device, furnished by the General Contractor, at locations as shown and as directed by the General Contractor. Provide connections as required and coordinate exact locations and configurations with the General Contractor and the door hardware vendor. Final connections to the equipment shall be by the Division 26 Contractor in cooperation with the General Contractor.
2. Electrically-Operated Doors: The Division 26 Contractor shall furnish and install a power supply to each electrically-operated door at locations as shown and as directed by the General Contractor. The Division 26 Contractor shall also install and wire door activation switches provided by the General Contractor. Provide connections as required and coordinate exact locations and configurations with the General Contractor and the door hardware vendor. Final connections to the equipment shall be by the Division 26 Contractor in cooperation with the General Contractor.

J. Owner Provided Equipment: The Division 26 Contractor shall provide a power source adjacent to equipment provided by the Owner. Coordinate exact locations and requirements with the General Contractor. Final connection to the equipment will be provided by the Division 26 Contractor. Provide receptacle configurations and/or provide direct connection as required by equipment and coordinate exact locations and configurations with the Owner. Do not apply power to equipment without the permission of the Owner.

## 3.3 ELECTRICAL CONNECTIONS

A. Make electrical connections in accordance with equipment manufacturer’s instructions.

B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.

C. Make wiring connections using wire and cable with insulation suitable for temperatures encountered in heat producing equipment.

D. Provide receptacle outlet where connection with attachment plug is indicated. Provide cord and cap where field-supplied attachment plug is indicated.

E. Provide suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.

F. Install disconnect switches, controllers, control stations, and control devices as indicated.

G. Modify equipment control wiring with terminal block jumpers as indicated.

H. Provide interconnecting conduit and wiring between devices and equipment where indicated.

**END OF SECTION**

# SECTION 26 22 13 - LOW-VOLTAGE DISTRIBUTION TRANSFORMERS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Distribution, dry-type transformers with nominal primary and secondary rating of 600 V and less, with capacities up to 1500 kVA.

    a. Two-winding transformers.
    b. Two-winding transformers rated for nonlinear loads.

B. Related Requirements:

1. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
2. Section 26 05 00 "General Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
3. Section 26 05 26 "Grounding and Bonding for Electrical Systems" specifies grounding and bonding products installed under this Section.
4. Section 26 05 29 "Hangers and Supports for Electrical Systems" specifies hangers and supports referenced by this Section.
5. Section 26 05 33 “Racewas and Boxes for Electrical Systems”
6. Section 26 05 53 "Identification for Electrical Systems" specifies electrical equipment labels and warning signs referenced by this Section.

C. References:

1. NEMA ST 1 - Specialty Transformers (Except General-Purpose Type).
2. NEMA ST 20 - Dry-Type Transformers for General Applications.
3. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment (International Electrical Testing Association).
4. NFPA 70 - National Electrical Code.
5. IEEE C57.96 (Standard transformers) and C57.110 (K Rated transformers) - Transformer Overload Capability.

### 1.2 ACTION SUBMITTALS

A. Submittals: Procedures for submittals. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Product Data:

1. For each type of product.

    a. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type and size of transformer.
    b. Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer.

C. Shop Drawings:

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of field connections.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment.
3. Include diagrams for power, signal, and control wiring.

## 1.3 INFORMATIONAL SUBMITTALS

A. Contract Closeout: Submittals for project closeout. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Manufacturers' Published Instructions: Record copy of official installation instructions issued to Installer by manufacturer for the following:

1. Transformer temporary heating, working clearances, anchoring, torque values, and insulation-resistance testing.

## 1.4 SUBMITTALS FOR CLOSEOUT

A. Contract Closeout: Submittals for project closeout. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Record actual locations of transformers in project record documents.

## 1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

## 1.6 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.

B. Products: Listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

## 1.7 DELIVERY, STORAGE, AND HANDLING

A. Material and Equipment: Transport, handle, store, and protect products as required under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Inspection: On receipt, inspect for and note shipping damage to packaging and transformer.

1. If manufacturer packaging is removed for inspection, and transformer will be stored after inspection, re-package transformer using original or new packaging materials that provide protection equivalent to manufacturer's packaging.

C. Storage: Store in warm, dry, and temperature-stable location in original shipping packaging.

D. Temporary Heating: Apply temporary heat in accordance with manufacturer's published instructions within enclosure of ventilated-type units, throughout periods during which equipment is not energized and when transformer is not in space that is continuously under normal control of temperature and humidity.

E. Handle in accordance with manufacturer’s written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

# PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

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

1. ABB.

2. Eaton.

3. Siemens.

4. Square D Schneider.

5. Substitutions: As permitted in relevant sections of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Source Limitations: Obtain each type of transformer from single source from single manufacturer.

## 2.2 TWO-WINDING TRANSFORMERS

A. Description: NEMA ST 20, factory-assembled, air cooled dry type transformers, ratings as indicated. Transformers shall be energy efficient with minimum efficiencies as set forth in the Department of Energy 1/1/16 Standards.

B. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

C. Primary Voltage: 480 delta volts, 3 phase.

D. Secondary Voltage: 208Y/120 volts, 3 phase.

E. Core Flux Density: Below saturation at 10 percent primary overvoltage.

F. Insulation and temperature rise: Class 220 insulation system with 115º C average winding temperature rise.

G. Case temperature: Do not exceed 35º C rise above ambient at warmest point at full load.

H. Winding Taps:

1. Transformers Less than 15 kVA: Two 5 percent below rated voltage, full capacity taps on primary winding.
2. Transformers 15 kVA and Larger: NEMA ST 20.

I. Sound Levels: NEMA ST 20.

J. Basic Impulse Level: 10 kV for transformers less than 300 kVA, 30 kV for transformers 300 kVA and larger.

K. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

L. Mounting:

1. 1-15 kVA: Suitable for wall mounting. Provide manufacturers standard wall mounting brackets.
2. 16-75 kVA: Suitable for wall or floor mounting. If wall mounted, provide manufacturers standard wall mounting brackets.
3. Larger than 75 kVA: Suitable for floor mounting.

M. Coil Conductors: Continuous windings with terminations brazed or welded. Individually insulate secondary conductors and arrange to minimize hysteresis and eddy current losses.

N. Electrostatic Shield: Copper, between primary and secondary windings.

O. Enclosure: NEMA ST 20, Type 1 ventilated. Provide lifting eyes or brackets.

P. Isolate core and coil from enclosure using vibration-absorbing mounts.

Q. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.

## 2.3 TWO-WINDING TRANSFORMERS RATED FOR NONLINEAR LOADS

A. Description: NEMA ST 20, factory-assembled, air cooled dry type transformers, ratings as indicated, designed to supply nonlinear load (K-rated). Transformers shall be energy efficient with minimum efficiencies as set forth in the Department of Energy 1/1/16 Standards.

B. Primary Voltage: 480 delta volts, 3 phase.

C. Secondary Voltage: 208Y/120 volts, 3 phase.

D. Core Flux Density: Below saturation at 10 percent primary overvoltage.

E. Insulation and temperature rise: Class 220 insulation system with 115º C average winding temperature rise.

F. Case temperature: Do not exceed 35º C rise above ambient at warmest point at full load.

G. Winding Taps:

1. Transformers Less than 15 kVA: Two 5 percent below rated voltage, full capacity taps on primary winding.
2. Transformers 15 kVA and Larger: NEMA ST 20.

H. Sound Levels: NEMA ST 20.

I. Basic Impulse Level: 10 kV for transformers less than 300 kVA, 30 kV for transformers 300 kVA and larger.

J. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

K. Mounting:

1. 1-15 kVA: Suitable for wall mounting. Provide manufacturers standard wall mounting brackets.
2. 16-75 kVA: Suitable for wall or floor mounting. If wall mounted, provide manufacturers standard wall mounting brackets.
3. Larger than 75 kVA: Suitable for floor mounting.

L. Coil Conductors: Continuous windings with terminations brazed or welded. Individually insulate secondary conductors and arrange to minimize hysteresis and eddy current losses at harmonic frequencies. Size secondary neutral conductor at twice the secondary phase conductor ampacity.

M. Electrostatic Shield: Copper, between primary and secondary windings.

N. Enclosure: NEMA ST 20, Type 1 ventilated. Provide lifting eyes or brackets.

O. Isolate core and coil from enclosure using vibration-absorbing mounts.

P. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.

## 2.4 SOURCE QUALITY CONTROL

A. Quality Control: Manufacturer quality control as required under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Production test each unit according to NEMA ST20.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for transformers.

B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's published instructions.

C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

D. Verify that ground connections are in place and requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance must be 5 Ω at location of transformer.

E. Environment: Enclosures must be rated for environment in which they are located. Covers for UL 50E, Type 4X enclosures may not cause accessibility problems.

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

## 3.2 INSTALLATION

A. Install wall-mounted transformers level and plumb with wall brackets fabricated.

1. Coordinate installation of wall-mounted and structure-hanging supports with actual transformer provided.
2. Mount wall-mounted transformers using integral flanges or accessory brackets furnished by the manufacturer.

B. Install transformers level and plumb on concrete base with vibration-dampening supports. Locate transformers away from corners and not parallel to adjacent wall surface.

C. Construct concrete bases and anchor floor-mounted transformers in accordance with manufacturer's published instructions and requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems."

1. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
2. Install floor-mounted transformers on vibration isolating pads suitable for isolating the transformer noise from the building structure. Use one ½" thick, 4" square, resilient waffle design, oil-resistant elastomeric pad at each corner of the transformer, between the concrete base and the transformer frame, each sized for load of 50 pounds per square inch minimum.
3. For wall hung transformer installations, use spring type Korfund Series CE, sized for the transformer load. Provide sound pads at each corner of the transformer sized for ½" deflections. Securely anchor wall mounting brackets to wall to provide adequate support.
4. Mount trapeze-mounted transformers as indicated utilizing minimum ½" galvanized all-thread rods and metal framing channels. Make double-nut connections between rids and channels. Locate transformers to provide adequate ventilation and accessibility.

D. Transformer Stacking Frame: Transformer stacking frames shall be constructed from 1⅝" x 1⅝" by 12 gage P1000 Unistrut channel, or approved equivalent, for the horizontal and vertical members. The maximum span for the horizontal members shall be 48 inches. The maximum height of vertical members shall be 60 inches. All connections shall be made with 1⅝" general fittings and post bases. Provide P2484W - 7 hole, 90° gusseted fittings at all horizontal to vertical connections. All connections shall follow requirements and recommendations of manufacturer.

E. Secure transformer to concrete base in accordance with manufacturer's published instructions.

F. Secure covers to enclosure and tighten bolts to manufacturer-recommended torques to reduce noise generation.

G. Remove shipping bolts, blocking, and wedges.

H. Transformers shall be installed in a manner to be fully compliant with the seismic restraint requirements of the North Carolina State Building Code. Provide mounting devices and hardware, bracing, fittings, etc. as required for seismic restraint.

## 3.3 CONNECTIONS

A. Ground equipment in accordance with Section 26 05 26 "Grounding and Bonding for Electrical Systems."

B. Connect wiring in accordance with Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

C. Use flexible conduit, under the provisions of Section 26 05 33 “Raceways and Boxes for Electrical Systems”, 2 feet minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.

D. Tighten electrical connectors and terminals in accordance with manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

E. Provide flexible connections at conduit and conductor terminations and supports to eliminate sound and vibration transmission to building structure.

## 3.4 FIELD QUALITY CONTROL

A. Quality Assurance: Field inspection, testing, adjusting shall be as required under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Inspect and test in accordance with NETA ATS, except Section 4, or provide for qualified technicians to perform testing according to the manufacturer’s recommendations.

## 3.5 ADJUSTING

A. Contract Closeout: Adjust installed work as required under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Measure primary and secondary voltages and make appropriate tap adjustments.

C. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 5 percent and not being

lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.

D. Output Settings Report: Prepare a written report recording output voltage and tap settings.

## 3.6 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

**END OF SECTION**

# SECTION 26 24 13 - SWITCHBOARDS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Switchboards.
2. Accessory components and features.

B. Related Requirements:

1. Section 03 30 00 “Cast-In-Place Concrete” specifies Equipment Bases and Foundations referenced by this Section.
2. Section 26 05 00 "General Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
3. Section 26 05 26 "Grounding and Bonding for Electrical Systems" specifies grounding and bonding referenced by this Section.
4. Section 26 05 53 "Identification for Electrical Systems" specifies electrical equipment labels and warning signs referenced by this Section.
5. Section 26 05 73 "Power System Studies" for Short-circuit, Overcurrent protective device coordination, arc-flash hazard analysis and arc-flash label requirements.
6. Section 26 24 21 “Utility Service Entrance”.
7. Section 26 28 13 “Fuses” specifies fuses referenced by this Section.
8. Section 26 43 13 “Surge Protective Devices for Low-Voltage Electrical Power Circuits” specifies surge protection referenced by this Section.

C. References:

1. ANSI C12 - Code for Electricity Metering.
2. ANSI C39.1 - Requirements for Electrical Analog Indicating Instruments.
3. ANSI C57.13 - Requirements for Instrument Transformers.
4. ANSI/UL 1283 Standard for Safety, Electromagnetic Interference Filters, 5th Ed.
5. ANSI/UL 1449 Standard for Safety, Surge Protective Devices, 4th Ed.
6. NEMA AB 1 - Molded Case Circuit Breakers.
7. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
8. NEMA PB 2 - Dead Front Distribution Switchboards.
9. NEMA PB 2.1 - Instructions for Safe Handling, Installation, Operation and Maintenance of Deadfront Switchboards Rated 600 Volts or Less.
10. NEMA 260 - Safety Labels for Padmounted Switchgear and Transformers Sited in Public Areas.
11. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment (International Electrical Testing Association).

12. NFPA 70 - National Electrical Code.
13. NFPA 780 Standard for the Installation of Lightning Protection Systems.
14. UL 96A Standard for Safety, Installation Requirements for Lightning Protection Systems, 12th Ed.

## 1.2 COORDINATION

A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided.

## 1.3 ACTION SUBMITTALS

A. Submittals: Procedures for submittals. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Product Data: Provide electrical characteristics including voltage, frame size and trip ratings, fault current withstand ratings, and time-current curves of all equipment and components.

C. Shop Drawings: Indicate front and side views of enclosures with overall dimensions shown; conduit entrance locations and requirements; nameplate legends; size and number of bus bars per phase, neutral, and ground; and switchboard instrument details.

## 1.4 INFORMATIONAL SUBMITTALS

A. Submittals: Submittals for information. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Test Reports: Indicate results of factory production tests.

C. Manufacturer’s Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

## 1.5 CLOSEOUT SUBMITTALS

A. Submittals for project closeout. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Record actual locations of switchboard in project record documents.

C. Maintenance Data: Include spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

## 1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

## 1.7 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.

B. Products: Listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated. Equipment used for service shall be third party testing agency service-entrance rated and labeled.

C. Switchboards shall have proper working clearances per the NEC.

## 1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Contract Closeout shall be as specified under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Furnish two of each key.

## 1.9 DELIVERY, STORAGE, AND HANDLING

A. Transport, handle, store, and protect products under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.

C. Deliver in 48-inch maximum width shipping splits, individually wrapped for protection and mounted on shipping skids.

D. Store in a clean, dry space. Provide space heaters to maintain a condensation free environment. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

E. Handle in accordance with NEMA PB 2.1 and manufacturer’s written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

## 1.10 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on shop drawings.

## 1.11 SOURCE QUALITY CONTROL

A. Manufacturer quality control shall be as specified under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Shop inspect and test switchboard according to NEMA PB 2.

## 1.12 MAINTENANCE MATERIALS

A. Contract Closeout shall be as specified under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Furnish two of each key.

# PART 2 - PRODUCTS

## 2.1 SWITCHBOARDS

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

1. ABB.
2. Eaton.
3. Siemens.
4. Square D Schneider.
5. Substitutions: As permitted in relevant sections of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Description: NEMA PB 2 switchboard with electrical ratings and configurations as indicated and specified.

C. Size: Maximum physical enclosure size as shown and detailed on the Drawings. The contractor is responsible for deviations from the size shown and required to meet NEC working clearance requirements.

D. Ratings:

1. Voltage: 277/480 volts.

2. Configuration: Three phase, four wire, grounded.
3. Main Bus: Rating as shown on the drawings.
4. Integrated Equipment Rating: Rating as shown on the drawings.

E. Main Section Devices: Individually mounted.

F. Distribution Section Devices: Panel mounted.

G. Auxiliary Section Devices: Individually mounted.

H. Bus Material: Copper with silver plating, standard size.

I. Bus Connections: Bolted, accessible from front only for maintenance.

J. Ground Bus: Extend length of switchboard.

K. Solid-state Trip Molded and Insulated Case Main Circuit Breakers: Stationary mounted, NEMA AB 1, with electronic sensing, timing and tripping circuits for adjustable current settings. Electronic trip units shall be provided with external, permanently-mounted power supplies in the gear where required to program trip units while the breakers are deenergized. Trip units shall be field-programmable with an internal display for programming and display and have:

1. Adjustable instantaneous trip.
2. Adjustable long time pickup and delay.
3. Adjustable short time pickup and delay.
4. Ground fault pickup and delay.
5. Arc flash reduction mode with external switch and indicator (all 1200A circuit breakers in compliance with NEC Art. 240.87). Provide performance testing in accordance with NEC Art. 240.84(C).
6. Include shunt trip, undervoltage release, and other accessories where indicated.
7. Display line currents and cause of trip.

L. Solid-state Molded Case Branch Circuit Breakers (group mounted) (larger than 100 amperes and/or where required by Coordination Study): Panel mounted, NEMA AB 1, with electronic sensing, timing and tripping circuits for adjustable current settings. Electronic trip units shall be provided with external, permanently-mounted power supplies in the gear where required to program trip units while the breakers are deenergized. Trip units shall be field-programmable with an internal display for programming and display and have:

1. Adjustable instantaneous trip.
2. Adjustable long time pickup and delay.
3. Adjustable short time pickup and delay.
4. Ground fault pickup and delay.
5. Arc flash reduction mode with external switch and indicator (all 1200A circuit breakers in compliance with NEC Art. 240.87).
6. Include shunt trip, undervoltage release, and other accessories where indicated.
7. Display line currents and cause of trip.

M. Conventional Thermal Magnetic Molded Case Circuit Breakers (100 amperes and smaller only and where not required by the Coordination Study to be SS trip type): NEMA AB 1, integral thermal and instantaneous magnetic trip in each pole.

1. Provide circuit breakers third party testing agency listed as Type HACR for air conditioning equipment branch circuits.
2. Include shunt trip, undervoltage release, and other accessories where indicated.

N. Line and Load Terminations: Accessible from the front of the switchboard, suitable for the conductor materials and sizes indicated.

O. Future Provisions: Fully equip spaces for future devices with bussing and bus connections, suitably insulated and braced for short circuit currents. Provide continuous current rating as indicated.

P. Enclosures: Type 1 – General Purpose.

1. Align sections at front only.
2. Switchboard Height: 96 inches, excluding floor sills, lifting members and pull boxes.
3. Finish: Manufacturer's standard light gray enamel over external surfaces. Coat internal surfaces with minimum one coat corrosion-resisting paint, or plate with cadmium or zinc.
4. Mimic Bus: Show bussing, connections and devices in single line form on the front panels of the switchboard using blue color factory painting, or approved equivalent means.

## 2.2 METERING

A. The switchboard shall be provided with a front mounted, digital power quality meter / analyzer package. The metering shall include a lighted LCD display of voltage, current, power, kVA, kVAR, power factor, frequency, total harmonic distortion, kW demand, amperes demand, kWH, kVARH, auxiliary voltage input and neutral current. Phase switching shall be provided and the display shall indicate the phase being displayed. The meter shall have an RS485 Modbus port for Owner interface. Provide all voltage and current transformers required to provide the above data.

B. Manufacturers: The metering/analyzer package shall be:

1. Eaton IQ 260.
2. General Electric/ABB.
3. Siemens.
4. Square D/Schneider.
5. Substitutions: refer to provisions of the General and supplemental General Conditions and Division 1 specification sections.

C. Install at 60" AFF to bottom of the meter case or, if the meter is to be installed above 60" AFF but no more than 78"AFF, provide an angle adapter to lower the meter viewing angle. Angle adapter shall be acceptable to the Architect/Engineer.

## 2.3 METERING TRANSFORMERS

A. Current Transformers: ANSI C57.13, 5 ampere secondary, bar or window type, with single secondary winding and secondary shorting device, primary/secondary ratio as required, burden and accuracy consistent with connected metering and relay devices, 60 Hertz.

B. Potential Transformers: ANSI C57.13, 120 volt secondary, disconnecting type with integral fuse mountings, primary/secondary ratio as required, burden and accuracy consistent with connected metering and relay devices, 60 Hertz.

## 2.4 ACCESSORY COMPONENTS AND FEATURES

A. Mounting Accessories: For anchors, mounting channels, bolts, washers, and other mounting accessories, comply with requirements in Section 26 05 48.16 "Seismic Controls for Electrical Systems" or manufacturer's instructions.

## 2.5 SOURCE QUALITY CONTROL

A. Manufacturer quality control shall be as specified under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Shop inspect and test switchboard according to NEMA PB 2.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. Receive, inspect, handle, and store switchboards in accordance with NEMA PB 2.1.

1. Lift or move panelboards with spreader bars and manufacturer-supplied lifting straps following manufacturer's published instructions.
2. Use rollers, slings, or other manufacturer-approved methods if lifting straps are not furnished.
3. Protect from moisture, dust, dirt, and debris during storage and installation.
4. Install temporary heating during storage in accordance with manufacturer's published instructions.

B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.

C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work or that affect performance of equipment.

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

## 3.2 PREPARATION

A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.

B. Provide 4 inch concrete housekeeping pad under the provision of Division 3.

## 3.3 INSTALLATION

A. Comply with manufacturer's published instructions, recommendations, applicable electrical codes and the contract drawings.

B. Reference Standards:

1. Switchboards and Accessories: Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NEMA PB 2.1.
2. SPD, comply with NECA 1.
3. Consult Architect for resolution of conflicting requirements.

C. Switchboards shall be installed in a manner to be fully compliant with the seismic restraint requirements of the North Carolina State Building Code. Provide mounting devices and hardware, bracing, fittings, etc. as required for seismic restraint. See Section 26 05 00, Paragraph 1.23 for additional requirements.

D. Special Techniques:

1. Equipment Mounting: Install switchboards on concrete base, 4 inch nominal thickness. Comply with requirements for concrete base specified in Section 26 05 29 "Hangers and Supports for Electrical Systems."

    a. Install conduits entering underneath switchboard, entering under vertical section where conductors will terminate. Install with couplings flush with concrete base. Extend 2 inch above concrete base after switchboard is anchored in place.
    b. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18 inch centers around full perimeter of concrete base.
    c. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
    d. Place and secure anchorage devices. Use setting drawings, templates, diagrams, published instructions, and directions furnished with items to be embedded.
    e. Install anchor bolts to elevations required for proper attachment to switchboards.
    f. Anchor switchboard to building structure at top of switchboard if required or recommended by manufacturer.

2. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, straps and brackets, and temporary blocking of moving parts from switchboard units and components.
3. Operating Instructions: Frame and mount printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.
4. Install filler plates in unused spaces of panel-mounted sections.
5. Install overcurrent protective devices, surge protection devices, and instrumentation.
    a. Set field-adjustable switches and circuit-breaker trip ranges.

E. Tighten accessible bus connections and mechanical fasteners after placing switchboard.

F. Use crimped connectors and splices only. Wire nuts are unacceptable.

G. Upon completion of installation, and prior to final inspection, the Electrical Contractor shall reduce in size the “as-built” single line diagram (riser), frame same under plexiglass, and mount in a conspicuous place adjacent to the switchboard.

## 3.4 CONNECTIONS

A. Bond conduits entering underneath switchboard to equipment ground bus with bonding conductor sized in accordance with NFPA 70.

B. Support and secure conductors within switchboard in accordance with NFPA 70.

C. Extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.

## 3.5 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

B. Switchboard Nameplates: Label each switchboard compartment with nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

D. Mimic Bus:

1. Entire single-line switchboard bus work, as depicted on factory record drawing, on minimum 0.032 inch thick anodized aluminum photoengraved nameplate, located at eye level on front cover of switchboard incoming service section.
2. Entire single-line switchboard bus work, as depicted on factory record drawing, on engraved minimum 0.0625 inch thick laminated-plastic nameplate, located at eye level on front cover of switchboard incoming service section.
3. Continuously integrated mimic bus factory applied to front of switchboard. Arrange in single-line diagram format, using symbols and letter designations consistent with final mimic-bus diagram.
4. Coordinate mimic-bus segments with devices in switchboard sections to which they are applied. Produce concise visual presentation of principal switchboard components and connections.
5. Presentation Media: Painted graphics in color contrasting with background color to represent bus and components, complete with lettered designations.

E. Service Equipment Label: Labeled, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

## 3.6 FIELD QUALITY CONTROL

A. Field inspection, testing and adjusting shall be as required under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Standard factory tests shall be performed on the equipment under this section. All tests shall be in accordance with the latest version of UL, IEEE, and NEMA standards.

C. Perform the following field tests and inspections with the assistance of a factory-authorized service representative.

1. Compare equipment nameplate data for compliance with Drawings and Specifications.
2. Inspect anchorage, alignment, grounding, and clearances.
3. Verify that electrical wiring installation complies with manufacturer's written installation requirements.

D. Tests and Inspections:

1. Acceptance Testing:

   a. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit. Open control and metering circuits within switchboard, and remove neutral connection to surge protection and other electronic devices prior to insulation test. Reconnect after test.
   b. Test continuity of each circuit.

2. Test ground-fault protection of equipment for service equipment in accordance with NFPA 70.

3. Provide performance testing of arc energy reduction systems as required by NEC Art. 240.87(C).
4. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
5. Correct malfunctioning units on-site where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
6. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

E. Nonconforming Work:

1. Switchboard will be considered defective if it does not pass tests and inspections.
2. An SPD will be considered defective if it does not pass tests and inspections.
3. Remove and replace defective units and retest.

F. Collect, assemble, and submit test and inspection reports, including certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

## 3.7 STARTUP SERVICE

A. Complete startup checks according to manufacturer's written instructions.

B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests, and reconnect them immediately after the testing is over.

C. Energize SPDs after power system has been energized, stabilized, and tested.

## 3.8 ADJUSTING

A. Testing, Adjusting, and Balancing: Adjust installed work under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

C. Tighten bolted bus connections in accordance with manufacturer’s instructions.

D. Adjust circuit breaker trip and time delay settings to values as required by the Coordination Study. Prior to final settings, adjust circuit breaker trip and time delay settings to minimum values that do not cause false tripping.

## 3.9 CLEANING

A. Clean installed work under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Cleaning: Vacuum dirt and debris from switchboard interior; do not use compressed air to assist in cleaning.

C. Touch up scratched or marred surfaces to match original finish.

## 3.10 PROTECTION

A. Temporary Heating: Apply temporary heat, to maintain temperature in accordance with manufacturer's published instructions, until switchboard is ready to be energized and placed into service.

**END OF SECTION**

# SECTION 26 24 16 – PANELBOARDS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Distribution Panelboards.
2. Branch Circuit Panelboards.

B. Related Requirements:

1. Section 26 05 00 "General Electrical" specifies additional abbreviations, definitions, submittals, qualifications, testing agencies, and other requirements applicable to the Work for electrical, communications, and electronic safety and security systems on Project, including wiring methods.
2. Section 26 05 26 “Grounding and Bonding”.
3. Section 26 05 29 "Hangers and Supports for Electrical Systems" specifies concrete bases and supports for panelboards installed by this Section.
4. Section 26 05 53 "Identification for Electrical Systems" specifies electrical equipment labels and warning signs installed by this Section.
5. Section 26 05 73 "Power System Studies" specifies short-circuit current studies, overcurrent protective device coordination studies, and arc-flash hazard analysis studies.
6. Section 26 28 13 "Fuses" specifies fuses and spare-fuse cabinets installed by this Section.
7. Section 26 43 13 "Surge Protective Devices for Low-Voltage Electrical Power Circuits" specifies Type 1 and Type 2 surge protective devices installed by this Section.

C. References:

1. NECA Standard of Installation (published by the National Electrical Contractors Association).
2. NEMA AB1 - Molded Case Circuit Breakers.
3. NEMA ICS 2 - Industrial Control Devices, Controllers and Assemblies.
4. NEMA KS1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
5. NEMA PB 1 - Panelboards.
6. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
7. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment (published by the International Electrical Testing Association).
8. NFPA 70 - National Electrical Code.

## 1.2 DEFINITIONS

A. MCCB: Molded-case circuit breaker.

B. VPR: Voltage protection rating.

## 1.3 ACTION SUBMITTALS

A. Submittals: Procedures for submittals. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Submit manufacturer's installation instructions. Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

## 1.4 INFORMATIONAL SUBMITTALS

A. Submittals: Submittals for information. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Submit manufacturer's installation instructions. Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

## 1.5 CLOSEOUT SUBMITTALS

A. Contract Closeout: Submittals for project closeout. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Record actual locations of panelboards and record actual circuiting arrangements in project record documents.

C. Maintenance Data: Include spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

D. Warranty documentation.

## 1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Contract Closeout. As required under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Furnish two of each panelboard key.

## 1.7 QUALIFICATIONS

A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.

C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

## 1.8 REGULATORY REGUIREMENTS

A. Conform to requirements of NFPA 70.

B. Products: 3rd Party Listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

## 1.9 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

B. Handle and prepare panelboards for installation in accordance with NEMA PB 1.

## 1.10 MAINTENANCE MATERIALS

A. Contract Closeout. As required under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Furnish two of each panelboard key.

# PART 2 - PRODUCTS

## 2.1 DISTRIBUTION PANELBOARDS

A. Manufacturers:

1. ABB.
2. Eaton.
3. Siemens.
4. Square D Schneider.
5. Substitutions: As permitted in relevant sections of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Description: NEMA PB 1, circuit breaker type.

C. Service Conditions:

1. Temperature: 104º F. (40º C.).
2. Altitude: N/A.
3. Terminal Rating: 75º C. minimum.

D. Panelboard Bus: Copper, ratings as indicated. Provide 100% copper ground and neutrals buses in each panelboard. Provide insulated ground bus where scheduled. Provide 200% copper neutral bus in each panelboard fed by a K rated transformer.

E. Minimum integrated short circuit rating: 10,000 amperes rms symmetrical for 208 volt panelboards; 30,000 amperes rms symmetrical for 480 volt panelboards, or as indicated.

F. Circuit Breakers: NEMA AB 1, bolt-on or plug-on (Square D I-Line and similar only) type.

1. Circuit breakers in distribution panelboards shall be fully rated.
2. Solid-state Trip Molded Case Main and Branch Circuit Breakers (where required by Coordination Study): Panel mounted, NEMA AB 1, with electronic sensing, timing and tripping circuits for adjustable current settings. Electronic trip units shall be provided with external, permanently-mounted power supplies in the gear where required to program trip units while the breakers are deenergized. Trip units shall be field-programmable with an internal display for programming and display and have:

    a. Adjustable instantaneous trip.
    b. Adjustable long time pickup and delay.
    c. Adjustable short time pickup and delay.
    d. Ground fault pickup and delay.
    e. Arc flash reduction mode with external switch and indicator (1,200A and larger).
    f. Include shunt trip, undervoltage release, and other accessories where indicated.
    g. Display line currents and cause of trip.

3. Conventional Thermal Magnetic Molded Case Branch Circuit Breakers: Circuit breakers with integral thermal and instantaneous magnetic trip in each pole.
4. Circuit Breaker Accessories: Trip units and auxiliary switches as indicated.

G. Enclosure: NEMA PB 1, Type 1 or Type 3R, cabinet box.

H. Cabinet Front: Flush and Surface cabinet front door-in-door type with concealed trim clamps, concealed hinge, metal directory frame, and flush lock all keyed alike. Finish in manufacturer’s standard gray enamel. Distribution panelboards larger than 400 amperes are not required to have door-in-door trims.

## 2.2 BRANCH CIRCUIT PANELBOARDS

A. Manufacturers:

1. ABB.
2. Eaton.
3. Siemens.
4. Square D Schneider.
5. Substitutions: As permitted in relevant sections of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Description: NEMA PB1, circuit breaker type, lighting and appliance branch circuit panelboard.

C. Service Conditions:

1. Temperature: 104º F. (40º C.).
2. Altitude: N/A.
3. Terminal Rating: 75º C. minimum.

D. Panelboard Bus: Copper, ratings as indicated. Provide 100% copper ground and neutrals buses in each panelboard. Provide 200% copper neutral bus where indicated. Provide insulated ground bus where scheduled. Provide 200% copper neutral bus in each panelboard fed by a K rated transformer.

E. Minimum Integrated Short Circuit Rating: 10,000 amperes rms symmetrical for 208 volt panelboards; 14,000 amperes rms symmetrical for 480 volt panelboards, or as indicated.

F. Circuit Breakers: NEMA AB 1, bolt-on type.

1. Circuit breakers in branch circuit panelboards shall be fully rated.
2. Solid-state Trip Molded Case Main Circuit Breakers (where required by Coordination Study): Panel mounted, NEMA AB 1, with electronic sensing, timing and tripping circuits for adjustable current settings. Electronic trip units shall be provided with external, permanently-mounted power supplies in the gear where required to program trip units while the breakers are deenergized. Trip units shall be field-programmable with an internal display for programming and display and have:

    a. Adjustable instantaneous trip.
    b. Adjustable long time pickup and delay.
    c. Adjustable short time pickup and delay.
    d. Ground fault pickup and delay.
    e. Arc flash reduction mode with external switch and indicator.
    f. Include shunt trip, undervoltage release, and other accessories where indicated.
    g. Display line currents and cause of trip.

3. Conventional Thermal Magnetic Molded Case Branch Circuit Breakers: Thermal magnetic trip circuit breakers, with common trip handle for all poles, listed as

Type SWD for lighting circuits and Class A ground fault interrupter circuit breakers where scheduled. Do not use tandem circuit breakers.

4. Conventional Thermal Magnetic Current Limiting Molded Case Branch Circuit Breakers: Circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole. Interrupting rating 100,000 symmetrical amperes, let-through current and energy level less than permitted for same size Class RK-5 fuse.
5. Circuit Breaker Accessories: Trip units and auxiliary switches as indicated.

G. Enclosure: NEMA PB 1, Type 1 or Type 3R.

H. Cabinet Box: 6 inches deep, 20 inches wide for 240 volt and less panelboards, 24 inches wide for 480 volt panelboards.

I. Cabinet Front: Flush and Surface cabinet front door-in-door type with concealed trim clamps, concealed hinge, metal directory frame, and flush lock all keyed alike. Finish in manufacturer's standard gray enamel.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.

B. Receive, inspect, handle, and store panelboards in accordance with NECA 407 and NEMA PB 1.1.

C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.

D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

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

### 3.2 INSTALLATION

A. Install panelboards in accordance with NEMA PB 1.1 and the NECA "Standard of Installation."

B. Install panelboards plumb. Install recessed panelboards flush with wall finishes.

C. Panelboards shall be installed in a manner to be fully compliant with the seismic restraint requirements of the North Carolina State Building Code. Provide mounting devices and hardware, bracing, fittings, etc. as required for seismic restraint. See Section 26 05 00, Paragraph 1.23 for additional requirements.

D. Height: 6 feet to top of panelboard; install panelboards taller than 6 feet with bottom no more than 4 inches above floor.

E. Provide filler plates for unused spaces in panelboards.

F. Provide typed circuit directory for each branch circuit panelboard. Final typed panelboard directories installed in the panelboard door pocket shall include final actual room names and numbers in addition to the general description shown on the panel schedules on the drawings. Revise directory to reflect circuiting changes required to balance phase loads.

G. Provide engraved plastic nameplates under the provisions of Section 26 05 53.

H. Provide spare conduits out of each recessed panelboard to an accessible location above ceiling and below floor. Minimum spare conduits: 5 empty 1 inch. Identify each as SPARE.

I. Ground and bond panelboard enclosures according to Section 26 05 26.

J. Bond grounding terminal buses of the normal and essential branch circuit panelboards in accordance with NEC Art. 517.14.

## 3.3 FIELD QUALITY CONTROL

A. Quality Control: Field inspection, testing and adjusting shall be as required under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Inspect and test in accordance with NETA ATS, except Section 4, or provide for qualified technicians to perform testing according to the manufacturer's recommendations.

## 3.4 ADJUSTING

A. Contract Closeout: Adjust installed work as required under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Cleaning: Vacuum dirt and debris from panelboard tubs; do not use compressed air to assist in cleaning.

C. Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.

D. Adjust circuit breaker trip and time delay settings to values as required by the Coordination Study. Prior to final settings, adjust circuit breaker trip and time delay settings to minimum values that do not cause false tripping.

## 3.5 PROTECTION

A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature in accordance with manufacturer's published instructions.

**END OF SECTION**

# SECTION 26 24 21 - UTILITY SERVICE ENTRANCE

## PART 1 - GENERAL

### 1.1 SECTION INCLUDES

Coordination with the serving electrical utility company.

### 1.2 RELATED SECTIONS

Not used.

### 1.3 REFERENCES

A. NECA Standard of Installation (National Electrical Contractors Association).

B. NFPA 70 - National Electrical Code.

### 1.4 SYSTEM DESCRIPTION

System Characteristics: 480Y/277 volts, three phase, four-wire, 60 Hertz.

### 1.5 SUBMITTALS FOR REVIEW

Not used.

### 1.6 SUBMITTALS FOR INFORMATION

Not used.

### 1.7 QUALITY ASSURANCE

A. Utility Company: Brunswick Electric Membership Cooperative, Shallotte, NC.

B. Perform Work in accordance with Utility Company requirements.

### 1.8 REGULATORY REQUIREMENTS

Conform to requirements of NFPA 70.

### 1.9 PRE-INSTALLATION MEETING

Convene one week prior to commencing work of this section. Review service entrance requirements and details with Utility Company representative. Notify the Architect/Engineer at least seven days prior to the scheduled meeting. Provide written meeting minutes to the Architect/Engineer.

## PART 2 - PRODUCTS

Not used.

## PART 3 - EXECUTION

### 3.1 PREPARATION

Coordinate with Utility Company and assist the Owner in obtaining permanent electric service to the Project. Utility Company fees will be paid by the Owner.

### 3.2 INSTALLATION

Install transformer pad, service conductors, raceways and metering equipment as required by Utility Company.

**END OF SECTION**

# SECTION 26 27 26 - WIRING DEVICES

## PART 1 - GENERAL

### 1.1 SECTION INCLUDES

A. Wall switches.

B. Wall box dimmers.

C. Receptacles.

D. Wall plates.

### 1.2 DESCRIPTION

Provide wiring devices in types, characteristics, grades, colors and electrical ratings for applications indicated which are UL listed and which comply with NEMA WD 1 and other applicable UL, NEMA and DSCC (Fed Spec) standards.

### 1.3 REFERENCES

A. NECA - Standard of Installation.

B. NEMA WD 1 - General Requirements for Wiring Devices.

C. NEMA WD 6 - Wiring Device - Dimensional Requirements.

D. NFPA 70 - National Electrical Code.

E. Underwriters Laboratories (UL 20, 244A, 498, 514C, 1472).

F. DSCC (Fed Spec) W-C-596G

### 1.4 SUBMITTALS FOR REVIEW

A. Submittals: Procedures for submittals. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Product Data: Provide manufacturer’s catalog information showing dimensions, colors, and configurations.

## 1.5 SUBMITTALS FOR INFORMATION

A. Submittals: Submittals for information. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Submit manufacturer's wiring and installation instructions.

C. Product Data: Catalog cut sheets with performance specifications demonstrating compliance with specified requirements.

## 1.6 QUALIFICATIONS

Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum 10 years documented experience.

## 1.7 WARRANTY

Provide manufacturer's full 1 year warranty minimum, unless specified otherwise.

## 1.8 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.

B. Provide Products listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

# PART 2 - PRODUCTS

## 2.1 WALL SWITCHES

A. Manufacturers:

1. Hubbell Model HBL1221 Series.
2. Leviton 1221.
3. Pass and Seymour PS20AC1.
4. Substitutions: Refer to provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Description: NEMA WD 1, UL, DSCC, heavy-duty, AC only, general-use, grounding type, back and side wired, single pole, three-way and four-way as indicated, snap switch with hex-head equipment grounding screw. Switches shall have a steel, nickel plated bridge with integral ground, one piece rivetless copper alloy spring contact arm and terminal plate and large silver cadmium oxide contacts. All switches shall have quiet operating mechanisms without the use of mercury switches. All switches shall be approved by a third party agency, approved for the voltage and current indicated.

C. Body and Handle: White plastic with toggle handle.

D. Indicator Light: Neon lighted handle type switch; red color handle. Voltage per system rating.

E. Locator Light: Neon lighted handle type switch; green color handle. Voltage per system rating.

F. Ratings:

1. Voltage: 120-277 volts AC.
2. Current: 20 amperes.

## 2.2 WALL BOX LED DIMMERS

A. Manufacturers:

1. Lutron Nova T dimmer and switch.
2. Leviton.
3. Arrow Hart.
4. Substitutions: Refer to provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Description: Solid-state electronic (0-10V) dimmers; high end minimum of 92% of line voltage; provide voltage compensation to assure flicker free dimming through common voltage variations.

C. Body and Handle: White plastic with preset slider.

D. Voltage: 120/277 volts.

E. Rating: Match load shown on drawings.

## 2.3 RECEPTACLES

A. Manufacturers:

1. Hubbell Model HBL 5362.
2. Leviton 5362.
3. Pass and Seymour 5362A.
4. Substitutions: Refer to provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Description: NEMA WD 1, UL, DSCC, heavy-duty, 20 ampere, 120 volt, general use, duplex, straight blade, grounding type receptacle arranged for back and side wiring, with separate single or double grounding terminals. Receptacles shall have a full wrap around brass bridge with integral ground and standup double wipe contacts. Self grounding or automatic type grounding receptacles are not acceptable in lieu of receptacles with

separate grounding screw lugs and a direct, green insulated conductor connection to the equipment grounding system.

C. Device Face and Body: White nylon or reinforced thermoplastic.

D. Configuration: NEMA WD 6, type as specified and indicated.

E. Convenience Receptacle: Type 5-20R.

## 2.4 HOSPITAL-GRADE RECEPTACLES (provide in all patient care areas)

A. Manufacturers:

1. Hubbell Model HBL 8300.
2. Leviton 8300.
3. Pass and Seymour 8300.
4. Substitutions: Refer to provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Hospital-Grade, Duplex Receptacles, 125V, 20A:

1. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap. Two pole, three wire, and self-grounding.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Standards: Comply with UL 498 Supplement sd and FS W-C-596.
4. Marking: Listed and labeled as complying with NFPA 70, "Health Care Facilities" Article.

## 2.5 GROUND FAULT CIRCUIT INTERRUPTERS (GFI)

A. Manufacturers:

1. Hubbell Model GFR8300.
2. Leviton.
3. Pass and Seymour.
4. Substitutions: Refer to provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Description: NEMA WD 1, UL, DSCC, heavy-duty, 20 ampere, 120 volt, general use, duplex, straight blade, grounding type receptacle arranged for back and side wiring, with separate single or double grounding terminals. Receptacles shall have a full wrap around brass bridge with integral ground and standup double wipe contacts. The electronic component’s circuit board shall be all glass with a conformal coating. Self grounding or automatic type grounding receptacles are not acceptable in lieu of receptacles with separate grounding screw lugs and a direct, green insulated conductor connection to the equipment grounding system.

C. Device Face and Body: White nylon or reinforced thermoplastic.

D. Configuration: NEMA WD 6, type as specified and indicated.

E. Convenience Receptacle: Type 5-20R.

## 2.6 WALL PLATES

A. Manufacturers:

1. Hubbell.
2. Leviton.
3. Pass and Seymour.
4. Substitutions: Refer to provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Device Plates: Single and combination, of types, sizes and with ganging and cutouts as indicated. Provide plates which mate and match with wiring devices to which attached. Material shall be smooth, 0.04” thick, type 302 Stainless Steel as manufactured by the device vendor. For devices supplied by the essential power system, material shall be red smooth nylon as manufactured by the device vendor.

C. Weatherproof Cover Plate: Exterior mounted receptacles, and those noted to be weatherproof, shall be provided with weatherproof PVC transparent cover plates, standard size, and shall be single or ganged as indicated on the contract drawings. Weatherproof plates shall be third party listed as “raintight while in use”.

# PART 3 - EXECUTION

## 3.1 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes, and do not cut holes for boxes with routers that are guided by riding against outside of boxes.

2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.

3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.

4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall comply with NFPA 70, Article 300, without pigtails.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the left.
2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.

F. Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan-speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device, listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

I. Adjust locations of floor service outlets to suit arrangement of partitions and furnishings.

## 3.2 GFCI RECEPTACLES

A. Install non-feed-through GFCI receptacles where protection of downstream receptacles is not required.

## 3.3 IDENTIFICATION

A. Comply with Section 26 05 53 "Identification for Electrical Systems."

B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

C. Essential Electrical System: Mark receptacles supplied from the essential electrical system to allow easy identification using a self-adhesive label.

## 3.4 FIELD QUALITY CONTROL

A. Test Instruments: Use instruments that comply with UL 1436.

B. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

C. Perform the following tests and inspections:

1. In healthcare facilities, prepare reports that comply with NFPA 99.
2. Test Instruments: Use instruments that comply with UL 1436.
3. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

D. Tests for Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault-current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

E. Test straight-blade convenience outlets in patient-care areas and hospital-grade outlets for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 oz. (115 g).

F. Wiring device will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

**END OF SECTION**

# SECTION 26 27 27 - OCCUPANCY SENSORS

## PART 1 - GENERAL

### 1.1 SECTION INCLUDES

Wall box and remote sensor type occupancy sensors and accessories.

### 1.2 REFERENCES

A. NECA - Standard of Installation.

B. NEMA WD 1 - General Requirements for Wiring Devices.

C. NEMA WD 6 - Wiring Device -- Dimensional Requirements.

D. NFPA 70 - National Electrical Code.

### 1.4 SUBMITTALS FOR REVIEW

A. Submittals: Procedures for submittals. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, ratings and configurations.

### 1.5 SUBMITTALS FOR INFORMATION

A. Submittals: Submittals for information. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Submit manufacturer's installation instructions.

### 1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

### 1.7 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.

B. Provide Products listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

## PART 2 - PRODUCTS

### 2.1 GENERAL

A. The Occupancy Sensor system shall sense the presence of human activity within the spaces indicated and fully control the “On” / “Off” function of the lighting loads automatically. Sensors shall turn “On” the load upon entrance into the room and shall not initiate “On” outside of entrance.

B. Acceptable technology is Passive Infrared (PIR), Ultrasonic and Microphonic. Dual Technology is required utilizing PIR and one of the other technologies.

C. Occupancy sensors shall have a minimum of 2 contacts (1 will be utilized for HVAC control).

D. Occupancy sensors shall be field convertible to operate in either the occupancy or vacancy mode.

E. Sensors shall automatically adjust time delays and sensitivity based on the activity level in the space.

F. All line voltage devices shall be UL Listed under Energy Management Equipment, or Industrial Control Equipment. UL Listing under Appliance Control shall not be accepted.

G. Product shall be manufactured in the USA and be warranted for 5 years.

### 2.2 WALL SWITCH LINE & LOW VOLTAGE SENSORS FOR SMALL AREAS

A. Description: Line and Low voltage, single gang, wall mounted occupancy sensor switch with one override or two (as shown) switch(es). Switch shall recess into single gang switch box and fit a standard GFI receptacle plate opening. Switches shall be compatible with standard three and four-way toggle switches. The low voltage device shall operate in conjunction with a line voltage power pack to control the connected lighting loads. All switches shall be approved by a third party agency, approved for the voltage and current indicated. Provide hard lens switches in storage rooms and other location subject to abuse.

B. Manufacturers

1. Hubbell.
2. Sensor Switch.
3. Wattstopper.
4. Substitutions: Refer to provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

C. Body and Handle: White or gray plastic.

D. Ratings:
Voltage: 120-277 volts AC.
Minimum Load Rating: 800 watts at 120 VAC, 1200 watts at 277 VAC. Sensors shall be compatible with LED lighting load types and require no minimum load

## 2.3 CEILING MOUNTED LOW VOLTAGE SENSORS FOR LARGE AREAS

A. Sensor Switches: Low voltage, recess ceiling mounted occupancy sensor switch. The device shall operate in conjunction with a line voltage power pack to control the connected lighting loads. Sensors shall operate on a class 2, three-conductor system. Multiple sensors shall be connectable to a single power pack. Sensor shall recess into a two gang outlet box. All devices shall be approved by a third party agency, approved for the voltage and current indicated.
Manufacturers:

1. Hubbell.
2. Sensor Switch.
3. Wattstopper.
4. Substitutions: Refer to provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Control units/Power packs: Devices shall be rated 20A at 120-277 volts and shall be compatible with LED lighting. They shall have the capacity to power additional remote heads or additional relays. Control relays may be paralleled to accommodate extra load or more than three heads or additional relays. Additional relay shall be used where there is more than one circuit being controlled or where there is a need to control multiple voltages.
Manufacturers:

1. Hubbell.
2. Sensor Switch.
3. Wattstopper.
4. Substitutions: Refer to provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

C. Sensor Body: White plastic.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. Ensure that outlet boxes are installed at proper height.

B. Ensure that wall openings are neatly cut and will be completely covered by wall plates.

C. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

## 3.2 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean debris from outlet boxes.

## 3.3 INSTALLATION

A. Install in accordance with NECA "Standard of Installation."

B. Install in locations in accordance with manufacturers recommendation.

C. Install devices vertically, plumb and level.

D. Connect wiring device grounding terminal to branch circuit equipment grounding conductor.

## 3.4 INTERFACE WITH OTHER PRODUCTS

A. Coordinate locations of outlet boxes provided under Section 26 05 34 to obtain mounting heights specified and indicated on drawings.

B. All wiring devices shall be installed at heights as required by the A.D.A.

C. Install wall switch 48 inches (1.2 m) above finished floor, measured to bottom of outlet box.

## 3.5 FIELD QUALITY CONTROL

A. Quality Control. As required under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Inspect each wiring device for defects.

C. Operate each system with circuit energized and verify proper operation.

## 3.6 ADJUSTING

A. Contract Closeout: Adjust installed work under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Adjust devices and wall plates to be flush and level.

## 3.7 CLEANING

A. Contract Closeout: Clean installed work under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Clean exposed surfaces to remove splatters and restore finish.

**END OF SECTION**

# SECTION 26 28 13 - FUSES

## PART 1 - GENERAL

### 1.1 SECTION INCLUDES

A. Fuses.

### 1.2 REFERENCES

A. NFPA 70 - National Electric Code.

B. NEMA FU 1 - Low Voltage Cartridge Fuses.

### 1.3 SUBMITTALS

A. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Product Data: Provide data sheets showing electrical characteristics including time-current curves.

### 1.4 PROJECT RECORD DOCUMENTS

A. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Record actual fuse sizes.

### 1.5 QUALIFICATIONS

Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

### 1.6 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.

B. Furnish products listed and classified by testing firm acceptable to authority having jurisdiction as suitable for purpose specified and indicated.

### 1.7 EXTRA MATERIALS

A. Provide no less than 10% of each fuse size and type installed, with a minimum of at least one set of three of each.

## PART 2 - PRODUCTS

### 2.1 FUSE REQUIREMENTS

A. Dimensions and Performance: NEMA FU 1, Class as specified or indicated.

B. Voltage: Provide fuses with voltage rating suitable for circuit phase-to-phase voltage.

C. UL Listed.

| | Circuit Type | Fuse type |
|---|---|---|
| 1. | Service Entrance and Feeder Circuits over 600Amp 200K Amp interrupting rating. | Class L |
| 2. | Service Entrance and Feeder Circuits 600Amp or less 200K Amp interrupting rating. | Class RK1 or J |
| 3. | Motor, Motor Controller and Transformer Circuits 200K Amp interrupting rating. | RK5 |

D. For individual equipment where fault current does not exceed 50KA use Class K5 fuses with 50KA interrupting rating.

E. Fusible safety switches with short-circuit withstand ratings of 100KA or 200KA require Class R or Class J rejection fuse block feature.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Install fuses in accordance with manufacturer’s instructions.

B. Install fuse with label oriented such that manufacturer, type, and size are easily read.

**END OF SECTION**

# SECTION 26 28 16 - ENCLOSED SWITCHES

## PART 1 - GENERAL

### 1.1 SECTION INCLUDES

A. Fusible switches.

B. Nonfusible switches.

### 1.2 RELATED SECTIONS

A. Section 26 05 29 – Supporting Devices.

B. Section 26 05 53 – Electrical Identification.

C. Section 26 28 13 – Fuses.

### 1.3 REFERENCES

A. NECA - Standard of Installation (published by the National Electrical Contractors Association).

B. NEMA FU1 - Low Voltage Cartridge Fuses.

C. NEMA KS1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

D. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems (published by the International Electrical Testing Association).

E. NFPA 70 - National Electrical Code.

### 1.4 SUBMITTALS FOR REVIEW

A. Submittals: Procedures for submittals. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Product Data: Provide switch ratings and enclosure dimensions.

### 1.5 SUBMITTALS FOR CLOSEOUT

A. Contract Closeout: Submittals for project closeout. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Record actual locations of enclosed switches in project record documents.

## 1.6 QUALIFICATIONS

Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

## 1.7 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.

B. Products: Listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

# PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

A. ABB.
B. Eaton.
C. Siemens.
D. Schneider/Square D.
E. Substitutions: As permitted in relevant sections of the General and Supplemental General Conditions and Division 1 Specifications Sections.

## 2.2 RATINGS

A. Service Conditions:

1. Temperature: 104°F. (40°C.).
2. Altitude: N/A.
3. Terminal Rating: 75°C. minimum.

B. Minimum Integrated Short Circuit Rating: 10,000 amperes rms symmetrical, or as indicated.

## 2.3 FUSIBLE SWITCH ASSEMBLIES

A. Description: NEMA KS 1, Type HD with externally operable handle interlocked (defeatable) to prevent opening front cover with switch in ON position, enclosed load interrupter knife switch. Mechanisms shall be non-teasible, positive, quick make-quick break type. Handle lockable in ON or OFF position. Switches shall have handles whose positions are easily recognizable in the ON or OFF position.

B. Fuse clips: Designed to accommodate NEMA FU1, Class R fuses.

## 2.4 NONFUSIBLE SWITCH ASSEMBLIES

Description: NEMA KS 1, Type HD with externally operable handle interlocked (defeatable) to prevent opening front cover with switch in ON position, enclosed load interrupter knife switch. Mechanisms shall be non-teasible, positive, quick make-quick break type. Handle lockable in ON or OFF position. Switches shall have handles whose positions are easily recognizable in the ON or OFF position.

## 2.5 ENCLOSURES

A. Fabrication: NEMA KS 1.

1. Interior Dry Locations: Type 1.
2. Exterior Locations: Type 3R.

# PART 3 - EXECUTION

## 3.1 INSTALLATION

A. Install in accordance with NECA “Standard of Installation”.

B. Switches shall be installed in a manner to be fully compliant with the seismic restraint requirements of the North Carolina State Building Code. Provide mounting devices and hardware, bracing, fittings, etc. as required for seismic restraint. See Section 26 05 00, Paragraph 1.22 for additional requirements.

C. Install fuses in fusible disconnect switches serving Division 26 equipment.

D. Apply adhesive tag on inside door of each fused switch indicating NEMA fuse class and size installed.

## 3.2 FIELD QUALITY CONTROL

A. Quality Control: Field inspection, testing and adjusting as required under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Inspect and test in accordance with NETA ATS, except Section 4, or provide for qualified technicians to perform testing according to the manufacturer’s recommendations.

**END OF SECTION**

# SECTION 26 28 17 - ENCLOSED CIRCUIT BREAKERS

## PART 1 - GENERAL

### 1.1 SECTION INCLUDES

Enclosed circuit breakers.

### 1.2 RELATED WORK

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

B. Section 26 05 26 - Grounding and Bonding.

C. Section 26 05 29 - Supporting Devices.

D. Section 26 05 53 - Electrical Identification.

### 1.3 REFERENCES

A. NECA (National Electrical Contractors Association) “Standard of Installation”.

B. NEMA AB 1 - Molded Case Circuit Breakers

C. NFPA 70 - National Electrical Code.

### 1.4 SUBMITTALS

A. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Product Data: Provide catalog sheets showing ratings, trip units, time current curves, dimensions, and enclosure details.

C. Manufacturer’s Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

### 1.5 QUALITY ASSURANCE

A. Perform Work in accordance with NECA Standard of Installation.

B. Maintain one copy of each document on site.

## 1.6 QUALIFICATIONS

Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

## 1.7 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.

**1.8** Furnish products listed and classified by testing firm acceptable to authority having jurisdiction as suitable for purpose specified and indicated.

## 1.9 EXTRA MATERIALS

A. Furnish under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Provide three of each size and type current limiter.

# PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

A. ABB.
B. Eaton.
C. Siemens.
D. Schneider/Square D.
E. Substitutions: As permitted in relevant sections of the General and Supplemental General Conditions and Division 1 Specifications Sections.

## 2.2 MOLDED CASE CIRCUIT BREAKER

A. Circuit Breaker: NEMA AB 1, bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles, listed as Type SWD for lighting circuits, Class A ground fault interrupter circuit breakers where scheduled.

B. Service Conditions:
   1. Temperature: 104º F. (40º C.).
   2. Altitude: N/A.
   3. Terminal Rating: 75º C. minimum.

C. Minimum Integrated Short Circuit Rating: 30,000 amperes rms symmetrical, or as indicated.

D. Where required by the Coordination Study, enclosed circuit breakers shall be solid state trip molded or insulated case type with electronic sensing, timing and tripping circuits for adjustable current settings. Electronic trip units shall be provided with external, permanently-mounted power supplies in the gear where required to program trip units while the breakers are deenergized. Trip units shall be field-programmable with an internal display for programming and display and have:

1. Adjustable instantaneous trip.
2. Adjustable long time pickup and delay.
3. Adjustable short time pickup and delay.

4. Arc energy reduction mode with external switch and indicator (all 1200A and larger circuit breakers in compliance with NEC Art. 240.87).
5. Include shunt trip, undervoltage release, and other accessories where indicated.
6. Display line currents and cause of trip.

## 2.3 PRODUCT OPTIONS AND FEATURES (as specified and as applicable)

A. Provide accessories as scheduled, to NEMA AB 1.

B. Shunt Trip Device: 120 volts AC.

C. Undervoltage Trip Device: 120 volts AC.

D. Auxiliary Switch: 120 volts AC.

E. Alarm Switch: 120 volts AC.

F. Electrical Operator: 120 volts AC.

G. Handle Lock: Include provisions for padlocking.

H. Provide mechanical trip device.

I. Provide insulated grounding lug in each enclosure.

## 2.4 ENCLOSURE

A. Enclosure: NEMA AB 1, Type 1 and 3R, as indicated.

B. Fabricate enclosure from steel.

C. Finish using manufacturer’s standard enamel finish, gray color.

# PART 3 - EXECUTION

## 3.1 INSTALLATION

A. Install enclosed circuit breakers where indicated, in accordance with manufacturer’s instructions.

B. Install enclosed circuit breakers plumb. Provide supports in accordance with Section 26 05 29.

C. Equipment shall be installed in a manner to be fully compliant with the seismic restraint requirements of the North Carolina State Building Code. Provide mounting devices and

hardware, bracing, fittings, etc. as required for seismic restraint. See Section 26 05 00, Paragraph 1.23 for additional requirements.

D. Height: 5 feet AFF to operating handle.

E. Provide engraved plastic nameplates under the provisions of Section 26 05 53.

## 3.2 FIELD QUALITY CONTROL

A. Field inspection and testing shall be performed under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Inspect and test each circuit breaker to NEMA AB 1.

C. Inspect each circuit breaker visually.

D. Perform several mechanical ON-OFF operations on each circuit breaker.

E. Verify circuit continuity on each pole in closed position.

F. Determine that circuit breaker will trip on overcurrent condition, with tripping time to NEMA AB 1 requirements.

G. Include description of testing and results in test report.

## 3.3 ADJUSTING

A. Adjust work under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Adjust circuit breaker trip and time delay settings to values as required by the Coordination Study. Prior to final settings, adjust circuit breaker trip and time delay settings to minimum values that do not cause false tripping.

**END OF SECTION**

# SECTION 26 29 13.03 - MANUAL AND MAGNETIC MOTOR 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 this Section.

### 1.2 SUMMARY

A. Section Includes:

1. Manual motor controllers.
2. Enclosed full-voltage magnetic motor controllers.
3. Combination full-voltage magnetic motor controllers.
4. Enclosures.
5. Accessories.
6. Identification.

B. Related Requirements:

Section 26 28 13 “Fuses” specifies fuses referenced by this Section.

C. References:

1. NECA (National Electrical Contractors Association) -Standard of Installation.
2. NEMA AB 1 (National Electrical Manufacturers Association) - Molded Case Circuit Breakers.
3. NEMA FU 1 (National Electrical Manufacturers Association) - Fuses.
4. NEMA ICS 2 (National Electrical Manufacturers Association) - Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated Not More Than 2000 Volts AC or 750 Volts DC.
5. NEMA ICS 5 (National Electrical Manufacturers Association) - Industrial Control and Systems: Control Circuit and Pilot Devices.
6. NEMA ICS 6 (National Electrical Manufacturers Association) - Industrial Control and Systems: Enclosures.
7. NEMA KS 1 (National Electrical Manufacturers Association) - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

### 1.3 DEFINITIONS

A. CPT: Control power transformer.

B. MCCB: Molded-case circuit breaker.

C. MCP: Motor circuit protector.

D. NC: Normally closed.

E. OCPD: Overcurrent protective device.

F. SCCR: Short-circuit current rating.

G. SCPD: Short-circuit protective device.

## 1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For each type of magnetic controller.

1. Include plans, elevations, sections, and mounting details.
2. Indicate dimensions, weights, required clearances, and location and size of each field connection.
3. Wire Termination Diagrams and Schedules: Include diagrams for signal, and control wiring. Identify terminals and wiring designations and color-codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features. Differentiate between manufacturer-installed and field-installed wiring.
4. Include features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

C. Product Schedule: List the following for each enclosed controller:

1. Each installed magnetic controller type.
2. NRTL listing.
3. Factory-installed accessories.
4. Nameplate legends.
5. SCCR of integrated unit.
6. For each combination magnetic controller include features, characteristics, ratings, and factory setting of the SCPD and OCPD.

    a. Listing document proving Type 2 coordination.

7. For each series-rated combination state the listed integrated short-circuit current (withstand) rating of SCPD and OCPDs by an NRTL acceptable to authorities having jurisdiction.

## 1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Seismic Qualification Data: Certificates, for magnetic controllers, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

## 1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For magnetic controllers to include in operation and maintenance manuals.

1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:

a. Routine maintenance requirements for magnetic controllers and installed components.
b. Manufacturer's written instructions for testing and adjusting circuit breaker and MCP trip settings.
c. Manufacturer's written instructions for setting field-adjustable overload relays.
d. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.
e. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor-running overload protection suit actual motors to be protected.

## 1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: Accredited by NETA.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

## 1.8 DELIVERY, STORAGE, AND HANDLING

A. Store controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.

B. If stored in areas subject to weather, cover controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install temporary electric heating, with at least 50 W per controller.

## 1.9 FIELD CONDITIONS

A. Ambient Environment Ratings: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than23 deg F and not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet for electromagnetic and manual devices.
3. The effect of solar radiation is not significant.

# PART 2 - PRODUCTS

## 2.1 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 use.

B. UL Compliance: Fabricate and label magnetic motor controllers to comply with UL 508 and UL 60947-4-1.

C. NEMA Compliance: Fabricate motor controllers to comply with ICS 2.

D. Seismic Performance: Magnetic controllers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the controller will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
2. Component Importance Factor: 1.5.

## 2.2 MANUAL MOTOR CONTROLLERS

A. Motor-Starting Switches (MSS): "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off or on.

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

a. ABB, Motion Business.
b. Eaton.
c. Siemens Industry, Inc., Energy Management Division.
d. Square D; Schneider Electric USA.

2. Standard: Comply with NEMA ICS 2, general purpose, Class A.
3. Surface mounting.
4. Red pilot light.

B. Fractional Horsepower Manual Controllers (FHPMC): "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.

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

   a. ABB, Motion Business.
   b. Eaton.
   c. Siemens Industry, Inc., Energy Management Division.
   d. Square D; Schneider Electric USA.

2. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push button; bimetallic type.
3. Overload Relays: NEMA ICS 2, bimetallic class as schedule on Drawings.
4. Pilot Light: Red.

C. Integral Horsepower Manual Controllers (IHPMC): "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.

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

   a. ABB, Motion Business.
   b. Eaton.
   c. Siemens Industry, Inc., Energy Management Division.
   d. Square D; Schneider Electric USA.

2. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push button; bimetallic type.
3. Overload Relays: NEMA ICS 2, bimetallic class as scheduled on Drawings.

## 2.3 ENCLOSED FULL-VOLTAGE MAGNETIC MOTOR CONTROLLERS

A. Description: Across-the-line start, electrically held, for nominal system voltage of 600-V ac and less.

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

1. ABB, Motion Business.
2. Eaton.
3. Siemens Industry, Inc., Energy Management Division.
4. Square D; Schneider Electric USA.

C. Standard: Comply with NEMA ICS 2, general purpose, Class A.

D. Configuration: Nonreversing.

E. Contactor Coils: Pressure-encapsulated type.

1. Operating Voltage: Manufacturer's standard, unless indicated.

F. Control Power:

1. For on-board control power, obtain from line circuit or from integral CPT. The CPT shall have capacity to operate integral devices and remotely located pilot, indicating, and control devices.

G. Overload Relays:

1. Thermal Overload Relays:

a. Inverse-time-current characteristic.
b. Class 10 tripping characteristic.
c. Heaters in each phase shall be matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
d. Ambient compensated.
e. Automatic resetting.

## 2.4 COMBINATION FULL-VOLTAGE MAGNETIC MOTOR CONTROLLER

A. Description: Factory-assembled, combination full-voltage magnetic motor controller consisting of the controller described in this article, indicated disconnecting means, SCPD and OCPD, in a single enclosure.

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

1. ABB, Motion Business.
2. Eaton.
3. Siemens Industry, Inc., Energy Management Division.
4. Square D; Schneider Electric USA.

C. Standard: Comply with NEMA ICS 2, general purpose, Class A.

D. Configuration: Nonreversing.

E. Contactor Coils: Pressure-encapsulated type.

1. Operating Voltage: Manufacturer's standard, unless indicated.

F. Control Power:

1. For on-board control power, obtain from line circuit or from integral CPT. The CPT shall have capacity to operate integral devices and remotely located pilot, indicating, and control devices.

G. Overload Relays:

1. Thermal Overload Relays:

a. Inverse-time-current characteristic.
b. Class 10 tripping characteristic.
c. Heaters in each phase shall be matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
d. Ambient compensated.
e. Automatic resetting.

H. Class II ground-fault protection shall comply with UL 1053 to interrupt low-level ground faults. The ground-fault detection system shall include circuitry that will prevent the motor controller from tripping when the fault current exceeds the interrupting capacity of the controller. Equip with start and run delays to prevent nuisance trip on starting, and a trip indicator.

I. Digital communication module, using RS-485 Modbus, RTU protocol, 2-wire connection to host devices with a compatible port to transmit the following to the LAN:

1. Instantaneous rms current each phase, and 3-phase average.
2. Voltage: L-L for each phase, L-L 3-phase average, L-N each phase and L-N 3-phase average - rms.
3. Active Energy (kWh): 3-phase total.

J. Fusible Disconnecting Means:

1. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate indicated fuses.
2. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

K. Nonfusible Disconnecting Means:

1. NEMA KS 1, heavy-duty, horsepower-rated, nonfusible switch.
2. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

L. MCP Disconnecting Means:

1. UL 489 and NEMA AB 3, with interrupting capacity to comply with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
2. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

M. MCCB Disconnecting Means:

1. UL 489 and NEMA AB 3, with interrupting capacity to comply with available fault currents; thermal-magnetic MCCB, with inverse-time-current element for low-level overloads and instantaneous magnetic trip element for short circuits.
2. Front-mounted, adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
3. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

## 2.5 ENCLOSURES

A. Comply with NEMA 250, Type 4X as indicated on Drawings, complying with environmental conditions at installed location.

B. The construction of the enclosures shall comply with NEMA ICS 6.

C. Controllers in hazardous (classified) locations shall comply with UL 1203.

## 2.6 ACCESSORIES

A. General Requirements for Control Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.

1. Push Buttons, Pilot Lights, and Selector Switches: Standard-duty, except as needed to match enclosure type. Heavy-duty or oil-tight where indicated in the controller schedule.

    a. Push Buttons: As indicated in the controller schedule.
    b. Pilot Lights: As indicated in the controller schedule.

## 2.7 IDENTIFICATION

A. Controller Nameplates: Laminated acrylic or melamine plastic signs, as described in Section 26 05 53 "Identification for Electrical Systems," for each compartment, mounted with corrosion-resistant screws.

B. Arc-Flash Warning Labels:

1. Comply with requirements in Section 26 05 73 "Power System Studies." Produce a 3.5-by-5-inch self-adhesive equipment label for each work location included in the analysis.
2. Comply with requirements in Section 26 05 53 "Identification for Electrical Systems." Produce a 3.5-by-5-inch self-adhesive equipment label for each work location included in the analysis. Labels shall be machine printed, with no field-applied markings.

a. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:

1) Location designation.
2) Nominal voltage.
3) Flash protection boundary.
4) Hazard risk category.
5) Incident energy.
6) Working distance.
7) Engineering report number, revision number, and issue date.

b. Labels shall be machine printed, with no field-applied markings.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine areas and space conditions for compliance with requirements for motor controllers, their relationship with the motors, and other conditions affecting performance of the Work.

### 3.2 INSTALLATION

A. Comply with NECA 1.

B. Wall-Mounted Controllers: Install magnetic controllers on walls with tops at uniform height indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Section 26 05 29 "Hangers and Supports for Electrical Systems" unless otherwise indicated.

C. Floor-Mounted Controllers: Install controllers on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 03 30 00 "Cast-in-Place Concrete."

D. Comply with requirements for seismic control devices specified in Section 26 05 48.16 "Seismic Controls for Electrical Systems."

E. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and NFPA 70.

F. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

G. Setting of Overload Relays: Select and set overloads on the basis of full-load current rating as shown on motor nameplate. Adjust setting value for special motors as required by NFPA 70 for motors that are high-torque, high-efficiency, and so on.

## 3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

## 3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

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

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections with the assistance of a factory-authorized service representative.

E. Tests and Inspections:

1. Comply with the provisions of NFPA 70B, "Testing and Test Methods" Chapter.
2. Visual and Mechanical Inspection:

    a. Compare equipment nameplate data with drawings and specifications.
    b. Inspect physical and mechanical condition.
    c. Inspect anchorage, alignment, and grounding.
    d. Verify the unit is clean.
    e. Inspect contactors:

        1) Verify mechanical operation.
        2) Verify contact gap, wipe, alignment, and pressure are according to manufacturer's published data.

    f. Motor-Running Protection:

        1) Verify overload element rating is correct for its application.
        2) If motor-running protection is provided by fuses, verify correct fuse rating.

    g. Inspect bolted electrical connections for high resistance using one of the two following methods:

1) Use a low-resistance ohmmeter. Compare bolted connection resistance values with values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data or NETA ATS Table 100.12. Bolt-torque levels shall be according to manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.

h. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.

3. Electrical Tests:

a. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Insulation-resistance values shall be according to manufacturer's published data or NETA ATS Table 100.1. In the absence of manufacturer's published data, use Table 100.5. Values of insulation resistance less than those of this table or manufacturer's recommendations shall be investigated and corrected.
b. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
c. Test motor protection devices according to manufacturer's published data.
d. Test circuit breakers as follows:

1) Operate the circuit breaker to ensure smooth operation.
2) For adjustable circuit breakers, adjust protective device settings according to the coordination study. Comply with coordination study recommendations.

e. Perform operational tests by initiating control devices.

4. Infrared Inspection: Perform the survey during periods of maximum possible loading. Remove all necessary covers prior to the inspection.

a. Comply with the recommendations of NFPA 70B, "Testing and Test Methods" Chapter, "Infrared Inspection" Article.
b. After Substantial Completion, but not more than 60 days after Final Acceptance, perform infrared inspection of the electrical power connections of each motor controller.
c. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each motor controller 11 months after date of Substantial Completion.
d. Report of Infrared Inspection: Prepare a certified report that identifies the testing technician and equipment used, and lists the following results:

1) Description of equipment to be tested.
2) Discrepancies.

3) Temperature difference between the area of concern and the reference area.
4) Probable cause of temperature difference.
5) Areas inspected. Identify inaccessible and unobservable areas and equipment.
6) Load conditions at time of inspection.
7) Photographs and thermograms of the deficient area.
8) Recommended action.

e. Equipment: Inspect distribution systems with imaging equipment capable of detecting a minimum temperature difference of 1 deg C at 30 deg C. The equipment shall detect emitted radiation and convert detected radiation to a visual signal.

f. Act on inspection results and recommended action, and considering the recommendations of NETA ATS, Table 100.18. Correct possible and probable deficiencies as soon as Owner's operations permit. Retest until deficiencies are corrected.

F. Motor controller will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

## 3.5 SYSTEM FUNCTION TESTS

A. System function tests shall prove the correct interaction of sensing, processing, and action devices. Perform system function tests after field quality control tests have been completed and all components have passed specified tests.

1. Develop test parameters and perform tests for the purpose of evaluating performance of integral components and their functioning as a complete unit within design requirements and manufacturer's published data.
2. Verify the correct operation of interlock safety devices for fail-safe functions in addition to design function.
3. Verify the correct operation of sensing devices, alarms, and indicating devices.

B. Motor controller will be considered defective if it does not pass the system function tests and inspections.

C. Prepare test and inspection reports.

## 3.6 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain electrical equipment.

**END OF SECTION**

# SECTION 26 29 23 - VARIABLE-FREQUENCY MOTOR CONTROLLERS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section includes separately enclosed, preassembled, combination VFCs, rated 600 V and less, for speed control of three-phase, squirrel-cage induction motors.

B. Related Requirements:
1. Section 26 05 26 "Grounding and Bonding for Electrical Systems" specifies grounding and bonding referenced by this Section.
2. Section 26 05 29 "Hangers and Supports for Electrical Systems" specifies hangers, supports, and concrete bases referenced by this Section.
3. Section 26 05 53 "Identification for Electrical Systems" specifies electrical equipment labels and warning signs referenced by this Section.
4. Section 26 28 13 “Fuses” specifies fuses referenced by this Section.

### 1.2 DEFINITIONS

A. BAS: Building automation system.

B. CPT: Control power transformer.

C. DDC: Direct digital control.

D. EMI: Electromagnetic interference.

E. LAN: Local area network.

F. LED: Light-emitting diode.

G. NC: Normally closed.

H. NO: Normally open.

I. OCPD: Overcurrent protective device.

J. PID: Control action, proportional plus integral plus derivative.

K. RFI: Radio-frequency interference.

L. TDD: Total demand (harmonic current) distortion.

M. THD(V): Total harmonic voltage demand.

N. VFC: Variable-frequency motor controller.

## 1.3 ACTION SUBMITTALS

A. Product Data: For each type and rating of VFC indicated.

1. Include dimensions and finishes for VFCs.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For each VFC indicated.

1. Include mounting and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

## 1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Required working clearances and required area above and around VFCs.
2. Show VFC layout and relationships between electrical components and adjacent structural and mechanical elements.
3. Show support locations, type of support, and weight on each support.
4. Indicate field measurements.

B. Qualification Data: For testing agency.

C. Seismic Qualification Data: Certificates, for each VFC, accessories, and components, from manufacturer.

1. Certificate of compliance.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based, and their installation requirements.

D. Product Certificates: For each VFC from manufacturer.

E. Harmonic Analysis Report: Provide Project-specific calculations and manufacturer's statement of compliance with IEEE 519.

F. Source quality-control reports.

G. Field quality-control reports.

H. Sample Warranty: For special warranty.

## 1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For VFCs to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:

    a. Manufacturer's written instructions for testing and adjusting thermal-magnetic circuit breaker and motor-circuit protector trip settings.
    b. Manufacturer's written instructions for setting field-adjustable overload relays.
    c. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
    d. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.
    e. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor-running overload protection suit actual motors to be protected.

## 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. Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
3. Indicating Lights: Two of each type and color installed.
4. Auxiliary Contacts: Furnish one spare(s) for each size and type of magnetic controller installed.
5. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

## 1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: Accredited by NETA.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

2. 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.
3. Comply with NFPA 70.
4. IEEE Compliance: Fabricate and test VFC according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

## 1.8 DELIVERY, STORAGE, AND HANDLING

A. If stored in space that is not permanently enclosed and air conditioned, remove loose packing and flammable materials from inside controllers and install temporary electric heating, with at least 250 W per controller.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for VFCs, including clearances between VFCs, and adjacent surfaces and other items.

## 1.9 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation, capable of driving full load without derating, under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than 14 deg F (minus 10 deg C) and not exceeding 104 deg F (40 deg C).
2. Ambient Storage Temperature: Not less than minus 4 deg F (minus 20 deg C) and not exceeding 140 deg F (60 deg C)
3. Humidity: Less than 95 percent (noncondensing).
4. Altitude: Not exceeding 100 feet.
5. Provide sealed and gasketed NEMA 4X enclosures in outdoor locations.

## 1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace VFCs that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Final Acceptance.

# PART 2 - PRODUCTS

## 2.1 VARIABLE-FREQUENCY MOTOR CONTROLLERS

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

1. Eaton.
2. General Electric Company; GE Consumer & Industrial.
3. Rockwell Automation, Inc.
4. Schneider Electric USA, Inc.
5. Siemens Industry, Inc., Building Technologies Division.

## 2.2 SYSTEM DESCRIPTION

A. General Requirements for VFCs:

1. VFCs and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with NEMA ICS 7 and NEMA ICS 61800-2.

B. Application: Variable torque for compressors, fans and pumps.

C. VFC Description: Variable-frequency motor controller, consisting of power converter that employs pulse-width-modulated inverter, factory built and tested in an enclosure, with integral disconnecting means and overcurrent and overload protection; listed and labeled by an NRTL as a complete unit; arranged to provide self-protection, protection, and variable-speed control of one or more three-phase induction motors by adjusting output voltage and frequency.

1. Units suitable for operation of inverter-duty motors as defined by NEMA MG 1, Section IV, Part 31, "Definite-Purpose Inverter-Fed Polyphase Motors."
2. Listed and labeled for integrated short-circuit current (withstand) rating by an NRTL acceptable to authorities having jurisdiction.

D. Design and Rating: Match load type, such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.

E. Output Rating: Three phase; 10 to 60 Hz, with voltage proportional to frequency throughout voltage range; maximum voltage equals input voltage.

F. Unit Operating Requirements:

1. Input AC Voltage Tolerance: Plus 10 and minus 10 percent of VFC input voltage rating.
2. Input AC Voltage Unbalance: Not exceeding 5 percent.
3. Input Frequency Tolerance: Plus or minus 3 percent of VFC frequency rating.
4. Minimum Efficiency: 96 percent at 60 Hz, full load.
5. Minimum Displacement Primary-Side Power Factor: 96 percent under any load or speed condition.
6. Minimum Short-Circuit Current (Withstand) Rating: 22 kA.
7. Ambient Temperature Rating: Not less than 32 deg F and not exceeding 104 deg F.
8. Humidity Rating: Less than 95 percent (noncondensing).
9. Altitude Rating: Not exceeding 3300 feet.

10. Vibration Withstand: Comply with NEMA ICS 61800-2.
11. Overload Capability: 1.1 times the base load current for 60 seconds; minimum of 1.8 times the base load current for three seconds.
12. Starting Torque: Minimum 100 percent of rated torque from 3 to 60 Hz.
13. Speed Regulation: Plus or minus 5 percent.
14. Output Carrier Frequency: Selectable; 0.5 to 15 kHz.
15. Stop Modes: Programmable; includes fast, free-wheel, and dc injection braking.

G. Inverter Logic: Microprocessor based.

H. Isolated Control Interface: Allows VFCs to follow remote-control signal over a minimum 40:1 speed range.

1. Signal: Electrical.

I. Internal Adjustability Capabilities:

1. Minimum Speed: 5 to 25 percent of maximum rpm.
2. Maximum Speed: 80 to 100 percent of maximum rpm.
3. Acceleration: 0.1 to 999.9 seconds.
4. Deceleration: 0.1 to 999.9 seconds.
5. Current Limit: 30 to minimum of 150 percent of maximum rating.

J. Self-Protection and Reliability Features:

1. Surge Suppression: Factory installed as an integral part of the VFC, complying with UL 1449 SPD, Type 1 or Type 2.
2. Loss of Input Signal Protection: Selectable response strategy, including speed default to a percent of the most recent speed, a preset speed, or stop; with alarm.
3. Under- and overvoltage trips.
4. Inverter overcurrent trips.
5. VFC and Motor-Overload/Overtemperature Protection: Microprocessor-based thermal protection system for monitoring VFCs and motor thermal characteristics, and for providing VFC overtemperature and motor-overload alarm and trip; settings selectable via the keypad.
6. Critical frequency rejection, with three selectable, adjustable deadbands.
7. Instantaneous line-to-line and line-to-ground overcurrent trips.
8. Loss-of-phase protection.
9. Reverse-phase protection.
10. Short-circuit protection.
11. Motor-overtemperature fault.

K. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts.

L. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped, unless "Bidirectional Autospeed Search" feature is available and engaged.

M. Bidirectional Autospeed Search: Capable of starting VFC into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to drive, motor, or load.

N. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.

O. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.

P. Integral Input Disconnecting Means and OCPD: NEMA KS 1, fusible switch with pad-lockable, door-mounted handle mechanism.

1. Disconnect Rating: Not less than 115 percent of NFPA 70 motor full-load current rating or VFC input current rating, whichever is larger.
2. Auxiliary Contacts: NO or NC, arranged to activate before switch blades open.
3. Auxiliary contacts "a" and "b" arranged to activate with circuit-breaker handle.

## 2.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: VFCs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7. The designated VFCs shall be tested and certified by an NRTL as meeting the ICC-ES AC 156 test procedure requirements.

1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

## 2.4 CONTROLS AND INDICATION

A. Status Lights: Door-mounted LED indicators displaying the following conditions:

1. Power on.
2. Run.
3. Overvoltage.
4. Line fault.
5. Overcurrent.
6. External fault.

B. Panel-Mounted Operator Station: Manufacturer's standard front-accessible, sealed keypad and plain-English-language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.

1. Keypad: In addition to required programming and control keys, include keys for HAND, OFF, and AUTO modes.
2. Security Access: Provide electronic security access to controls through identification and password with at least three levels of access: View only; view and operate; and view, operate, and service.

    a. Control Authority: Supports at least four conditions: Off, local manual control at VFC, local automatic control at VFC, and automatic control through a remote source.

C. Historical Logging Information and Displays:

1. Real-time clock with current time and date.
2. Running log of total power versus time.
3. Total run time.
4. Fault log, maintaining last four faults with time and date stamp for each.

D. Indicating Devices: Digital display mounted flush in VFC door and connected to display VFC parameters including, but not limited to:

1. Output frequency (Hz).
2. Motor speed (rpm).
3. Motor status (running, stop, fault).
4. Motor current (amperes).
5. Motor torque (percent).
6. Fault or alarming status (code).
7. PID feedback signal (percent).
8. DC-link voltage (V dc).
9. Set point frequency (Hz).
10. Motor output voltage (V ac).

E. Control Signal Interfaces:

1. Electric Input Signal Interface:

    a. A minimum of six multifunction programmable digital inputs.

2. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the DDC system for HVAC or other control systems:

    a. 0- to 10-V dc.
    b. 4- to 20-mA dc.
    c. Potentiometer using up/down digital inputs.
    d. Fixed frequencies using digital inputs.

3. Output Signal Interface: A minimum of one programmable analog output signal(s) (0- to 10-V dc), which can be configured for any of the following:

    a. Output frequency (Hz).
    b. Output current (load).

c. DC-link voltage (V dc).
d. Motor torque (percent).
e. Motor speed (rpm).
f. Set point frequency (Hz).

4. Remote Indication Interface: A minimum of two programmable dry-circuit relay outputs (120-V ac, 1 A) for remote indication of the following:

a. Motor running.
b. Set point speed reached.
c. Fault and warning indication (overtemperature or overcurrent).
d. PID high- or low-speed limits reached.

F. PID Control Interface: Provides closed-loop set point, differential feedback control in response to dual feedback signals. Allows for closed-loop control of fans and pumps for pressure, flow, or temperature regulation.

1. Number of Loops: As required. Coordinate with other trades.

G. Coordination with Division 17 Life Support Systems Automation: Coordinate VFD control with Division 17 requirements.

H. Interface with DDC System for HVAC: Factory-installed hardware and software shall interface with DDC system for HVAC to monitor, control, display, and record data for use in processing reports. VFC settings shall be retained within VFC's nonvolatile memory.

1. Hardwired Points:

a. Monitoring: On-off status, as required. Coordinate with other trades.
b. Control: On-off operation, as required. Coordinate with other trades.

2. Communication Interface: Comply with ASHRAE 135. Communication shall interface with DDC system for HVAC to remotely control and monitor lighting from a DDC system for HVAC operator workstation. Control features and monitoring points displayed locally at lighting panel shall be available through the DDC system for HVAC.

## 2.5 LINE CONDITIONING AND FILTERING

A. Input Line Conditioning: Provide input filtering, as required, to limit THD(V) at input terminals of all VFCs to less than 5 percent.

B. Output Filtering: Provide output reactors for motor loads with more than 75 feet of feeder conductor length from the VFD output terminals to the motor terminal box or local disconnecting means.

C. EMI/RFI Filtering:

1. CE marked; certify compliance with IEC 61800-3.

## 2.6 BYPASS SYSTEMS (when required by other trades)

A. Bypass Operation: Safely transfers motor between power converter output and bypass circuit, manually, automatically, or both. Selector switches set modes and indicator lights indicate mode selected. Unit is capable of stable operation (starting, stopping, and running) with motor completely disconnected from power converter.

B. Bypass Mode:

1. Manual operation only; requires local operator selection at VFC. Transfer between power converter and bypass contactor, and retransfer shall only be allowed with the motor at zero speed.
2. Field-selectable automatic or manual, allows local and remote transfer between power converter and bypass contactor and retransfer, either via manual operator interface or automatic-control system feedback.

C. Bypass Controller:

1. Two-Contactor-Style Bypass: Two-contactor-style bypass allows motor operation via the power converter or the bypass controller; with input isolating switch and barrier arranged to isolate the power converter and permit safe troubleshooting and testing, both energized and de-energized, while motor is operating in bypass mode.

    a. Bypass Contactor: Load-break, NEMA-rated contactor.
    b. Output Isolating Contactor: Non-load-break, NEMA-rated contactor.
    c. Isolating Switch: Non-load-break switch arranged to isolate power converter and permit safe troubleshooting and testing of the power converter, both energized and de-energized, while motor is operating in bypass mode; pad-lockable, door-mounted handle mechanism.

D. Bypass Contactor Configuration: Full-voltage (across-the-line) type.

1. NORMAL/BYPASS selector switch.
2. HAND/OFF/AUTO selector switch.
3. NORMAL/TEST Selector Switch: Allows testing and adjusting of VFC while the motor is running in the bypass mode.
4. Contactor Coils: Pressure-encapsulated type with coil transient suppressors.

    a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.
    b. Power Contacts: Totally enclosed, double break, and silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.

5. Control Circuits: 120-V ac; obtained from integral CPT, with primary and secondary fuses, of sufficient capacity to operate all integral devices and remotely located pilot, indicating, and control devices.

    a. CPT Spare Capacity: 50 VA.

6. Overload Relays: Integral VFD overload protection.

E. Damper control circuit with end-of-travel feedback capability.

F. Sleep Function: Senses a minimal deviation of a feedback signal and stops the motor. On an increase in speed-command signal deviation, VFC resumes normal operation.

G. Motor Preheat Function: Preheats motor when idle to prevent moisture accumulation in the motor.

H. Remote Indicating Circuit Terminals: Mode selection, controller status, and controller fault.

I. Remote digital operator kit.

J. Communication Port: RS-232 port, USB 2.0 port, or equivalent connection capable of connecting a printer and a notebook computer.

## 2.7 ENCLOSURES

A. VFC Enclosures: NEMA 250, to comply with environmental conditions at installed location.

1. Dry and Clean Indoor Locations: Type 1.
2. Outdoor Locations: Type 4X.

B. Plenum Rating: UL 1995; NRTL certification label on enclosure, clearly identifying VFC as "Plenum Rated."

## 2.8 ACCESSORIES

A. General Requirements for Control-Circuit and Pilot Devices: NEMA ICS 5; factory installed in VFC enclosure cover unless otherwise indicated.

1. Push Buttons: Covered.
2. Pilot Lights: Push to test.
3. Selector Switches: Rotary type.
4. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory-applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.

B. Reversible NC/NO bypass contactor auxiliary contact(s).

C. Control Relays: Auxiliary and adjustable solid-state time-delay relays.

D. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage protection via VFD onboard voltage protection.

E. Breather and drain assemblies, to maintain interior pressure and release condensation in NEMA 250, Type 4X enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.

F. Space heaters, with NC auxiliary contacts, to mitigate condensation in NEMA 250, Type 4X enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.

G. Cooling Fan and Exhaust System: For NEMA 250,Type NEMA-4X; UL 508 component recognized: Supply fan, with composite intake and exhaust grills and filters; 120-V ac; obtained from integral CPT.

H. Sun shields installed on fronts, sides, and tops of enclosures installed outdoors and subject to direct and extended sun exposure.

I. Spare control-wiring terminal blocks; wired.

## 2.9 SOURCE QUALITY CONTROL

A. Testing: Test and inspect VFCs according to requirements in NEMA ICS 61800-2.

1. Test each VFC while connected to its specified motor.
2. Verification of Performance: Rate VFCs according to operation of functions and features specified.

B. VFCs will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

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

B. Examine VFC before installation. Reject VFCs that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFC installation.

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

## 3.2 INSTALLATION

A. Coordinate layout and installation of VFCs with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Wall-Mounting Controllers: Install with tops at uniform height and with disconnect operating handles not higher than 79 inches above finished floor, unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not on walls, provide freestanding racks complying with Section 26 05 29 "Hangers and Supports for Electrical Systems."

C. Floor-Mounting Controllers: Install VFCs on 4-inch nominal thickness concrete base. Comply with requirements for concrete base specified in Section 03 30 00 "Cast-in-Place Concrete."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.

D. Roof-Mounting Controllers: Install VFC on roofs with tops at uniform height and with disconnect operating handles not higher than 79 inches above finished roof surface unless otherwise indicated, and by bolting units to curbs or mounting on freestanding, lightweight, structural-steel channels bolted to curbs. Seal roof penetrations after raceways are installed.

1. Curbs and roof penetrations are specified in Section 07 72 00 "Roof Accessories."
2. Structural-steel channels are specified in Section 26 05 29 "Hangers and Supports for Electrical Systems."

E. Equipment shall be installed in a manner to be fully compliant with the seismic restraint requirements of the North Carolina State Building Code. Comply with mounting and anchoring requirements specified in Section 26 05 48 "Vibration and Seismic Controls for Electrical Systems." See Section 26 00 10 “Supplemental Requirements for Electrical”, Paragraph 1.25 for additional requirements.

F. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

G. Install fuses in each fusible-switch VFC.

H. Install fuses in control circuits if not factory installed. Comply with requirements in Section 26 28 13 "Fuses."

I. Install heaters in thermal-overload relays. Select heaters based on actual nameplate full-load amperes after motors are installed.

J. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.

K. Comply with NECA 1.

L. Install wiring from VFC to motor in conduit and locate the VFC within ten (10) feet and within sight of the motor.

## 3.3 CONTROL WIRING INSTALLATION

A. Install wiring between VFCs and remote devices and facility's central-control system. Comply with requirements in Section 26 05 23 "Control-Voltage Electrical Power Cables."

B. Bundle, train, and support wiring in enclosures.

C. Connect selector switches and other automatic-control devices where applicable.

1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switches are in manual-control position.
2. Connect selector switches with control circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor-overload protectors.

## 3.4 IDENTIFICATION

A. Identify VFCs, components, and control wiring. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each VFC with engraved nameplate.
3. Label each enclosure-mounted control and pilot device.

B. Operating Instructions: Frame printed operating instructions for VFCs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFC units.

## 3.5 FIELD QUALITY CONTROL

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

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections with the assistance of a factory-authorized service representative.

D. Acceptance Testing Preparation:

1. Test insulation resistance for each VFC element, bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

E. Tests and Inspections:

1. Inspect VFC, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
2. Test insulation resistance for each VFC element, component, connecting motor supply, feeder, and control circuits.
3. Test continuity of each circuit.
4. Verify that voltages at VFC locations are within 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Architect before starting the motor(s).
5. Test each motor for proper phase rotation.
6. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
7. Perform the following infrared (thermographic) scan tests and inspections, and prepare reports:

    a. Initial Infrared Scanning: After Final Acceptance, but not more than 60 days after Final Acceptance, perform an infrared scan of each VFC. Remove front panels so joints and connections are accessible to portable scanner.
    b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each VFC 11 months after date of Final Acceptance.
    c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

8. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. VFCs will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies the VFC and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

## 3.6 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

## 3.7 ADJUSTING

A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.

B. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

C. Adjust the trip settings of instantaneous-only circuit breakers and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to 6 times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed 8 times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Architect before increasing settings.

D. Set field-adjustable circuit-breaker trip ranges as specified in Section 26 05 73 "Power System Studies."

E. Set field-adjustable pressure switches.

## 3.8 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until controllers are ready to be energized and placed into service.

B. Replace VFCs whose interiors have been exposed to water or other liquids prior to Final Acceptance.

## 3.9 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, reprogram, and maintain VFCs.

**END OF SECTION**

# SECTION 26 32 13 – PACKAGED ENGINE-GENERATOR SYSTEM

## PART 1 - GENERAL

### 1.1 SECTION INCLUDES

This Section includes a packaged, outdoor, engine-generator set for Level 1 emergency power supply with the following:

A. Packaged engine-generator set.

B. Exhaust silencer and fittings.

C. Battery.

D. Remote annunciator(s).

E. Weather-protective, sound-attenuating enclosure.

F. Sub-base fuel tank.

G. Access stairs and platforms, if required.

### 1.2 RELATED SECTIONS

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

B. Section 26 05 26 - Grounding and Bonding.

C. Section 26 05 29 Supporting Devices.

D. Section 26 05 53 - Electrical Identification.

E. Section 26 36 00 - Automatic Transfer Switches.

F. Section 26 56 50 – Electrical Systems Commissioning.

### 1.3 REFERENCES

A. NEMA AB1 - Molded Case Circuit Breakers.

B. NEMA MG1 - Motors and Generators.

C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum.)

D. NFPA 30 - Flammable and Combustible Liquids Code.

E. NFPA 37 - Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines

F. NFPA 70 - National Electrical Code.

G. NFPA 101 - Life Safety Code.

H. NFPA 110 - Emergency and Standby Power Systems.

## 1.4 SUBMITTALS

A. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Shop Drawings: Indicate electrical characteristics and connection requirements. Show plan and elevation views with overall and interconnection point dimensions, fuel consumption rate curves at various loads, ventilation and combustion air requirements, electrical diagrams including schematic and interconnection diagrams.

C. Product Data: Provide data showing dimensions, weights, ratings, interconnection points, and internal wiring diagrams for engine, generator, control panel, battery, battery rack, exhaust silencer, vibration isolators, sub-base fuel tank, weather protective housing, remote annunciator, etc.

Provide:

1. A complete Bill of Materials for all components.
2. Dimensioned plan and elevation drawings of the engine-generator set.
3. Dimensioned plan and elevation drawings of the sub-base fuel tank.
4. Dimensioned plan and elevation drawings of the gen set enclosure. Provide dimensions from the centerline of the top control panel switch and the output circuit breaker handle(s).
5. Dimensioned plan, details and elevation drawings and proposed materials of the access platform and stairs, if required.

D. Test Reports: Indicate results of performance testing.

E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

F. Manufacturer's Certificate: Certify that Products meet or exceed specified requirements.

G. Manufacturer's Field Reports: Indicate procedures and findings.

## 1.5 OPERATION AND MAINTENANCE DATA

A. Operation Data: Include instructions for normal operation.

B. Maintenance Data: Include instructions for routine maintenance requirements, service manuals for engine and day tank, oil sampling and analysis for engine wear, and emergency maintenance procedures.

C. Maintain one copy of document on site.

## 1.6 QUALITY ASSURANCE

Perform Work in accordance with NFPA 110.

## 1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience, and with service facilities within 100 miles of Project.

B. Supplier: Authorized distributor of specified manufacturer with minimum three years documented experience.

## 1.8 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70, NFPA 101 and NFPA 110.

B. Equipment shall be UL 2200 listed.

C. Furnish Products listed and classified by testing firm acceptable to authority having jurisdiction as suitable for purpose specified and indicated.

## 1.9 DELIVERY, STORAGE, AND HANDLING

A. Accept unit on site on skids. Inspect for damage.

B. Protect equipment from dirt and moisture by securely wrapping in heavy plastic.

## 1.10 MAINTENANCE SERVICE

Furnish service and maintenance, at manufacturer-recommended intervals, of engine-generator set for one year from Date of Substantial Completion.

## 1.11 MAINTENANCE MATERIALS

Furnish one set of tools required for preventative maintenance of the engine-generator

system. Package tools in adequately sized metal tool box.

### 1.12 EXTRA MATERIALS

Provide two of each fuel oil and air filter element.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Caterpillar.

B. Cummins.

C. MTU.

D. Substitutions: Under provisions of relevant sections of the General and Supplemental General Conditions and Division 1 Specifications Sections.

### 2.2 PACKAGED ENGINE-GENERATOR SYSTEM

A. Description: NFPA 110, standby rated, engine-generator system conforming to NFPA 99.

B. Engine-generator set shall provide back-up power for the emergency power distribution system during utility power outage. Power outage sensing, generator starting, transfer of load, re-transfer to normal power and engine cool-down running time shall be completely automated and shall not require attended operation.

C. Minimum System Capacity: 1,500 Kw / 1,875 kVA at elevation of 50 feet above sea level, standby rating using engine-mounted radiator.

### 2.3 ENGINE

A. Type: Water-cooled inline or V-type, two or four stroke compression ignition Diesel engine.

B. Fuel System: No. 2 diesel fuel oil (ASTM D396).

C. Engine speed: Not to exceed 1800 rpm.

D. Governor: Isochronous type to maintain engine speed within 0.25 percent, steady state, and 5 percent, no load to full load, with recovery to steady state within 2 seconds following sudden load changes.

E. Safety Devices: Engine shutdown on high water temperature, low oil pressure,

overspeed, and engine overcrank. Limits as selected by manufacturer.

F. Engine Starting: DC starting system with positive engagement, number and voltage of starter motors in accordance with manufacturer's instructions. Include remote starting control circuit, with MANUAL-OFF-REMOTE selector switch on engine-generator control panel.

G. Engine Jacket Heater: Thermal circulation immersion type water heater with integral thermostatic control, contactor in a NEMA rated enclosure, sized to maintain engine jacket water at 120°F, and suitable for operation on 120 or 208 volts AC as shown. Heater shall be disconnected while the engine is running.

H. Radiator: Provide a closed recovery cooling system with sufficient capacity to cool the engine when the generator set is delivering full rated load at a minimum ambient temperature of 110°F (43°C). Radiator, fan, engine driven centrifugal water pump and thermostatic valve shall be provided and the system protected against freezing and corrosion. Radiator air flow restriction 0.5 inches of water maximum.

I. Engine Accessories: Fuel filter, lube oil filter, intake air filter, lube oil cooler, manual fuel priming pump, fuel shut-off solenoid, gear-driven water pump, a fuel transfer pump (if needed to lift the fuel from the fuel tank) and a replaceable fuel filter element conveniently located for servicing. Include fuel pressure gauge, water temperature gauge, and lube oil pressure gauge on engine/generator control panel.

J. Lubricating System: The engine shall have a lubricating oil pump for supplying oil under pressure to the main bearings, crank pin bearings, pistons, piston pins, timing gears, camshaft bearings and valve rocker mechanism. Full flow oil filters, conveniently located for servicing shall be provided. Lube oil drain extension and valve terminated on the outside of the generator base shall be provided.

K. Mounting: Provide unit with suitable spring-type vibration isolators and mount on structural steel base, which shall allow mounting to a raised concrete pad or to a sub-base fuel tank. Anchor bolts and vibration isolators shall be used to mount the steel base to the concrete pad. Vibration isolators shall be one piece units, resistant to corrosion and environmental degradation. When sub-base fuel tanks are specified, vibration isolators shall be located between the generator set and the sub-base fuel tank.

## 2.4 GENERATOR

A. Generator: NEMA MG1, three phase, four wire, reconnectable brushless synchronous generator with brushless exciter. Generator shall be revolving field type, close coupled or directly coupled to the engine flywheel. The generator shall have a single ball bearing support for the rotor and the rotor shall be dynamically balanced up to 25% overspeed.

B. Standby rating: No less than 1,500 kW / 1,875 kVA at 0.8 power factor, 480/277 volts, 60 Hz at 1800 rpm.

C. Insulation Class: F.

D. Temperature Rise: 105°C Standby.

E. Enclosure: NEMA MG1, open drip proof.

F. Voltage Regulator: Shall be of solid state design and provide voltage-per-hertz operation to match engine and generator characteristics, with voltage regulation plus or minus 1 percent from no load to full load. Steady state voltage modulation shall not exceed one cycle per second. For any addition of load up to and including 90% of rated, the voltage shall recover to and remain within the steady band in not more than 1.5 seconds. Frequency regulation from no load to rated load shall conform with engine governor performance. For any addition of load up to 90% of rated load, the frequency shall recover to the steady state frequency within 5 seconds. Include manual controls to adjust voltage droop, voltage level (plus or minus 5 percent) and voltage gain. Regulator to be mounted on top or side of the generator and enclosed in a NEMA rated enclosure. An isolation transformer in the voltage regulator circuit shall be provided.

G. The minimum rating of the engine-generator set specified in previous paragraphs is estimated. The Contractor shall provide an engine-generator set capable of simultaneous starting and continuous operation, with no greater than twenty (20) percent voltage dip and without set overload, of the loads shown on the Drawings. Provide documentation of set capacity and voltage dip with shop drawings.

## 2.5 ACCESSORIES

A. Skid-Mounted Sub-base Fuel Tank: UL 142 listed, welded steel tank, with fill and vent, minimum capacity 72 hours engine-generator run time at 75% load minimum. The tank shall be factory installed, piped and connected in accordance with the manufacturer's installation instructions, NFPA 37 and the North Carolina State Building and Mechanical Codes. Provide all Code-required accessories. The unit shall have the structural integrity to support the generator set and associated components. It shall include, but not be limited to, the following: heavy gauge steel double wall tank with all welded construction, prime coated and non-corrosive finished gloss black painted outside, 110% primary tank capacity secondary containment, internal baffles to separate hot fuel return from the engine from cooler fuel supplied to the engine, fuel fill containment device, lockable fuel filler cap, low fuel level alarm switch, fuel level gauge, inter-tank leak detection alarm switch, fuel line check valve, tank drains for primary and containment, threaded pipe connections and all other accessories required for proper operation. Normal and emergency venting ports. Tank shall have proper number and size fittings with proper overhead clearance to accommodate the remote fill system, tank probe, and remote vents. Tank shall have a minimum interior height of 18” and shall have a tank extension a minimum of 18” beyond the footprint of the generator and be the full width of the tank. Also, all vents and other required fittings shall be located in this tank extension area with no internal bracing or other interior obstructions below the fill and probe fittings.

B. Vibration Isolation Devices

1. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized-

steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.

2. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic restraint.

    1) Housing: Steel with resilient vertical-limit stops to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to 1/4-inch thick, elastomeric isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
    2) Outside Spring Diameter: Not less than 80 percent of compressed height of the spring at rated load.
    3) Minimum Additional Travel: 50 percent of required deflection at rated load.
    4) Lateral Stiffness: More than 80 percent of rated vertical stiffness.
    5) Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

C. Exhaust Silencer: Super critical grade silencer to reduce engine exhaust noise in accordance with dBA requirements listed above, with muffler companion flanges and seamless flexible stainless steel exhaust connector, sized in accordance with engine manufacturer's instructions. The silencer shall be all-welded heavy duty carbon steel construction and shall include a compressed thermal/acoustical insulation packed shell. In addition to its acoustical values, the two (2) inch minimum thick packed shell shall be provided to reduce the outer surface temperature.

D. Exhaust Piping: Manufacturer’s standard for factory supplied enclosure.

E. Batteries: Heavy duty, diesel starting type lead-acid storage batteries capable of four 15 second cranks followed by a 15 second rest period at 0°F. Match battery voltage to starting system. Include necessary cables and clamps.

F. Battery Tray: Treated for electrolyte resistance, constructed to contain spillage.

G. Battery Charger: Automatic solid state, current limiting, float equalizing type designed to float at 2.17 volts per cell and equalize at 2.33 volts per cell. Minimum continuous output of 10 amperes DC. Charger shall be capable of recharging a completely discharged battery in a maximum of 8 hours. Include overload protection, voltage surge suppressors, full wave rectifier, DC voltmeter and ammeter, low DC voltage alarm relay, malfunction alarm contact, and 120 volt AC fused input. Provide in NEMA-1 wall mounted enclosure.

H. Remote Emergency Stop Switch: Weatherproof, surface wall mounted, unless otherwise indicated, adjacent to the engine-generator set and labeled with an engraved, three layer, laminated plastic nameplate “GENERATOR EMERGENCY STOP”. Push button shall be protected from accidental operation. See Drawings for location.

I. Line Circuit Breaker: Three molded case circuit breakers on generator output, as shown on the Drawings, with integral solid state LSI trip unit, sized in accordance with NFPA 70. Circuit breaker shall be installed in a separate enclosure. Circuit breakers shall be third party testing agency service entrance rated and labeled. Include battery-voltage operated

shunt trip, connected to open circuit breaker on engine failure. Unit mount in enclosure to meet NEMA 250, Type 1 requirements.

J. Control conductors installed between the transfer equipment and the emergency generator shall be kept entirely independent of all other wiring and shall meet the conditions of NEC Article 700.10(D)(2). The integrity of the generator remote start circuit shall be monitored for broken, disconnected, or shorted wires. Loss of integrity shall start the generator in accordance with NEC Article 700.10 (D)(3). Start-stop controls shall be closed loop and electrically supervised and protected as required by Codes.

K. Engine-Generator Control Panel: NEMA 250, Type 1 generator mounted control panel enclosure with engine and generator controls and indicators. Include provision for padlock and the following equipment and features:

1. Frequency Meter: Digital, 45-65 Hz. range.
2. AC Output Voltmeter: Digital, 2 percent accuracy, with phase selector switch.
3. AC Output Ammeter: Digital, 2 percent accuracy, with phase selector switch.
4. AC wattmeter, digital.
5. Output voltage adjustment.
6. Push-to-test indicator lamps, one each for low oil pressure, high water temperature, over-speed, and over-crank.
7. Engine start/stop selector switch.
8. Engine running time meter.
9. Oil pressure gauge.
10. Water temperature gauge.
11. Auxiliary Relay: 3PDT, operates when engine runs, with contact terminals prewired to terminal strip.
12. Additional visual indicators and alarms as required by NFPA 110.
13. Remote Alarm Contacts: Pre-wire SPDT contacts to terminal strip for remote alarm functions required by NFPA 110 for a Level 1 system.

L. Remote Annunciator Panel: NFPA 110 compliant, flush mounted panel with painted finish and silk screened lettering, in manufacturer's standard color. Provide alarm horn, indicators and alarms and switching as follows:

1. High battery voltage (alarm).
2. Low battery voltage (alarm).
3. Low fuel (alarm).
4. Intertank leakage.
5. Battery charger malfunction.
6. System ready.
7. Anticipatory-high water temperature.
8. Anticipatory-low oil pressure.
9. Low coolant temperature.
10. Mode switch not in auto position (alarm).
11. Over-crank (alarm).
12. Emergency stop (alarm).
13. High water temperature (alarm).
14. Over-speed (alarm).

15. Low oil pressure (alarm).
16. Line power available.
17. Generator power available.
18. Lamp test and horn silence switch.
19. Emergency stop switch.
20. Permanent Emergency Source Out of Service.
21. Additional visual indicators and alarms as required by NFPA 110 for a Level 1 system.

M. Sound attenuated, weather protective enclosure: UL2200 listed, non-walk-in, reinforced, 14-gauge minimum aluminum powder painted housing with locked, hinged side (and end, if required) access panels providing maintenance access to the engine and generator, output circuit breakers, control panel and all service points, with tamper resistant, lockable side and rear doors and panels.

1. Include fixed louvers, battery rack, and internally-mounted silencer. Provide non-hydroscopic sound insulated interior panels with metal perforated skin. Provide thermal Insulation, manufacturer's standard materials and thickness selected in coordination with block heater to maintain winter interior temperature within operating limits required by engine-generator-set components.
2. Enclosures shall be primed and finish painted in a color as selected by the Architect. Hardware, latches and hinges shall be stainless steel. Roof shall be peaked to allow drainage of rain water. Unit shall have sufficient guards to prevent entrance by rodents and small animals.
3. Average sound attenuation shall be Level II (maximum of 73 dbA at 7 meters). Exhaust gasses and cooling air shall be discharged vertically.
4. Provide exterior emergency stop pushbutton and exterior oil and coolant drains with interior valves.
5. Provide a minimum of three watertight, impact-resistant, general illumination, LED lighting fixtures with a minimum 5,000 lumens output each, a weatherproof GFCI convenience receptacle and a weatherproof switch for the lighting. Position the lighting fixtures to illuminate the housing interior and controls. Power from the circuits indicated on the Drawings.
6. Provide a minimum of three watertight, impact-resistant, general illumination, LED lighting fixtures with a minimum 5,000 lumens output each and a weatherproof 30 minute timer switch. Position the lighting fixtures to illuminate the housing interior and controls. Power from the generator battery.
7. Provide permanent access platform, stairs and handrails for access to controls and circuit breakers to maintain no greater than 6’-7” to top of any control device or circuit breaker handle, and for maintenance access via enclosure access panels. Stair and platform shall be hot dip galvanized, aluminum and/or fiberglass and shall comply with OSHA and all local jurisdiction requirements. Platform shall provide for 180 degree "full swing opening" of all side (and end, if required) service doors and at least 135 degree opening of the control panel door.

8. Enclosure housing and sub-base fuel tank shall be suitably constructed to withstand 150 mph wind loads.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install raceways as prescribed by NEC Article 700.

C. Systems shall be installed in a manner to be fully compliant with the seismic restraint requirements of the North Carolina State Building Code. Provide mounting devices and hardware, bracing, fittings, etc. as required for seismic restraint. See Specifications Section 26 05 00, Paragraph 1.23 for additional requirements.

D. Commission the system as detailed below.

### 3.2 FIELD QUALITY CONTROL

A. Field inspection, testing and adjusting shall be as required under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.1.

### 3.3 ADJUSTING

A. Testing, Adjusting, and Balancing: Adjust installed work under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Adjust all operating mechanisms for free mechanical movement.

C. Adjust all control parameters and settings to values as recommended by the manufacturer and as instructed by Architect/Engineer.

D. Adjust generator output voltage and engine speed.

### 3.4 MANUFACTURER'S FIELD SERVICES

Furnish manufacturer’s field representative to supervise final connections and system adjustments.

### 3.5 COMMISSIONING

The term “commission” and “commissioning” as used in this document includes, but is not limited to:

1. Static and operational testing and start-up of the electrical equipment.
2. Providing qualified and manufacturer trained and certified personnel to conduct/assist in tests.
3. Providing equipment, materials and test instrumentation necessary to conduct testing.
4. Providing equipment, materials, test instrumentation and labor necessary to correct deficiencies found during the commissioning process which fulfills contract and warranty requirements.
5. Providing operation and maintenance information and as-built drawings to the Architect/Engineer for review verification and organization, prior to distribution.
6. Providing Owner training for the systems specified.

## 3.6 TESTING AND DEMONSTRATION

A. Load Bank Test:
Provide a full load test utilizing a portable test bank for four hours minimum for each engine-generator set. Each test shall be performed at the job site in the presence of the Owner and Architect. Each test shall include one hour at 50% load, one hour at 75% load and two hours at 100% load. Upon completion of the load test, the generators shall be shut down after the cool down period. The generators shall then be started and immediately upon reaching rated rpm, 100% load shall be applied to demonstrate one step full load capability. The capability of the system to pick up full standby service load within 10 seconds of power outage shall also be demonstrated. After testing is complete:

1. A copy of the generator test report shall be submitted to the Architect.
2. Test results shall record the following parameters in 20 minute intervals during four hour test:
   a. Kilowatts.
   b. Amperes.
   c. Voltage.
   d. Coolant temperature.
   e. Room temperature.
   f. Frequency.
   g. Oil pressure.
   h. Fuel flow.

B. Building Loads Test: Following the load bank test, start the buildings load test. Simulate power outage, including automatic starting cycle, and automatic shutdown and return to normal, by interrupting normal source, and demonstrate that system operates with actual building loads to provide standby power. The test shall demonstrate the capability of each engine-generator set to operate the loads stated in Paragraph 2.4 G. Test all alarm and shutdown circuits by simulating conditions. Test duration shall be one hour minimum.

C. Demonstrate supervision of generator sets starting circuits.

D. Perform and document the following additional testing:

1. Commissioning: See Specifications Section 26 56 50 - Electrical Systems

Commissioning for requirements.

2. Level 1 Acceptance Testing: Refer to NFPA 110 Section 7.13.2.1 Level 1 acceptance testing for requirements.

E. A full tank of fuel shall be provided, replacing any fuel used for testing. Diesel fuel shall be treated with and alcohol-free additive to disperse water and clean injectors.

## 3.7 TRAINING

Prior to final acceptance, the manufacturer's authorized representative shall provide comprehensive training and thoroughly and competently instruct the Owner's designated personnel in proper operation of the system and in all required periodic maintenance. Training shall include, but not be limited to, operation (all aspects including normal and emergency modes), maintenance and troubleshooting of the equipment. A minimum of eight (8) hours on-site time, in addition to load bank testing, shall be allocated for this purpose.

## 3.8 DOCUMENTATION

Upon final completion of the system, a documentation package shall be provided and shall include three (3) bound (in three ring binders with index tabs) copies of complete manufacturer’s operation and instruction manuals. Provide one bound original (no photocopies) and two additional bound copies (photocopies are acceptable) of the total documentation package. The manuals shall include operation and maintenance procedures, complete parts lists, dimensional drawings, unit wiring diagrams and schematics, and interconnection wiring drawings. Include instructions for routine maintenance requirements, service manuals for engine and day tank, oil sampling and analysis for engine wear, and emergency maintenance procedures. The following shall also be provided:

A. System record drawings.

B. Instruction manuals as supplied by the manufacturer for all components and electronics.

C. Product specification sheets for all equipment without instruction manuals.

## 3.9 CLEANING

A. Clean installed work under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Touch up scratched or marred surfaces to match original finish.

C. Clean engine and generator surfaces. Replace oil and fuel filters.

## 3.10 WARRANTY

The Contractor shall provide the following minimum manufacturers factory warranty for each engine-generator set and associated equipment:

A. All equipment shall be new and warranted free of faulty workmanship and damage.

B. The warranty shall include all parts, labor (including travel with no travel time or distance limitations), expenses and equipment necessary to perform replacement and/or repairs.

C. The total system (parts and labor) shall be warranted free of defects for a period of three (3) years from date of final acceptance.

D. Replacement of defective materials and repair of faulty workmanship shall take place within 48 hours of notification by Owner and shall be guaranteed at no cost to the Owner during the warranty period.

E. The minimum warranty provisions specified above shall not diminish the terms of individual equipment manufacturer's warranties.

F. The printed warranty shall be included in the contract documents.

## 3.11 FINAL ACCEPTANCE

The installation shall be supervised, checked and tested by a qualified representative of the engine-generator set manufacturer. Written certification, by the qualified manufacturer's representative, verifying manufacturer's startup procedures were followed and full system functionality was achieved shall be submitted to the Architect/Engineer and Owner prior to final acceptance.

**END OF SECTION**

# SECTION 26 36 00 - TRANSFER SWITCHES

## 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 contactor-type automatic transfer switches rated 600 V and less and transfer switch accessories.

### 1.3 RELATED SECTIONS

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

B. Section 26 05 26 - Grounding and Bonding.

C. Section 26 05 29 Supporting Devices.

D. Section 26 05 53 - Electrical Identification.

E. Section 26 32 13 - Packaged Engine Generator System.

F. Section 26 56 50 – Electrical Systems Commissioning.

### 1.4 REFERENCES

A. NEMA ICS 10 - AC Transfer Switch Equipment.

B. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems (International Electrical Testing Association).

C. NFPA 70 - National Electrical Code.

### 1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for transfer switches.
2. Include rated capacities, operating characteristics, electrical characteristics, and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, details showing minimum clearances, conductor entry provisions, gutter space, and installed features and devices.
2. Include material lists for each switch specified.
3. Single-Line Diagram: Show connections between transfer switch, power sources, and load.
4. Riser Diagram: Show interconnection wiring between transfer switches, engine-generator set, etc.

## 1.6 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Data: Certificates, for transfer switches, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Field quality-control reports.

## 1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:

a. Features and operating sequences, both automatic and manual.
b. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

## 1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications:

1. Member company of NETA.

a. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

## 1.9 WARRANTY

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

1. Warranty Period: Five years from date of Final Acceptance.

## PART 2 - PRODUCTS

## 2.1 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. Comply with NEMA ICS 1.

C. Comply with NFPA 110.

D. Comply with UL 1008 unless requirements of these Specifications are stricter.

E. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.

F. Tested Fault-Current Closing and Short-Circuit Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.

1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.
2. Short-time withstand capability for 3 cycles.

G. Repetitive Accuracy of Solid-State Controls: All settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.

H. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.62. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.

I. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism. Switches for emergency or standby purposes

shall be mechanically and electrically interlocked in both directions to prevent simultaneous connection to both power sources.

J. Neutral Switching: Switches shall be three pole with solid neutral.

K. Annunciation, Control, and Programming Interface Components: Devices at transfer switches for communicating with remote programming devices, annunciators, or annunciator and control panels shall have communication capability matched with remote device.

L. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, by color-code or by numbered or lettered wire and cable with printed markers at terminations. Color-coding and wire and cable markers are specified in Section 26 05 53 "Identification for Electrical Systems."

1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
4. Accessible via front access.

M. Enclosures: General-purpose NEMA 250, Type 1, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

## 2.2 AUTOMATIC SEQUENCE OF OPERATION

A. Initiate Time Delay to Start Alternate Source Engine Generator: Upon initiation by normal source monitor when source drops below range of 70-95% of rated voltage (factory set at 85%).

B. Time Delay To Start Alternate Source Engine Generator: 0.05 to 6 seconds (factory set at 3 seconds) to allow for momentary dips.

C. Initiate Transfer Load to Alternate Source: Upon initiation by normal source monitor and permission by alternate source monitor. Generator voltage has reached range of 75-100% of rated voltage (factory set at 90%) and generator rated frequency of 85-100% (factory set at 90%).

D. Time Delay Before Transfer to Alternate Power Source: 0 to 10 seconds, adjustable.

E. Initiate Retransfer Load to Normal Source: Upon permission by normal source and inphase monitors.

F. Time Delay Before Transfer to Normal Power: 0 to 30 minutes, adjustable; bypass time delay in event of alternate source failure.

G. Time Delay Before Engine Shut Down: 0 to 15 minutes, adjustable, of unloaded operation. To allow engine to cool before shutdown.

## 2.3 CONTACTOR-TYPE AUTOMATIC TRANSFER SWITCHES

A. Shall be provided by the generator vendor as part of a package system.

B. Comply with Level 1 equipment according to NFPA 110.

C. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.

1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are unacceptable.
2. Switch Action: Double throw; mechanically held in both directions.
3. Contacts: Silver composition or silver alloy for load-current switching. Contactor-style automatic transfer-switch units, rated 600 A and higher, shall have separate arcing contacts.
4. Conductor Connectors: Suitable for use with conductor material and sizes.
5. Material: Hard-drawn copper, 98 percent conductivity.
6. Main and Neutral Lugs: Mechanical type.
7. Ground Lugs and Bus-Configured Terminators: Mechanical type.
8. Ground bar.
9. Connectors shall be marked for conductor size and type according to UL 1008.

D. Automatic Open-Transition Transfer Switches: Interlocked to prevent the load from being closed on both sources at the same time.

1. Sources shall be mechanically and electrically interlocked to prevent closing both sources on the load at the same time.

E. Manual Switch Operation: Under load, with door closed and with either or both sources energized. Transfer time is same as for electrical operation. Control circuit automatically disconnects from electrical operator during manual operation.

F. Manual Switch Operation: Unloaded. Control circuit automatically disconnects from electrical operator during manual operation.

G. Electric Switch Operation: Electrically actuated by push buttons designated "Normal Source" and "Alternative Source." Switch shall be capable of transferring load in either direction with either or both sources energized.

H. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval shall be adjustable from 1 to 30 seconds.

I. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.

J. Automatic Transfer-Switch Controller Features:

1. Controller operates through a period of loss of control power.
2. Undervoltage Sensing for Each Phase of Normal and Alternate Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable

from 85 to 100 percent of nominal, and dropout voltage shall be adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.

3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
4. Time Delay for Retransfer to Normal Source: Adjustable from zero to 30 minutes, and factory set for 10 minutes. Override shall automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
5. Test Switch: Simulate normal-source failure.
6. Switch-Position Pilot Lights: Indicate source to which load is connected.
7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.

    a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
    b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."

8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
9. Transfer Override Switch: Overrides automatic retransfer control so transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
11. Engine Shutdown Contacts:

    a. Instantaneous; shall initiate shutdown sequence at remote engine-generator controls after retransfer of load to normal source.
    b. Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.

12. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods shall be adjustable from 10 to 30 minutes. Factory settings shall be for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:

    a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
    b. Push-button programming control with digital display of settings.
    c. Integral battery operation of time switch when normal control power is unavailable.

K. Provide a strip heater inside the switch enclosure.

## 2.4 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect components, assembled switches, and associated equipment according to UL 1008. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

B. Prepare test and inspection reports.

1. For each of the tests required by UL 1008, performed on representative devices, for emergency systems. Include results of test for the following conditions:

a. Overvoltage.
b. Undervoltage.
c. Loss of supply voltage.
d. Reduction of supply voltage.
e. Alternative supply voltage or frequency is at minimum acceptable values.
f. Temperature rise.
g. Dielectric voltage-withstand; before and after short-circuit test.
h. Overload.
i. Contact opening.
j. Endurance.
k. Short circuit.
l. Short-time current capability.
m. Receptacle withstand capability.
n. Insulating base and supports damage.

# PART 3 - EXECUTION

## 3.1 INSTALLATION

A. Floor-Mounting Switch: Anchor to base by bolting.

1. Install transfer switches wall mounted or on cast-in-place concrete equipment base(s) as shown.
2. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.
3. Provide workspace and clearances required by NFPA 70.

B. Identify components according to Section 26 05 53 "Identification for Electrical Systems."

C. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

D. Comply with NECA 1.

## 3.2 CONNECTIONS

A. Wiring to Remote Components: Match type and number of cables and conductors to generator sets, control, and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.

B. Wiring Method: Install cables in raceways and cable trays except within electrical enclosures. Conceal raceway and cables except in unfinished spaces.

1. Comply with requirements for raceways and boxes specified in Section 26 05 33 "Conduit" and Section 26 05 34 “Boxes.”

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

D. Ground equipment according to Section 26 05 26 "Grounding and Bonding."

E. Connect wiring according to Section 26 05 19 "Building Wire and Cable."

F. Route and brace conductors according to manufacturer's written instructions. Do not obscure manufacturer's markings and labels.

G. Brace and support equipment according to Section 26 05 00, Para. 1.22.

H. Final connections to equipment shall be made with liquidtight, flexible metallic conduit no more than 18 inches (457 mm) in length.

## 3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. All testing shall be in compliance with Specifications Section 26 06 50 Electrical Commissioning and NFPA 110 Section 7.13.2.1 Level 1 acceptance testing requirements.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. After installing equipment, test for compliance with requirements according to NETA ATS.
2. Visual and Mechanical Inspection:

a. Compare equipment nameplate data with Drawings and Specifications.
b. Inspect physical and mechanical condition.
c. Inspect anchorage, alignment, grounding, and required clearances.
d. Verify that the unit is clean.

e. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
f. Verify that manual transfer warnings are attached and visible.
g. Verify tightness of all control connections.
h. Inspect bolted electrical connections for high resistance using one of the following methods, or both:

1) Use of low-resistance ohmmeter.
2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data.

i. Perform manual transfer operation.
j. Verify positive mechanical interlocking between normal and alternate sources.
k. Perform visual and mechanical inspection of surge arresters.
l. Inspect control power transformers.

1) Inspect for physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.
2) Verify that primary and secondary fuse or circuit-breaker ratings match Drawings.

3. Electrical Tests:

a. Perform insulation-resistance tests on all control wiring with respect to ground.
b. Perform a contact/pole-resistance test. Compare measured values with manufacturer's acceptable values.
c. Verify settings and operation of control devices.
d. Calibrate and set all relays and timers.
e. Verify phase rotation, phasing, and synchronized operation.
f. Perform automatic transfer tests.
g. Verify correct operation and timing of the following functions:

1) Normal source voltage-sensing and frequency-sensing relays.
2) Engine start sequence.
3) Time delay on transfer.
4) Alternative source voltage-sensing and frequency-sensing relays.
5) Automatic transfer operation.
6) Interlocks and limit switch function.
7) Time delay and retransfer on normal power restoration.
8) Engine cool-down and shutdown feature.

4. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.

a. Check for electrical continuity of circuits and for short circuits.
b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
c. Verify that manual transfer warnings are properly placed.
d. Perform manual transfer operation.

5. After energizing circuits, perform each electrical test for transfer switches stated in NETA ATS and demonstrate interlocking sequence and operational function for each switch at least three times.

    a. Simulate power failures of normal source to automatic transfer switches and retransfer from emergency source with normal source available.
    b. Simulate loss of phase-to-ground voltage for each phase of normal source.
    c. Verify time-delay settings.
    d. Verify pickup and dropout voltages by data readout or inspection of control settings.
    e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
    f. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for one pole deviating by more than 50 percent from other poles.
    g. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

6. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.

    a. Verify grounding connections and locations and ratings of sensors.

D. Coordinate tests with tests of generator and run them concurrently.

E. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

F. Transfer switches will be considered defective if they do not pass tests and inspections.

G. Remove and replace malfunctioning units and retest as specified above.

H. Prepare test and inspection reports.

1. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.
2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

3. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
4. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.

## 3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment.

B. Training shall include testing ground-fault protective devices and instructions to determine when the ground-fault system shall be retested. Include instructions on where ground-fault sensors are located and how to avoid negating the ground-fault protection scheme during testing and circuit modifications.

C. Coordinate this training with that for generator equipment.

**END OF SECTION**

# SECTION 26 37 00 – DUAL PURPOSE GENERATOR DOCKING STATION

## 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 a Dual Purpose Generator Docking Station.

### 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.
2. Include rated capacities, operating characteristics, electrical characteristics, and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, details showing minimum clearances, conductor entry provisions, gutter space, and installed features and devices.
2. Include material lists for each switch specified.
3. Single-Line Diagram: Show connections between docking station, power sources, and load.

### 1.4 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Data: Certificates, for docking station, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Field quality-control reports.

## 1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

## 1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications:

1. Member company of NETA.

a. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

## 1.7 WARRANTY

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

1. Warranty Period: Five years from date of project final acceptance.

# PART 2 - PRODUCTS

## 2.1 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. Comply with NEMA ICS 1.

C. Comply with UL 1008 unless requirements of these Specifications are stricter.

## 2.2 DUAL PURPOSE GENERATOR DOCKING STATION

A. Provide a Dual Purpose Docking Station for connection of a temporary standby engine-generator set to support the facility during maintenance or a failure of the permanently installed engine-generator set and provide load bank testing connections for the permanent engine-generator set.

B. Docking Station shall be third party listed to UL 1008 standards as a Transfer Switch Accessory. The Station shall be rated as shown on the drawings, 480/277 volts, three pole, four wires and ground. Provide 100% neutral and ground connection capability. Short circuit current rating shall be 30 kA RMS symmetrical minimum. The cabinet shall be wall mounted in a NEMA Type 3R enclosure and the Type 3R rating shall be

maintained with temporary cables installed with or without cables connected. Cabinet shall have tamper resistant lockable doors to prevent unauthorized entry.

C. Provide a molded case, thermal magnetic circuit breaker with key interlock as shown on the Drawings to interlock the permanent generator and temporary generator.

D. Accessories: Provide with phase rotation monitor, auto start terminals, 20A, 120VAC, GFCI battery charger receptacle, 30A, 208V block heater receptacle and systems to electrically supervise starting controls as required by Codes which must be installed inside the docking station behind the enclosure door. Provide receptacle while in use covers. Coordinate start-stop connections to automatic transfer switches. Provide distinctive labels on both the block heater and battery charger receptacles clearly identifying them for the specific use and stating other uses are not permitted.

E. Cabinet shall include two sets of color-coded Crouse-Hinds J-Series Cam-Lok receptacle connectors (Male and Female). Female Cam-Loks shall be enclosed behind a pad-lockable door. Male Cam-Loks shall be enclosed behind a key interlocked trap door. Provide with Kirk Key locks installed on outer door housing male Cam-Loks and permanent generator circuit breaker to interlock the permanent generator and temporary generator. Dual Purpose Docking Station shall be Trystar SBDS-6 or approved equal.

F. The enclosure shall be finished in ANSI 61 gray powder coat. Provide AL/CU compatible lugs adequate to accommodate conductor sizes and quantities shown on the Drawings. Enclosure shall be suitably constructed to withstand 150 mph wind. Provide documentation of wind rating with shop drawings. Comply with requirements in Specifications Section 16019 Electrical Identification.

G. The docking station shall be front accessible.

H. Bus:

1. All bus bars shall be tin-plated copper. Bus ampacity shall be based on NEMA standard temperature rise criteria of 65 degrees C over a 40 degrees C ambient (outside the enclosure).
2. Provide a full capacity neutral bus where a neutral bus is indicated on the drawings.
3. A copper ground bus.
4. All hardware used on conductors shall be high-tensile strength and zinc-plated. All bus joints shall be provided with conical spring-type washers.

I. Shop Drawings: Indicate electrical characteristics and connection requirements. Show dimensioned plan and elevation views with overall and interconnection point dimensions, electrical single line diagram. Also provide:

1. A complete Bill of Materials for all components.
2. Nameplate schedule.
3. Conduit entry/exit locations.
4. Short circuit, voltage and continuous current ratings.
5. Cable terminal sizes.

6. Product data sheets.
7. Seismic certification and equipment anchorage details.

J. Wiring and Terminations

1. All connections for phases, neutral, ground, accessories, etc., shall be clearly marked via permanent labeling.
2. Each single pole Cam-Lok receptacle connector shall be rated for no less than 100 amps at 90 deg C. Provide multiple receptacles per phase, neutral, and ground as required. Receptacle contact material shall be brass. Cam-type receptacles shall be suitable for use in outdoor environments and be UL 498 listed for Attachment Plugs and Receptacles and UL 1691. Provide with color coded NEMA 3R receptacle covers.
3. Small wiring, necessary fuse blocks and terminal blocks within the station shall be furnished as required. Control components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer's wiring diagrams.
4. Where applicable all control wire shall be Type SIS, bundled and secured with nylon ties. Insulated locking spade terminals shall be provided for all control connections, except where saddle type terminals are provided integral to a device. All groups of control wires leaving the panel shall be provided with terminal blocks with suitable numbering strips. Provide wire markers at each end of all control wiring.

## 2.3 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect components, assembled switches, and associated equipment according to UL 1008. Ensure proper operation.

# PART 3 - EXECUTION

## 3.1 INSTALLATION

A. Wall-Mounting Station: Anchor by bolting.

1. Install as shown.
2. Provide workspace and clearances required by NFPA 70.

B. Identify components according to Section 26 05 53 "Identification for Electrical Systems."

C. Comply with NECA 1.

## 3.2 CONNECTIONS

A. Wiring Method: Install cables in raceways except within electrical enclosures.

1. Comply with requirements for raceways and boxes specified in Section 26 05 33 "Raceways and Boxes for Electrical Systems."

B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

C. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

E. Route and brace conductors according to manufacturer's written instructions. Do not obscure manufacturer's markings and labels.

F. Brace and support equipment according to Section 26 05 00, Para. 1.22.

## 3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. After installing equipment, test for compliance with requirements according to NETA ATS.

C. Coordinate tests with tests of generator to verify interlocking.

D. Report results of tests and inspections in writing.

E. Remove and replace malfunctioning units and retest as specified above.

F. Prepare test and inspection reports.

## 3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain docking station and related equipment.

B. Training shall include normal operation and maintenance training.

C. Coordinate this training with that for generator equipment.

**END OF SECTION**

# SECTION 26 41 13 - LIGHTNING PROTECTION FOR STRUCTURES

## 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 criteria for a delegated design of lightning protection for structures and structure elements.

### 1.3 ACTION SUBMITTALS

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

B. Shop Drawings: For air terminals and mounting accessories.

1. Layout of the lightning protection system, along with details of the components to be used in the installation.
2. Include indications for use of raceway, data on how concealment requirements will be met, and calculations required by NFPA 780 for bonding of grounded and isolated metal bodies.

### 1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer and manufacturer. Include data on listing or certification by UL.

B. Certification, signed by Contractor, that roof adhesive is approved by manufacturer of roofing material.

C. Field quality-control reports.

D. Comply with recommendations in NFPA 780, Annex D, "Inspection and Maintenance of Lightning Protection Systems," for maintenance of the lightning protection system.

E. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features, including the following:

1. Ground rods.
2. Ground loop conductor.

## 1.5 QUALITY ASSURANCE

A. Installer Qualifications: Certified by UL, trained and approved for installation of units required for this Project.

B. System Certificate: UL Master Label.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 780, "Definitions" Article.

## 1.6 COORDINATION

A. Coordinate installation of lightning protection with installation of other building systems and components, including electrical wiring, supporting structures and building materials, metal bodies requiring bonding to lightning protection components, and building finishes.

B. Coordinate installation of air terminals attached to roof systems with roofing manufacturer and Installer.

C. Flashings of through-roof assemblies shall comply with roofing manufacturers' specifications.

# PART 2 - PRODUCTS

## 2.1 LIGHTNING PROTECTION SYSTEM COMPONENTS

A. Comply with UL 96 and NFPA 780.

B. Roof-Mounted Air Terminals: NFPA 780, Class I aluminum unless otherwise indicated.

1. Air Terminals More than 24 Inches (600 mm) Long: With brace attached to the terminal at not less than half the height of the terminal.
2. Single-Membrane, Roof-Mounted Air Terminals: Designed specifically for single-membrane roof system materials. Comply with requirements in Division 07 roofing Sections.

C. Main and Bonding Conductors: Aluminum.

D. Ground Loop Conductor: The same size and type as the main conductor except tinned.

E. Ground Rods: Copper-clad, sectional type; 3/4 inch in diameter by 10 feet long.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Install lightning protection components and systems according to UL 96A and NFPA 780.

B. Install conductors with direct paths from air terminals to ground connections. Avoid sharp bends.

C. Conceal the following conductors:

1. System conductors, except between air terminals.
2. Down conductors.
3. Interior conductors.
4. Conductors within normal view of exterior locations at grade within 200 feet (60 m) of building.

D. Cable Connections: Use crimped or bolted connections for all conductor splices and connections between conductors and other components. Use exothermic-welded connections in underground portions of the system.

E. Cable Connections: Use exothermic-welded connections for all conductor splices and connections between conductors and other components.

1. Exception: In single-ply membrane roofing, exothermic-welded connections may be used only below the roof level.

F. Air Terminals on Single-Ply Membrane Roofing: Comply with roofing membrane and adhesive manufacturer's written instructions.

G. Bond extremities of vertical metal bodies exceeding 60 feet (18 m) in length to lightning protection components.

H. Ground Loop: Install ground-level, potential equalization conductor and extend around the perimeter of structure.

1. Bury ground ring not less than 24 inches from building foundation.
2. Bond ground terminals to the ground loop.
3. Bond grounded building systems to the ground loop conductor within 12 feet of grade level.

I. Bond lightning protection components with intermediate-level interconnection loop conductors to grounded metal bodies of building at 60-foot intervals.

## 3.2 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Division 26 Section "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

## 3.3 CORROSION PROTECTION

A. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture unless moisture is permanently excluded from junction of such materials.

B. Use conductors with protective coatings where conditions cause deterioration or corrosion of conductors.

## 3.4 FIELD QUALITY CONTROL

A. Notify the Owner at least 48 hours in advance of inspection before concealing lightning protection components.

B. UL Inspection: Meet requirements to obtain and provide a UL Master Label for system.

**END OF SECTION**

# SECTION 26 43 13 - SURGE PROTECTION DEVICES FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

## PART 1 - GENERAL

### 1.1 SUMMARY

Section includes field-mounted surge protection devices (SPD) for low-voltage (120VAC to 480VAC) power distribution and control equipment.

### 1.2 RELATED DOCUMENTS

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

B. Section 26 05 26 - Grounding and Bonding.

C. Section 26 05 29 Supporting Devices.

D. Section 26 05 53 - Electrical Identification.

### 1.3 DEFINITIONS

A. ATS: Acceptance Testing Specifications.

B. SVR: Suppressed voltage rating.

C. SPD: Surge Protection Device.

### 1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating weights, electrical characteristics, furnished specialties, and accessories.

B. Qualification Data: For qualified testing agency.

C. Product Certificates: For SPD, from manufacturer.

D. Field quality-control reports.

E. Operation and Maintenance Data: For SPD to include in emergency, operation, and maintenance manuals.

F. Warranties: Sample of special warranties.

## 1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

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

C. Comply with IEEE C62.41.2 and test devices according to IEEE C62.45.

D. Comply with NEMA LS 1.

E. Comply with UL 1283 and UL 1449.

F. Comply with NFPA 70.

## 1.6 PROJECT CONDITIONS

A. Service Conditions: SPDs shall be rated for continuous operation under the following conditions unless otherwise indicated:

1. Maximum Continuous Operating Voltage: Not less than 115 percent of nominal system operating voltage.
2. Operating Temperature: 30 to 120 deg F.
3. Humidity: 0 to 85 percent, noncondensing.
4. Altitude: Less than 20,000 feet above sea level.

## 1.7 COORDINATION

Coordinate location of SPDs to provide shortest lead length and allow adequate clearances for maintenance.

## 1.8 WARRANTY

A. Manufacturer's standard form in which manufacturer agrees to repair or replace components of surge suppressors that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Ten (10) years from date of Substantial Completion.

# PART 2 - PRODUCTS

## 2.1 SURGE PROTECTION DEVICES (SPDs)

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

1. Eaton Model SPDxxx208Y3K and SPDxxx480Y3K, Basis of Design.
2. ABB.
3. Siemens.
4. Schneider/Square D.

B. Surge Protection Devices:

1. Comply with UL 1449, 5th Edition.
2. Short-circuit current rating complying with UL 1449, and matching or exceeding the panelboard short-circuit rating and redundant suppression circuits; with thermally protected metal-oxide varistors.
3. LED indicator lights for power and protection status of each phase and neutral.
4. Audible alarm, with silencing switch, to indicate when protection has failed.
5. Form-C contacts rated at 5A and 250VAC, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
6. Six-digit transient event counter with reset button and nonvolitile memory to totalize transient surges.
7. Warranty: 15 years.
8. Peak Single-Impulse Surge Current Rating: See Drawings for device ratings.

## 2.2 ENCLOSURES

A. Indoor Enclosures: NEMA 250 Type 1.

# PART 3 - EXECUTION

## 3.1 INSTALLATION

A. Install SPD at service entrance on load side, with ground lead bonded to service entrance ground.

B. Install SPD with conductors or buses between suppressor and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.

C. SPD circuit breaker and feeder conductors shall be as recommended by the device manufacturer, or #8 AWG copper, whichever is greater. Install in metallic raceway.

D. Coordinate SPD circuit breaker rating with actual SPD provided.

## 3.2 FIELD QUALITY CONTROL

A. Inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS, "Surge Arresters, Low-Voltage Surge Protection Devices" Section. Certify compliance with test parameters.
2. After installing SPDs, but before electrical circuitry has been energized, test for compliance with requirements.
3. Complete startup checks according to manufacturer's written instructions.

C. SPD will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

## 3.3 STARTUP SERVICE

A. Do not energize or connect electrical equipment to their sources until SPDs are installed and connected.

B. Do not perform insulation resistance tests of the distribution wiring equipment with the SDP installed. Disconnect before conducting insulation resistance tests, and reconnect immediately after the testing is over.

**END OF SECTION**

# SECTION 26 51 00 - INTERIOR LUMINAIRES

## PART 1 - GENERAL

### 1.1 SECTION INCLUDES

A. Interior solid-state luminaires that use LED technology.

B. Building mounted exterior luminaires.

C. Luminaire accessories.

### 1.2 DEFINITIONS

A. Retain terms that remain after this Section has been edited for a project.

B. CCT: Correlated color temperature.

C. CRI: Color Rendering Index.

D. Fixture: See "Luminaire."

E. IP: International Protection or Ingress Protection Rating.

F. LED: Light-emitting diode.

G. Lumen: Measured output of lamp and luminaire, or both.

H. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

### 1.3 SUBMITTALS FOR REVIEW

A. Submittals: Procedures for submittals. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Shop Drawings: Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.

C. Product Data: Provide dimensions, ratings, and performance data.

D. Submittal information will include IES and Photometric files with the fixture specifications. IES Photometric and LM79 data for the submitted LED fixtures, IES file must been from an NVLAP (National Voluntary Laboratory Accreditation Program) accredited laboratory. Submittal information will also include a referenced location for a current installation of the

proposed products where the operational performance of these proposed products can be observed and evaluated by the Owner. Provide photometric calculation for the following:

1. Each lobby.
2. Each waiting room.
3. Typical exam room.
4. Typical office.
5. All procedure rooms.
6. Each interior floor plan with emergency lighting fixtures only.
7. Corridors.

## 1.4 SUBMITTALS FOR INFORMATION

A. Submittals: Submittals for information. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Submit manufacturer's installation instructions. Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

## 1.5 SUBMITTALS FOR CLOSEOUT

A. Contract Closeout: Submittals for project closeout. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Submit manufacturer's operation and maintenance instructions for each product.

## 1.6 QUALIFICATIONS

Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

## 1.7 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.

B. Conform to requirements of NFPA 101.

C. Lighting systems shall comply with the North Carolina State Energy Code.

D. Products: Listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

## 1.8 EXTRA PRODUCTS

A. Furnish one replacement LED lighting module for each type. Furnish one replacement LED lighting module for each 24 of each module type, but no less than one.

B. Furnish one replacement LED driver type for each 24 of each type, but no less than one.

C. Furnish one replacement exit lighting fixture for each 24 of each type, but no less than one.

# PART 2 - PRODUCTS

## 2.1 LUMINAIRES

A. Furnish Products as scheduled. Refer to relevant sections of the General and Supplemental General Conditions and Division 1 Specifications Sections for substitutions and product options.

B. All lighting fixtures shall be approved by third party testing agencies and NFPA and shall bear their label.

C. All fixtures shall have a stock, or standard finish unless otherwise specified. Fixtures subject to corrosive or damp environments shall have corrosion resistant hardware and finishes.

D. All fixtures shall be installed complete and operational.

E. Lighting fixture types shall be furnished as required by the Lighting Fixture Schedule as indicated on the drawings. Catalog numbers are provided as a guide to the design and quality of fixture desired. Equivalent designs and equal quality fixtures of other manufacturers listed will be acceptable upon approval of the Architect/Engineer. The Contractor shall verify from the contract drawings the type ceilings or walls the fixture is to be used with and shall provide compatible mounting attachments and trim. Provide all accessories or additional materials required to maintain the ceiling fire rating as required by regulatory authorities.

F. Interior Area LED Fixtures/Lamps:

1. Kelvin temperature of in the range of 3500k to 4000k unless otherwise indicated in schedule.
2. 75 plus lumens per watt minimum.
3. CRI 80 or greater.
4. 5-year warranty minimum with L70 of 50,000 hours or greater.
5. Modular design for field replacement of parts.
6. Series parallel matrix for prevention of LED string outages (not applicable to exit lights and recessed can fixtures).
7. Tool less access to driver and LED modules.
8. UL certified up to 90F degrees operating temperature.

G. LED Drivers: Suitable for environment in which they are to be installed.

1. Power Factor: 90 percent, minimum.
2. Load regulation shall be +/-1% from no load to full load.
3. Total Harmonic Distortion Rating: Less than 20 percent.
4. Case temperature shall be rated for –40 deg C through +80 deg C and provided with thermal protection and self-limited short circuit and overload protection.
5. Output shall be isolated.
6. Driver Life Rating shall have less than 0.5% failure rate at the LED module's maximum L70 rated life.
7. Driver manufacturer to be an industry leader, such as Advance or approved equal

## 2.2 LENSES

Lenses shall be clear virgin acrylic material with uniform 3/16" square based female cone prisms aligned 45° to the length and width of the lens panel. Minimum prism depth shall be 0.080" with a nominal panel thickness of 0.156" and a minimum overall panel thickness of 0.150" to 0.160" inches.

# PART 3 - EXECUTION

## 3.1 INSTALLATION

A. Install suspended luminaires using pendants supported from swivel hangers. Provide pendant length required to suspend luminaire at indicated height.

B. Where a recessed fixture replaces a section or part of an acoustical ceiling tile, or a section or part of a suspended gypsum board ceiling, the fixture shall be supported at two (2) diagonal corners to the steel frame of the building. Supports shall be provided with the same type of wire as used to support the lay-in ceiling track or GWB ceiling system and shall be distinguished by color and tag. Attach one end of the wire to one corner of the fixture and the other end to the building's structural system. The lay-in or flange fixture shall then be screwed to the main runners of the lay-in ceiling track or GWB ceiling system at all four (4) corners using sheet metal screws. For fire rated suspended ceiling, luminaire shall be supported to the Building Structure as per the Ceiling Design Criteria, luminaire shall then be screwed to the main runners of the suspended ceiling track at all four (4) corners using sheet metal screws. The Contractor shall be responsible for coordination work with the ceiling contractor; however, the ceiling contractor will provide framed openings for reception of lighting fixtures. All recessed fixtures shall be furnished with all necessary mounting accessories. Also, see the ASTM Section "E-580-02" items 3.3, 4.3, 5.5& 5.6 and the NEC 300.11 & 410-36(B)

C. Locate recessed ceiling luminaires as indicated on reflected ceiling plan.

D. Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with each other. Secure to prevent movement.

E. Exposed Grid Ceilings: Support surface mounted luminaires on grid ceiling directly from building structure. Provide auxiliary members spanning ceiling grid members to support surface mounted luminaires. Fasten surface mounted luminaires to ceiling grid members using bolts or screws.

F. Install recessed luminaires to permit removal from below.

G. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.

H. Install wall mounted luminaires, emergency lighting units and exit signs at height as indicated on Drawings.

I. Install accessories furnished with each luminaire.

J. Connect luminaires, emergency lighting units and exit signs to branch circuit outlets provided under Section 26 05 33 using flexible conduit.

K. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.

L. Bond products and metal accessories to branch circuit equipment grounding conductor.

M. Install specified lamps in each emergency lighting unit, exit sign, and luminaire.

## 3.2 FIELD QUALITY CONTROL

A. Quality Assurance: Field inspection, testing and adjusting shall be as required under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

## 3.3 ADJUSTING

A. Contract Closeout: Adjust installed work as required under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Aim and adjust luminaires as directed.

## 3.4 CLEANING

A. Contract Closeout: Clean installed work as required under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Clean electrical parts to remove conductive and deleterious materials.

C. Remove dirt and debris from enclosures.

D. Clean photometric control surfaces as recommended by manufacturer.

E. Clean finishes and touch up damage.

## 3.5 DEMONSTRATION AND INSTRUCTIONS

A. Contract Closeout: Demonstrate installed work as required under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Demonstrate luminaire operation for minimum of two hours.

## 3.6 PROTECTION OF FINISHED WORK

A. Contract Closeout: Protect installed work as required under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Relamp luminaires that have failed lamps at Substantial Completion. Replace LED modules in which more than 5% of the LEDs have failed lamps at Final Acceptance of the Work.

**END OF SECTION**

# SECTION 26 52 00 - EMERGENCY AND EXIT LIGHTING

## PART 1 - GENERAL

### 1.1 SUMMARY

Section includes emergency egress lighting units and exit signs.

### 1.2 STANDARDS

A. UL 924

B. NFPA 101 - Life Safety Code.

C. NFPA 70 - National Electrical Code.

D. North Carolina State Building Code including Energy Code.

E. NEMA - Standards

### 1.3 SUBMITTALS FOR REVIEW

A. Submittals: Procedures for submittals. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Shop Drawings: Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.

C. Product Data: Provide dimensions, ratings, and performance data.

### 1.4 SUBMITTALS FOR INFORMATION

A. Submittals: Submittals for information. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Submit manufacturer’s installation instructions. Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

### 1.5 SUBMITTALS FOR CLOSEOUT

A. Contract Closeout: Submittals for project closeout. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Submit manufacturer’s operation and maintenance instructions for each product.

## 1.6 QUALIFICATIONS

Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

## 1.7 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.

B. Conform to requirements of NFPA 101.

C. Products: Listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated. Products shall also meet or exceed the standards listed in Part 2.

# PART 2 - PRODUCTS

## 2.1 GENERAL

A. All lighting fixtures shall be listed as emergency lighting equipment and third party testing agency and NFPA approved and shall bear their label.

B. All fixtures shall have a stock, or standard finish unless otherwise specified.

C. All emergency lighting fixtures shall be completely self-contained, provided with maintenance free battery, automatic charger and other features. They shall be installed complete with lamps, batteries, etc. which shall be new and unused at time of final inspection of the project for acceptance.

D. Lighting fixture types shall be furnished as required by the Lighting Fixture Schedule on the contract drawings and as herein specified. Catalog numbers are provided as a guide to the design and quality of fixture desired. Equivalent designs and equal quality fixtures of other manufacturers listed will be acceptable upon approval of the Architect/Engineer. The Contractor shall verify from the contract drawings the type of ceilings or walls the fixture is to be used with and shall provide compatible mounting attachments and trim. Provide all accessories or additional materials required to maintain the ceiling fire rating as required by regulatory authorities.

E. Emergency lighting fixtures and exit signs shall be as shown on the lighting fixture schedule on the contract drawings, and as herein specified.

F. Emergency Lighting Fixture Warranty: The entire unit shall be warranted for three years. The battery must have a additional two more years pro-rated warranty. Warranty shall date from the date of final project acceptance and be included in the contract document.

## 2.2 EMERGENCY LIGHTING (EGRESS) UNITS

A. Product Description: Self-contained LED emergency lighting unit automatically activated when the line voltage drops below 80%.

B. Battery: Ten year normal life expectancy, 12 volt, sealed, maintenance-free, lead calcium type, with 1.5 hour minimum capacity at 50 watts load. Battery shall be a high temperature type with an operating range of 0° C. to 60º C., contain a resealable pressure vent and sintered positive and negative terminals. A low voltage disconnect switch shall be included if a Lead battery is used, to disconnect the battery from the load and prevent damage from a deep discharge during an extended power outage.

C. Battery Charger: Automatic, solid state, full wave rectification, surge protected, current-limiting, dual-rate type, with filtered output of sufficient capacity to recharge discharged battery to full charge within twelve hours. Provide fused output circuit, low voltage battery disconnect, brownout and short circuit protection. Thermal protection shall sense circuitry temperature and adjust charge current to prevent overheating and charger failure. Thermal compensation shall adjust charger output to provide optimum charge voltage relative to ambient temperature. Regulated charge voltage shall maintain constant charge voltage over a wide range of line voltages. AC lockout circuit shall allow battery connection before AC power is applied and prevent battery damage due to deep discharge.

D. Mounting: Surface wall or recessed ceiling as indicated by the drawings.

E. Housing: White polycarbonate, with steel backbox/housing or steel with white finish. Wall mount unit with hinged faceplate and adjustable mounting hardware. Ceiling mount unit with T bar hangar kit.

F. Self-Diagnostics: Electronics shall automatically, or manually upon demand, conduct self test on battery condition (including actual discharge), charger, lamps and internal wiring integrity per NEC and NFPA at prescribed intervals. A pilot light shall indicate the unit is connect to AC power. Provide test switch and visual indicator(s) of unit operational condition including charger status, ready and service code. Test switch shall simulate operation of the unit upon loss of AC power by energizing lamps from the battery, and also exercise the transfer relay.

G. Electrical Connection: Conduit connection.

H. Input Voltage: Dual voltage input (120/277 volts).

## 2.3 EXIT LIGHTING UNITS

A. Product Description: Self-contained exit lighting unit automatically activated when the line voltage drops below 80%.

B. Battery: Ten year normal life expectancy, 6 or 12 volt, sealed, maintenance-free, lead calcium type, with 1.5 hour minimum capacity. Battery shall be a high temperature type with an operating range of 0º C. to 60º C. and contain a resealable pressure vent and sintered positive and negative terminals. A low voltage disconnect switch shall be

included if lead battery is used, to disconnect the battery from the load and prevent damage from a deep discharge during an extended power outage.

C. Battery Charger: Automatic, solid state, surge protected, full wave rectification, current-limiting, dual-rate type, with filtered output of sufficient capacity to recharge discharged battery to full charge within twelve hours. Provide fused output circuit, low voltage battery disconnect, brownout and short circuit protection. Thermal protection shall sense circuitry temperature and adjust charge current to prevent overheating and charger failure. Thermal compensation shall adjust charger output to provide optimum charge voltage relative to ambient temperature. Regulated charge voltage shall maintain constant charge voltage over a wide range of line voltages. AC lockout circuit shall allow battery connection before AC power is applied and prevent battery damage due to deep discharge.

D. Lamps: LED, discrete or diffuse. Maximum failure rate shall be 25% within a seven year period, otherwise, if exceeded the manufacturer shall replace the entire unit at no cost to the Owner.

E. Face:

1. Standard Unit: Single or dual face as indicated or required. Translucent plastic face with red letters on white background.
2. Architectural/Edge Lit Unit: Clear transparent plastic panel with red letters on clear or mirrored background.

F. Directional Arrows: As indicated or universal type for field adjustment.

G. Mounting: Universal, surface wall, back or end mount, or ceiling, top or pendant mount.

H. Housing: White polycarbonate for standard unit, metallic enclosure with clear plexiglass signage panel for architectural/edge lit unit.

I. Self-Diagnostics: Electronics shall automatically, or manually upon demand, conduct self test on battery condition (including actual discharge), charger, lamps and internal wiring integrity per NEC and NFPA at prescribed intervals. Provide test switch and visual indicator(s) of unit operational condition including charger status, ready and service code. Test switch shall simulate operation of the unit upon loss of AC power by energizing lamps from the battery. This simulation shall also exercise the transfer relay.

J. Electrical Connection: Conduit connection.

K. Input Voltage: Dual voltage input (120/277 volts).

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Install suspended exit signs using pendants supported from swivel hangers. Provide pendant length required to suspend sign at indicated height.

B. Install surface-mounted emergency lighting units and exit signs plumb and adjust to align with building lines and with each other. Secure to prevent movement.

C. Install wall-mounted emergency lighting units and exit signs at height as indicated.

D. Install accessories furnished with each emergency lighting unit and exit sign.

E. Emergency and exit lighting fixtures shall be installed in a manner to be fully compliant with the seismic restraint requirements of the North Carolina State Building Code. Provide mounting devices and hardware, bracing, fittings, etc. as required for seismic restraint. See Specifications Section 26 05 00 for additional requirements.

F. Connect emergency lighting units to branch circuit outlets provided under this Division as indicated.

G. Exposed Grid Ceilings: Support surface mounted luminaires on grid ceiling directly from building structure. Provide auxiliary members spanning ceiling grid members to support surface mounted luminaires. Fasten surface mounted luminaires to ceiling grid members using bolts or screws.

H. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within unit.

I. Install specified lamps in each emergency lighting unit.

J. Ground and bond emergency lighting units and exit signs under the provisions of Section 26 05 26.

K. Locate emergency lighting fixtures and exit signs as indicated on reflected ceiling plan.

L. Install recessed luminaires to permit removal from below.

M. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.

N. Install screws to secure recessed grid-supported luminaires in place.

O. Install accessories furnished with each luminaire.

### 3.2 FIELD QUALITY CONTROL

A. Quality Assurance: Field inspection, testing and adjusting shall be as required under provisions of the General and Supplemental General Conditions and Division 1

Specifications Sections.

B. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

## 3.3 ADJUSTING

A. Contract Closeout: Adjust installed work as required under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Aim and adjust emergency lighting fixture heads to illuminate paths of egress.

## 3.4 CLEANING

A. Contract Closeout: Clean installed work as required under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Clean electrical parts to remove conductive and deleterious materials.

C. Remove dirt and debris from enclosures.

D. Clean photometric control surfaces as recommended by manufacturer.

E. Clean finishes and touch up damage.

## 3.5 DEMONSTRATION AND INSTRUCTIONS

A. Contract Closeout: Demonstrate installed work as required under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Demonstrate normal luminaire operation for minimum of ninety minutes after the unit has been permanently installed and charged for a minimum of 24 hours. The battery run time test shall be completed a minimum of 10 days prior to final inspection by Architect/Engineer. Any unit which fails the test shall be repaired or replaced, and tested again. A copy of the test report shall be sent to the Architect.

## 3.6 PROTECTION OF FINISHED WORK

A. Contract Closeout: Protect installed work as required under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Relamp emergency lighting units and exit signs that have failed lamps at Substantial Completion. Replace exit signs in which more than 5% of the LEDs have failed lamps at Substantial Completion.

**END OF SECTION**

# SECTION 27 05 36

# CABLE TRAYS FOR COMMUNICATIONS 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 steel basket tray style cable trays and cable runways and accessories.

B. Related Sections include the following:

1. Section 07 84 13 "Penetration Firestopping" for fire stopping materials and installation at penetrations through walls, ceilings, and other fire-rated elements.

### 1.3 SUBMITTALS

A. Product Data: Include data indicating dimensions, characteristics, and finishes for each type of cable runway indicated.

B. Shop Drawings: For each type of cable tray and cable runway.

1. Show fabrication and installation details of cable runway, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including beam clamps, brackets, hanger rods, strut support, splice-plate connectors, expansion-joint assemblies, grounding clamps, straight lengths, and fittings.
2. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
3. Seismic-Restraint Details: Signed and sealed by a qualified professional engineer.
    a. Design Calculations: Calculate requirements for selecting seismic restraints.
    b. Detail fabrication, including anchorages and attachments to structure and to supported cable runways.

C. Coordination Drawings: Floor plans and sections drawn to scale. Include scaled cable runway layout and relationships between components and adjacent structural and mechanical elements. Show the following:

1. Vertical and horizontal offsets and transitions.
2. Clearances for access above and to side of cable runways.

3. Vertical elevation of cable runways above floor or bottom of ceiling structure.

D. Product Certificates: For each type of cable runway, signed by product manufacturer.

E. Manufacturer Seismic Qualification Certification: Submit certification that cable runways, accessories, and components will withstand seismic forces defined in Section 26 05 29 "Hangers and Supports for Electrical Systems" & Section 26 05 53 “Vibration and Seismic Controls for Electrical Systems.” Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

   a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

2. Dimensioned Outline Drawings of Cable Runway Units: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

F. Field Test Reports: Written reports specified in Part 3.

G. Operation and Maintenance Data: For cable runways to include in Operations and Maintenance manuals.

## 1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain cable runway components through one source from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NEMA VE 1, "Metal Cable Runway Systems," if cable runway types specified are defined in the standard.

D. Comply with NFPA 70.

## 1.5 COORDINATION

A. Coordinate layout and installation of cable runways and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC ductwork, piping, and equipment, fire-suppression system, and partition assemblies.

# PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

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

1. B-Line Systems, Inc.
2. Cablofil.
3. Chalfant Cable Runways.
4. Enduro Systems, Inc.
5. G&S Metals Corp.
6. Mono-Systems, Inc.
7. MPHusky.
8. Niedax-Kleinhuis USA.
9. OBO Bettermann.
10. Snaketray.
11. Thomas & Betts Corporation.
12. Wiremaid Products Division.

## 2.2 MATERIALS AND FINISHES

A. Cable Runways, Fittings, and Accessories:

1. Rectangular steel tubing.
2. 132 lb/ft maximum load, supported every 5’ minimum.
3. Protect steel hardware against corrosion by galvanizing according to ASTM B 633 or cadmium plating according to ASTM B 766.
4. Fabricate cable runway products with rounded edges and smooth surfaces.

B. Basket Style Cable Trays, Fittings, and Accessories:

1. Configuration: Wires are formed into a standard 2-by-4-inch wire mesh pattern with in- tersecting wires welded together. Mesh sections must have at least one bottom longi- tudinal wire along entire length of section.
2. Materials: High-strength-steel longitudinal wires with no bends.
3. Safety Provisions: Wire ends along wire-basket sides (flanges) rounded during manu- facturing to maintain integrity of cables and installer safety.
4. Sizes: Straight sections shall be furnished in standard 118-inch lengths
5. Connector Assemblies: Bolt welded to plate shaped to fit around adjoining tray wires and mating plate. Mechanically joins adjacent tray wires to splice sections together or to create horizontal fittings.
6. Connector Assembly Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.
7. Hardware and Fasteners: Steel, zinc plated according to ASTM B 633.
8. Straight Section and Fitting Side Rails and Rungs: Steel complies with the minimum mechanical properties of ASTM A 1008/A 1008M, Grade 33, Type 2.

9. Steel Tray Splice Plates: ASTM A 1011/A 1011M, HSLAS, Grade 50, Class 1.
10. Fasteners: Steel complies with the minimum mechanical properties of ASTM A 510/A 510M, Grade 1008.
11. Finish: Electrogalvanized before fabrication.
    a. Standard: Comply with ASTM B 633.
    b. Hardware: Galvanized, ASTM B 633.

## 2.3 CABLE TRAY AND RUNWAY ACCESSORIES

A. Fittings: Long sweep tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray and runway.

B. Cable tray and runway supports and connectors, including bonding jumpers, as required.

## 2.4 SOURCE QUALITY CONTROL

A. Perform design and production tests according to NEMA VE 1.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. Examine substrates, areas, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

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

C. Cable trays to be furnished and installed by Division 26 Electrical Contractor.

## 3.2 CABLE RUNWAY INSTALLATION

A. The installation and location of the cable runway shall be closely examined in the field prior to installation. Install runway after racks and wall mounted equipment has been completed. The contractors shall closely coordinate the layout of all ductwork, piping, installation, steel beams and joists, light fixtures, etc. and leave adequate space for the cable runway and future access.

B. Install the bottom of the cable runway rack supports and maintain level elevation on walls throughout the room.

C. Remove burrs and sharp edges from cable runways.

D. Fasten cable runway supports securely to building structure as specified in Section 26 05 29 "Hangers and Supports for Electrical Systems" and the drawing details, unless otherwise indicated. Utilize strut for an underneath support along with two vertical drops of 3/8” all thread and hardware. Cable runway manufacturer’s standard single drop supports and clips are not acceptable.

1. Locate and install supports according to NEMA VE 1, minimum of one every 10 feet (3 m).

2. Cable runway shall be installed level and shall not sag or lean after cable placement.

E. Make connections to equipment with flanged fittings fastened to cable runway and to equipment. Support cable runway independently of fittings. Do not carry weight of cable runway on equipment enclosure.

F. Install expansion connectors where cable runway crosses building expansion joint and in cable runway runs that exceed 90 feet (27 m). Space connectors and set gaps according to NEMA VE 1.

G. Make changes in direction and elevation using standard fittings and not butting on section of runway up against another. Confirm radius of runway meets or exceeds requirements by cable manufacturer and cable specifications.

H. Provide drop out fittings where cable ends at telecom room or telecom rack.

I. Make cable runway connections using standard fittings. Confirm radius of runway meets or exceeds requirements by cable manufacturer and cable specifications.

J. Locate cable runway above water piping unless accessibility to cable runway is required or unless otherwise indicated.

K. Seal penetrations through fire and smoke barriers according to Section 26 05 00 "Common Work Results for Electrical."

L. Sleeves: Change over from cable runway to sleeves when cable runway passes through a wall. Provide a quantity and size of sleeves that meets or exceed the same cross sectional area as the cable runway. Providing bonding bushings on the sleeves and ground the sleeves to the cable runway to maintain grounding continuity. Provide firestopping around cables in sleeves through fire rated walls once all cabling is complete.

M. Sleeves for Future Cables: Install capped sleeves for future cables through firestop-sealed cable runway penetrations of fire and smoke barriers.

N. Workspace: Install cable runways with sufficient space to permit access for installing cables.

O. Install barriers to separate cables of different systems, such as voice/data, catv, cctv/security, etc.

P. Unless specifically noted on the drawings, covers are not required unless installing cable runway underneath piping that could have leaks or condensation. Install covers after installation of cable is completed.

Q. Maintain 12” of clearance from all walls, structure, and foreign items such as ductwork and piping. Coordinate installation with all trades.

R. Provide 18” x 1” (unless otherwise noted) horizontal tubular stringer type cable runway over the length of each row of voice/data racks and in each telecom and security room. Provide 18” x 1” (unless otherwise noted) vertical wall-mounted tubular stringer type cable runway between sleeves through floors and horizontal overhead cable runway in each telecom room.

## 3.3 CABLE TRAY INSTALLATION

A. Install cable trays according to NEMA VE 2.

B. Install cable trays as a complete system, including fasteners, hold-down clips, support systems, barrier strips, adjustable horizontal and vertical splice plates, elbows, reducers, tees, crosses, cable dropouts, adapters, covers, and bonding.

C. Install cable trays so that the tray is accessible for cable installation and all splices are accessible for inspection and adjustment.

D. Remove burrs and sharp edges from cable trays.

E. Join aluminum cable tray with splice plates; use four square neck-carriage bolts and locknuts.

F. Fasten cable tray supports to building structure and install seismic restraints, when required.

G. Design fasteners and supports to carry cable tray, the cables, and a concentrated load of 200 lb. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems. “Comply with seismic-restraint details according to Section 26 05 48.16 "Seismic Controls for Electrical Systems.

H. Place supports so that spans do not exceed maximum spans on schedules and provide clear- ances shown on Drawings. Install intermediate supports when cable weight exceeds the load- carrying capacity of the tray rungs.

I. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.

J. Support bus assembly to prevent twisting from eccentric loading.

K. Install center-hung supports for single-rail trays designed for 60 versus 40 percent eccentric loading condition, with a safety factor of 3.

L. Locate and install supports according to NEMA VE 2. Do not install more than one cable tray splice between supports.

M. Support center support hangers for wire-basket trays with 1/4-inch-3/8-inch diameter rods.

N. Make changes in direction and elevation using manufacturer's recommended fittings.

O. Make cable tray connections using manufacturer's recommended fittings.

P. Seal penetrations through fire and smoke barriers. Comply with requirements in Section 07 84 13 "Penetration Firestopping."

Q. Install cable trays with enough workspace to permit access for installing cables.

## 3.4 CABLE TRAY GROUNDING

A. Ground cable trays according to NFPA 70 unless additional grounding is specified. Comply with requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems."

B. Cable trays with communications cable shall be bonded together with splice plates listed for grounding purposes or with listed bonding jumpers.

C. Cable trays with control conductors shall be bonded together with splice plates listed for grounding purposes or with listed bonding jumpers.

D. Bond cable trays to power source for cables contained within with bonding conductors sized according to NFPA 70, Article 250.122, "Size of Equipment Grounding Conductors."

## 3.5 CONNECTIONS

A. Provide grounding clip at each cable tray and runway section or fitting to maintain continuity. Ground cable tray and runway on one end of each run to the grounding bus bar in the telecommunications room. Provide bonding jumpers at all expansion fittings.

B. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

C. Remove paint from all connection points before making connections. Repair paint after the connections are completed.

D. Connect pathways to cable trays and runways according to NEMA VE 2.

## 3.6 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality-control testing:

1. After installing cable trays and runways and after electrical circuitry has been energized, test for compliance with requirements.

2. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements.

3. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable trays, vibrations, and thermal expansion and contraction conditions, which may cause or have caused damage.

4. Verify that the number, size, and voltage of cables in cable trays do not exceed that permitted by NFPA 70. Verify that communications or data-processing circuits are sep- arated from power circuits by barriers or are installed in separate cable trays.

5. Verify that there are no intruding items such as pipes, hangers, or other equipment in the cable tray.

6. Remove dust deposits, industrial process materials, trash of any description, and any blockage of tray ventilation.

7. Visually inspect each cable tray joint and each ground connection for mechanical con- tinuity. Check bolted connections between sections for corrosion. Clean and retorque in suspect areas.

8. Check for improperly sized or installed bonding jumpers.

9. Check for missing, incorrect, or damaged bolts, bolt heads, or nuts. When found, re- place with specified hardware.

10. Perform the following electrical test and visual and mechanical inspections:

    a. Visually inspect each cable tray and runway joint and each ground connection for mechanical continuity.
    b. Measure ground resistance of each system of cable tray and runway to the telecommunications grounding bus bar. Record resistance in ohms. Maximum ground resistance to be 5 ohms.

11. Report results in writing and correct any deficiencies.

## 3.7 PROTECTION

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

1. Repair damage to galvanized finishes with zinc-rich paint recommended by cable runway manufacturer.

**END OF SECTION**

# SECTION 27 41 00 -AUDIOVISUAL SYSTEMS

## PART 1 - GENERAL

### 1.1 SECTION INCLUDES

A. General: Comply with all Contract Documents, including, but not limited to, Divisions 00, 01, 09 and 26 of the general contract specifications.

B. Statement of Work: Provide and install complete and operational Audiovisual System(s) as outlined in these specifications and related drawings.

C. In general, the EC is providing all pathways and the Owner's TC is providing all network cabling to a plate. It is the responsibility of the AV Contractor to provide all wiring, plates, connections, AV cabling, equipment, rigging, all support means and miscellaneous equipment for complete and operational System(s) if specified in this or other related documents or not.

D. Provide for the coordination, provision, installation, inspection, testing, instruction, and warranties of the Audiovisual System(s).

E. Provide all materials, equipment, transportation, and necessary labor for a complete and operational Audiovisual System(s).

F. Additional section information:
1. Required licenses, permits and low voltage permits including any required bonding or insurance requirements to comply with general conditions of specifications and contract documentation.
2. Verification of the dimensions and conditions at the job site.
3. Installation in accordance with the contract documentation, applicable installation procedures or codes as set forth by the state or county of the project or manufacturers' recommendations.
4. Submittal information and provisions.
5. Documented Audiovisual System(s) testing procedures.
6. Instruction of operating personnel.
7. Manuals and provisions thereof.
8. Maintenance and warranties.

G. Definitions:
1. "Contractor" – Integrator who has been awarded the contract to perform the work under this section.
2. The term "shall" is mandatory, the term "will" is informative, and the term "should" is advisory.
3. "Provide and install" – To supply, install, and connect up complete and ready for safe and regular operation.
4. "Indicated", "shown", or "noted" – As indicated on drawings or specifications.
5. "Equivalent", "similar", or "equal" – Of base bid manufacturer, equal in materials, size, color, design, and efficiency of specified product, conforming to base bid manufacturers.
6. "Reviewed", "satisfactory", "accepted", "approved", "directed" – As reviewed, satisfactory, accepted, approved, or directed by the Owner.

H. "Professional grade" – Equipment that is intended for commercial, not residential, use and is rated for continuous duty.
   1. "User-friendly controls" – Controls that are designed and laid out for ease of use in a logical, easily recognizable, format that utilizes industry standard symbols wherever applicable.
   2. "Labels" – All labels on audio-visual equipment and racks shall be self-adhering black laminate with white engraved letters as outlined in Section 3.04.

I. Below is a listing of specification standards, tests, or recommended installation methods and procedures or applicable installation or safety codes.
   1. National Electrical Code (NEC)
   2. National Electrical Manufacturer's Association (NEMA)
   3. Underwriters Laboratories (UL)
   4. Electronics Industries Association (E.I.A.)
   5. American National Standards Institute (ANSI)
   6. Audiovisual System Engineering, by Davis and Davis Second Edition.
   7. Handbook for Sound Engineering Third Edition by Glen Ballou
   8. Video Engineering by Arch Luther, Andrew Inglis
   9. Basic Television and Video Systems Sixth Edition, by Bernard Grob, Charles Herndon
   10. BICSI/INFOCOMM AV Design Reference Manual

## 1.2 SCOPE OF WORK

A. The Contractor shall provide Audiovisual System(s) compatible with the Owner's communications systems (i.e. teleconferencing software, screen sharing, digital signage software, room reservation software, telephone, video, and computer systems) and operations.

B. The Contractor shall provide equipment that, where required, shall conform to the applicable requirements of the Underwriters Laboratories, Inc., local codes, the National Electrical Code and any other governing codes. Such items shall bear a label or mark indicating their conformance to the above requirements.

C. The Contractor shall provide complete and operational system(s) configured and installed for user-friendly operation and low maintenance. Provide for reprogramming of the control button software two (2) times, as directed by the Owner or Consultant, before Final Acceptance. Provide for two (2) level adjustments of the Audio System(s), as directed by the Owner or Consultant, before Final Acceptance. On-site factory technical support shall be provided, if necessary, to assure performance.

D. The Contractor shall restore all finish hardware to original condition including painting, ceiling modifications, and attachments as specified in Division 09 Finishes.

E. Installation work shall be in compliance with all applicable standards and all governing codes and regulations of the authorities having jurisdiction and the Contract Documents.

F. The Contractor shall validate exact location and installation of the equipment, power, conduit, and raceway systems.

G. All software affiliated with the equipment, including but not limited to, the audio DSP, Control System, etc. is the property of the Owner and will be provided on labeled

CDs for archival purposes at project acceptance.

H. The Contractor shall supply all control software, programming service codes, programming notes, files interactive source codes, all media and associated software, touch panel design, all passwords, licenses, dangles and “keys” or other associated control or programming items at no additional cost to the Owner at commissioning.

## 1.3 SYSTEM(S) DESCRIPTION AND REQUIREMENTS

A. The following is a basic room type description and is not intended to be all-inclusive for proper installation or operation of systems. The AV specification and the AV Bid Set drawings need to be fully reviewed together to ensure that the design intent and list of design intent equipment is completely understood.

B. Conduits:
1. It is the Contractors responsibility to first coordinate in the field and then review all installed sizes and locations of conduit runs, boxes, telecom outlets, electrical outlet, AV outlets provided and installed under Division 26 and provide fit-up and coordination drawings as required for proper communication and understanding between trades.
2. Provide a written acceptance of all field conditions or a list of any discrepancies within ten (10) working days from Notice to Proceed.

## 1.4 DELIVERY, STORAGE AND HANDLING

A. The Contractor shall carefully control handling and installation of all items which are not replaceable, so that completion of the work will not be delayed by hardware or equipment losses before, during, and after installation. The Contractor is responsible for all items until Final Acceptance.

B. The Contractor shall, prior to installation, protect exposed surfaces with material which is easily removed without marring finishes.

C. The Contractor shall, without cost to the Owner/Consultant, replace any products damaged during storage, handling or during installation.

## 1.5 SCHEDULING

A. The Contractor shall submit a schedule to the Owner/General Contractor for approval within 10 (ten) working days from notice to proceed. The schedule shall show sequence of work, etc. from time of Notice to Proceed to final sign off. This schedule shall be submitted in Microsoft Project (or similar program) in both paper and electronic format, with submittals.

B. It is the responsibility of the Contractor to coordinate the installation of the system(s) to be compatible with the work of the other trades. The Contractor shall attend progress meetings and provide continuous on-site project management.

C. It is the responsibility of the Contractor to arrange with the Owner/Consultant a mutually acceptable time and date(s) for Acceptance Testing, based upon project dates and schedule provided.

D. The Contractor shall provide operating personnel with extensive training for each system type and/or room type as outlined in Section 1.03.

## 1.6 BID/TECHNICAL PROPOSALS

A. The Contractor shall be experienced in the provision of systems similar in complexity to those required for this project and Contractor shall provide documentation demonstrating the below minimum criteria:

1. A primary business of the Contractor/Installer shall be the installation of audio and video systems.
2. At least three (3) years experience working for Brunswick County with the specified equipment and systems.
3. Be an authorized dealer and service facility for the products furnished.
4. Maintain a technically trained installation crew and service crew for maintenance and installation of the specified system(s).
5. Lead Installer shall have attended factory training in DSP and video controller for equipment specified in this specification.
    a. Contractor shall demonstrate that the installation staff consists of 50% CTS-I trained personnel and have at least one (1) CTS-D on staff.
6. Final Audiovisual System(s) shall be approved by the Consultant.
7. Upon request of the Owner/Consultant, Contractor shall demonstrate that he has:
    a. Sufficient facilities and equipment for this work.
    b. Sufficient staff with the appropriate technical expertise and experience for this project.
8. All Bid proposals shall be valid for ninety (90) days from date received.
9. Any deviations from specified equipment must be explained in full detail including reasons for any deviations and product comparisons to the originally specified product. Submission of said comparisons does not constitute acceptance of changes and in fact may be declined. If substitutions are rejected/declined, Contractors bid may be rejected for “non-responsiveness” unless a bid has been supplied with “as-specified” equipment.

B. Provide a list of three (3) references with locations, names of contacts, and contact phone and email information with brief system descriptions and dollar amounts for each reference. References shall be no more than three (3) years old and be of similar size, type, and complexity as the system set forth.

C. A detailed equipment list in Microsoft Excel format (both hard copy and electronic) showing Item Number, Item Description, Manufacturer, Part Number, Quantity, and Price. This shall be generated from this document and related drawings.

D. The Bid proposal will include all labor and cabling for all optional equipment listed in specification and AV Bid set drawings. Please list as separate budgetary items.

## 1.7 SUBMITTALS

A. Provide the following for approval no later than thirty (30) days after Notice to Proceed and prior to commencement of work:

1. A complete list of all products incorporated within the work with all quantities listed. Each product shall be listed with specification section references in Excel format.
2. Complete functional diagrams of each system required for a complete and operational system with descriptive narratives of any deviations from the specified system design.

3. All shop drawings defined as required.

B. Shop Drawings:
1. Shall match the size of the construction documents.
2. Shall be scaled appropriately but not less than 1/8" =1'.
3. Shall show detailed schematic wiring diagrams showing interconnection of Contractor- provided components and fabricated products, wiring and cabling diagrams depicting cable types, and device designators. Each component shall have a unique designator and use same designator throughout the project.
4. Shall show location of all equipment in racks, consoles, or on tables, with complete dimensions, wire routing, and cabling.
5. Shall show all A.C. power outlet locations and terminal strip locations within each equipment rack including all sequencing as required for proper start-up and shut down.
6. Shall show plans and sections of the building and adjacent grounds with the location of all installed equipment such as loudspeakers, racks, consoles, plates/panels, antennas, (etc.).
7. Shall show patch panel layouts and labeling strips, including color schemes, as necessary.
8. Shall show full fabrication detail of custom enclosures and millwork indicating dimensions, material, finish, and openings for equipment.
9. Shall show all speaker mounting details including hardware types and load capacity. Structural information with design calculations and a copy of the PE's certifications for each item/drawing.
10. Shall provide complete drawings for all fabricated plates and panels. Drawings shall include dimensional locations of components, component type, engraving information, plate color information, and a complete bill of materials for each plate and sample plates per type.
11. Shall show complete labeling schemes for all cabling and equipment components for project. Include font size and styles along with a sample cable label and equipment label. All labeling shall be consistent within the project scope.
12. Shall show a complete wire schedule showing source and destination and indicating conduit location and sizing. Provide conduit sizing and layout coordination information.

## 1.8 PROJECT CONDITIONS

A. Verify conditions on the job site applicable to this work. Notify Owner's Representative/Consultant in writing of discrepancies, conflicts, or omissions promptly upon discovery.

B. If conditions exist on the jobsite which make it impossible to install work as shown on the drawings or detailed in the specifications, recommend solutions and submit drawings showing how the work may be installed as well as an adjusted new schedule to the Consultant and Owner for approval.

## 1.9 FINAL INSPECTION AND TESTING/COMMISIONING

A. Upon completion of installation and Contractor commissioning (as outlined in Section 3), the Consultant shall perform system(s) inspection and testing.

B. To assist the Consultant, the Contractor shall provide a minimum of one person for inspection and two persons for testing who are familiar with all aspects of the specified system(s).

C. The process of testing the system(s) may necessitate moving and/or adjusting certain components such as speaker aiming, transformer tap values, software adjustments, DSP adjustments, controller adjustments.

D. Testing will include operation of each system and all components. The Contractor will provide required test equipment, tools, and materials required to perform necessary repairs and/or adjustments.

E. In the event that adjustments or work is required during testing, or to bring the systems into specification, the Contractor shall continue his work until the system(s) are acceptable with no addition to the contract price. If approval is delayed due to defective equipment, and/or failure of equipment or installation that meets the requirements of this specification, the Contractor shall pay for additional time and expenses to the Owner at the rate specified by the Owner.

F. All Control Systems shall be fully tested prior to commissioning. Once the Control Programming is finalized all source code (complied and raw), programming, and touch panel software shall be burned on to a CD ROM and delivered to the Owner. All Control System programming (including source, files, touch panel design), and DSP and video controller shall become the property of the Owner.

G. Contractor shall supply to Consultant all DSP and video controller layouts for review and comment and authorization prior to installation. Contractor shall provide any necessary adjustments to software as deemed by the Consultant.

## 1.10 WARRANTY

A. All equipment provided by the Contractor shall be installed per manufacturer's specifications and warranted by the Contractor for a minimum period of one (1) year from the date of written acceptance, unless otherwise noted, to meet all performance requirements outlined herein. Warranties shall not be pro-rated.

B. During the warranty period, no charges shall be made for any labor, equipment, or transportation to maintain performance and functions.

C. The Contractor shall respond with a remedy to a trouble call within twenty-four (24) hours upon receipt of such a call, and shall provide a 24-hour service phone number. Downtime for system(s) shall be no longer than a 24-hour period. All replacement parts/components shall be of equal or higher level of service.

D. Equivalent replacement equipment shall be temporarily provided when immediate on-site repairs cannot be made.

E. At least two routine inspections and adjustment visits will be scheduled for the first year, coordinated with Owner and the findings reported.

F. Provide a separate price for an optional yearly service contract for years two (2) through five, to begin at the end of the initial warranty and service contract. Provide details on coverage and options.

G. The Contractor shall be present at the first use of the system (scheduled by the Owner), and one additional event as requested by the Owner for no additional charge.

### 1.11 INSTRUCTION OF OWNER PERSONNEL

A. After final inspection and completion, provide instruction to Owner-designated personnel on the operation and maintenance of the system(s).

B. Develop an instructional course based on the use of the system(s) and manufacturers' recommendations. Provide a minimum of three (3) hours of instruction, per system type, on two separate occasions separated by a length of time established by the Owner. Total training time shall not be less than a total of six (6) hours. Arrange the course so that operational and maintenance classes are separate. Each instruction time shall be video recorded and provided to the Owner.

C. Submit an outline of the course with sample instructional aids for approval one (1) week prior to scheduled instruction sessions.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Electronic component models shall be commercially available for a least one (1) year prior to bid or be approved by the Consultant.

B. All equipment and material shall be new unless specified in this specification.

C. All equipment must be UL listed or built to UL standards, where required.

D. Video control equipment shall be Crestron, Extron or equal.

E. Audio equipment shall be Biamp or equal.

F. Backboxes and mounts shall be by Chief or equal.

G. Displays by LG, Samsung, Sharp, or Sony.

H. Cameras, sound bars, and/or microphones by Biamp, Cisco, Crestron, Extron, Logitech, Kramer, Marshall, Shure, and Vaddio.

### 2.2 GENERAL

A. All equipment shall be professional grade and rated for continuous duty. Basic guidelines have been prepared with manufacturer names, makes, and model numbers included as minimum performance requirements. These must be satisfied, unless a variance (exemption document) is submitted and approved by the Consultant.

B. System(s) shall be installed and configured for simplicity of operation, with user-friendly controls.

C. Product quantity is as required for complete and operable system(s). If any quantities are given, the Contractor shall provide at least the given amount. Some of the products listed under this section may not be required to fulfill the work as outlined.

D. Regardless of the length or completeness of the descriptive paragraphs listed herein, each device shall meet published manufacturer's specifications.

E. Remove all manufacturer's nameplates or logos from product, such as found on speaker(s), within the public sight lines or spaces when applicable.

F. Paint all wall and ceiling mounted speaker grilles and enclosures as directed by the Consultant/Architect.

G. The Contractor is responsible for providing a fully operational turnkey system. The following equipment list and attached drawings are for final design intent purposes.

H. The Contractor shall program no less than five (5) presets on the audio console such that the first preset will reset the console to a default "cleared" setup and each of the other presets will be for various levels of user group activities. Additionally, settings that are not needed for everyday use will be locked out and the password will be given to Owner. Additionally, no less than three (3) user groups will be programmed and password protected.

## 2.3 PLATES AND PANELS/FLOOR BOXES

A. Provide plates and panels as described/detailed in the drawings and as required for fully operable system(s).

B. Custom plates shall be 1/8" thick aluminum, standard EIA sizes, sized to cover rough-in/boxes behind plates.

C. Coordinate plastic or stainless steel plates and all device colors with the architect.

D. Lettering shall be in all caps and numbers engraved with black or white lettering to the base material with a minimum size of 0.25".
   1. Font Size shall be 1/8"
      a. Font Style shall be Helvetica

## 2.4 CABLES AND WIRING

A. All audio cable shall be stranded copper conductors.

B. Shielded cables located in raceways shall have aluminum foil shield with drain wire.

C. Where cables run exposed in a return plenum space, provide plenum rated cable.

D. Where cables are routed above ceilings, provide separately supported j-hooks on no more than 5 foot centers.

E. The following are examples of cables as required for fully operable system(s).
   1. Microphone/Line Level cable: 22/2 shielded jacket.
      a. Plenum - West Penn 25291B
      b. Non Plenum – West Penn 452
   2. Speaker Level cable: 14/2 unshielded.
      a. Plenum – West Penn 25226B
      b. Non Plenum – West Penn 226

3. Speaker Level cable: 16/2 unshielded.
   a. Plenum – West Penn 25225B
   b. Non Plenum – West Penn 225
4. Loudspeaker cable: 10/2 unshielded.
   a. Plenum – West Penn 25210
   b. Non Plenum – West Penn HA210
5. Communications cable: 22/9 shielded.
   a. Plenum – West Penn D253653
   b. Non Plenum – West Penn D3653
6. Communications cable: 24/9 shielded.
   a. Plenum – West Penn D252404
   b. Non Plenum – West Penn D2404
7. Control cable: 22/10 shielded jacket.
   a. Plenum – West Penn 253272B
   b. Non Plenum – West Penn 3272
   c. Non Plenum – West Penn 4245F
8. Ethernet cable: Cat6 F/UTP shielded.
   a. Plenum – West Penn 254246F
   b. Non Plenum – West Penn 4246F
9. RGBHV cable: 25/5 shielded.
   a. Plenum – West Penn 255CRGB
   b. Non Plenum – West Penn 5CRGB
10. HD/SDI cable: 18/1 braided
    a. Plenum - West Penn 256350
    b. Non Plenum - 6350
11. CATV cable: 18/1 braided
    a. Plenum – West Penn 25841
    b. Non Plenum – West Penn 841
12. Hybrid HDMI/Fiber cable:
    a. Plenum – FSR DR-PCB-H###
13. Fiber Optic cable – OM3
    a. Plenum – West Penn M9C014
    b. Non Plenum – West Penn M9C006

## 2.5 PROPOSED SUBSTITUTIONS

A. Where specific equipment is described and is not a County standard or requirements, it is not the intention to discriminate against the products of other manufacturers, but rather to establish a standard of quality. All proposed substitutions should be submitted as alternates with exemption documentation for Consultant approval and complete product data sheets.

B. The Owner/Consultant requires manufacturer's original specification tests. The Owner/Consultant will evaluate and approve/disapprove all substitutions.

C. Items designated "no substitutions" will be specified items only. Submission of items other than specified shall not be considered and will disqualify RFP submission.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Follow ANSI standards as a minimum.

B. Provide shaft locks or security covers on non-user operated equipment having front panel access.

C. Install XLR-type connectors wired as follows: Pin 2 High, Pin 3 Low, and Pin 1 Shield.

D. Mount all equipment, speakers, plates and panels, plumb and level.

E. Permanently install all equipment to be firmly mounted and held in place. Provide necessary equipment supports to hold and support loads with at least a 5:1 safety factor.

F. Validate bracing or blocking for proper mounting and safety.

### 3.2 EQUIPMENT HOUSING

A. Locate operator useable equipment and patch panels at an appropriate operating height.

### 3.3 LABELING

A. Provide engraved label over each user-operated control that describes the function or purpose of the control. Adjust size of label to appropriate size for location.

B. Provide each terminal strip with a unique descriptor and numerical designator for each strip. Show strip information on the drawings.

C. Provide logical and legible cable and wiring labels permanently attached for easy identification to each cable on both ends.

D. Label on cables shall be adhesive style striping covered with clear, heat shrink tubing, sized appropriately for the cable.

E. Wiring designator shall be alphanumeric code, unique for each cable.

F. Each cable type shall be labeled starting with different destinations (i.e. mic series “Mxxx”, speaker series “Sxxx”, etc.).

G. Locate the cable designator at the origination and the destination of each circuit. Locate cable designator within 2” of connection point.

### 3.4 CONTRACTOR COMMISSIONING

A. Prior to energizing or testing the system(s), ensure the following:
1. All products are installed in a proper and safe manner per the manufacturers’

instructions.
2. Insulation and shrink tubing are present where required.
3. Dust, debris, solder, splatter, etc. is removed.
4. Cable is dressed, routed, and labels and all connections are consistent with regard to polarity.
5. All labeling has been provided and installed.
6. All products are neat, clean, unmarred and securely fastened.
7. All debris has been cleaned and removed from the site.
8. All electronic devices are properly grounded.

B. Perform the following test. Record all results in the final project manual.
1. Test each AC power outlet for proper connections for hot, neutral and ground.
2. Measure and record the DC resistance for the technical ground in the equipment racks and console. Resistance should be 0.15 ohms or less.
3. Measure the impedance of each speaker line from the amplifier rack.

C. Speaker Verification Test:
1. Provide a low level distinctive tone to each amplifier input.
2. Systematically turn on each amplifier, one by one, and verify that the correct speaker is being driven. Correct wiring as required for proper operation.

D. Constant Voltage Speaker test:
1. Provide a low level distinctive tone to each amplifier input.
2. Systematically turn on each amplifier, one by one, and verify that the correct speaker is being driven. Correct wiring as required for proper operation.
3. Walk the areas covered by the speakers and check for even level volume coverage. Adjust any speakers that are not correct by changing tap values as required for even volume level.

E. Speaker Polarity:
1. Use an electronic polarity checker to test each reinforcement speaker. All speakers should have the same relative polarity.

F. System(s) Gain Adjustment:
1. Adjust each active device to have unity gain from the console output to the input of the amplifiers.
2. With all amplifiers turned off, connect a sine wave and pink noise to an input of the console. Using a RMS voltmeter, adjust the scale to an output between -10 and 0dBu. Once level has been established, it should remain unchanged throughout the testing.

G. Amplifier Level Adjustment:
1. Adjust the gain of each amplifier to provide consistent and appropriate levels throughout the seating areas/facilities.
2. With the console and other electronic devices feeding the amplifiers adjusted as described above, adjust the output of the console to be -10dB on the output VU meter.
3. Adjust the appropriate amplifiers to achieve 85dBA in the area covered by one of the speakers. Use a calibrated sound level meter to make the adjustments.

4. If the speaker is utilizing an active crossover, mute the individual bandpass sections to adjust each section independently.
5. Start with the speaker closest to the stage area or the booth location as appropriate. Once that speaker has been adjusted to the above criteria, repeat this procedure for each speaker cabinet.
6. Amplifiers should be set to provide an average of 85dBA plus or minus 1.5dB throughout each seating section.

H. Amplifier Level Adjustment 70 volt System:
1. Adjust the level of the 70 volt systems to achieve a volume level appropriate for their location and intended use.
2. After initial amplifier adjustment, walk all areas utilizing the 70 volt systems and check for volume uniformity. If any changes of 3dB or more occur, adjust that specific area or speaker as required for even coverage.

I. Input Verification Test:
1. Using a microphone, portable signal generator, or CD player, send signal from every microphone input to the console. Check every connection location in the facility.
2. Verify video signal presence at each component input with test equipment and verify the proper signal and uniform strength.
3. Verify that the receptacle under test appears at the correct position on the patch bay and is operating properly.
4. In a similar manner, check any other inputs or tie lines, as appropriate.

J. Impedance:
1. Measure absolute impedance value of each loudspeaker line at 250, 500, 1000, and 2000 Hz without the amplifier connected but with all speakers connected. Record the impedance levels versus frequency for each loudspeaker line.
2. Impedance must not be below the rated load impedance of respective amplifier and may be any value equal to or above that.
3. Check the resistance of the lines for loudspeaker, line level, and microphone receptacles with the receptacles opened and shorted. Document and repair any shorts or discontinuities found.

K. Polarity:
1. Verify the polarity of each device in the shop to obtain true polarity throughout the system.
2. Verify and document that polarity is kept throughout the system after wiring from inputs through output devices or receptacles.

L. Gain Structure:
1. Turn off amplifiers and set equalizers and filter controls to flat response. Do not bypass any equalizers or filters.
2. Adjust compressors and limiters to a 1:1 compression ratio and a +10 dBu limiting threshold. Do not bypass these processors.
3. Insert pink noise into the mixer or mixing console and adjust levels to obtain a 0 dBu reading for the mixer or mixing console output. Distribute this output to all

systems and subsystems.

4. Adjust the output of line level electronics and signal processors to obtain a 0 dBu output at the output terminals. For equipment with input level controls, adjust the input controls so that input levels peak at -10 dB. For equipment not capable of providing 0 dBu output, adjust to achieve as close to 0 dBu as possible.
5. Turn amplifier gain controls to minimum and turn on the power amplifiers. Adjust the gain controls to achieve a +4 dBu output level for low impedance amplifiers and a +18 dBu output level for high impedance or constant voltage amplifiers.

M. Hum and Noise Level:
1. Without changing the gain, terminate microphone and line level inputs with proper shielded resistors of 150 and 600 ohms respectively.
2. Measure and record overall hum and noise levels for each power amplifier output from each input and with all inputs simultaneously. Hum and noise shall be at least 50 dBA below rated power output levels with amplifier controls set for optimum signal-to-noise,
using input from line level and microphone sources.

N. Electrical Distortion:
1. Load amplifier outputs with appropriate resistors matching the nominal impedance of the output terminals in place of the actual loudspeaker loads.
2. Adjust gain controls as for hum and noise level test.
3. Apply 250 Hz, 500 Hz, 1 kHz, and 2 kHz sine wave signal from an oscillator with less than 0.01% Total Harmonic Distortion to one input, such that a level of 0 dBu is obtained on the mixer.
4. Measure and record the electrical distortion at each power amplifier output. Distortion shall be less than 0.5%.

O. Parasitic Oscillation and Radio Frequency Pick-up:
1. Set up system for each specified mode of operation.
2. Using a 5 MHz bandwidth oscilloscope and loudspeaker monitoring.
3. Ensure that the system is free from spurious oscillation and RF pick-up with the absence of any input signal and with a 160 Hz signal at a 0 dBu level on the mixer or mixing console.
4. Repeat this test for each mode of operation of the lighting dimmers (incandescent, neon, and fluorescent).

P. Background Noise:
1. Using a calibrated ANSI S1.4-1983 (1997) Type 1 or IEC 60651-01-1994, precision sound level meter, determine the average ambient noise level in the room. Record the level derived. The average background noise shall be 60 dBA or below during performance of the following tests. If noise level exceeds this criterion, promptly notify the Consultant before proceeding further.

Q. Buzzes and Rattles:
1. Apply a 1 kHz sine wave signal such that a 0 dBu level is obtained on the mixer or mixing console.
2. Sweep loudspeaker systems from 50 Hz to 5 kHz at 6dB below full amplifier

power. Listen for buzzes, rattles, vibrations or resonance. Locate and correct problems.

3. If the cause is outside the system, promptly notify the Consultant, indicating the cause and recommended corrections.

R. Coverage:
1. Using pink noise as an input, adjust loudspeakers and output levels to provide ±6 dB coverage in the octave band centered at 1 kHz throughout the areas served by the system.
2. Measure and record results.

S. Equalization:
1. Equalize the sound systems in order to provide uniform seat-to-seat response, raise the threshold of feedback, suppress ring modes, and insure natural, pleasing sound in equal and adequate amplitude with maximum degree of intelligibility, and provide performance conforming to the requirements specified under "Acceptance Testing."
2. Turn off systems except the speaker system under test.
3. Using pink noise as an input and with system equalizers set to bypass operation, determine the average frequency response of the loudspeaker system in the room using a 1/3 octave real time analyzer.
4. Record the frequency response derived.
5. Locate the analyzer microphone approximately 1 m above the floor at a point which approximates the average frequency response, within ±3 dB from 50 Hz to 16 kHz.
6. Record the frequency response at this location.
7. Using pink noise as an input and with system equalizers set to normal operation, set low and high pass filters at 63 Hz and 16 kHz respectively.
8. Adjust the 1/3 octave filter settings to obtain the following response curves, minimizing the variation (±3 dB) between adjacent filter settings:
   a. Roll off -6 dB per octave below 125 Hz.
   b. Maintain ±3 dB, 125 Hz to 4 kHz.
   c. Roll off -3 dB per octave from 4 kHz to 12 kHz.
   d. Roll off sharply above 12 kHz.
   e. With any system microphone open, make minor adjustments to maximize gain before feedback. No more than 3 filter settings shall be adjusted.
   f. Record the frequency response derived.

T. System Input and Output Levels
1. Using pink noise source material and a calibrated ANSI S1.4-1983 (1997) Type 1 or IEC 60651-01-1994, precision sound level meter, perform the following:
   a. For microphone level inputs: locate a pink noise source at a distance of 300 mm from the corresponding system microphone. Adjust the pink noise source to provide a level of 75 dBA at the microphone and set mixer levels to achieve a 0 dBu level at the mixer output.
   b. For line level inputs: use system program source equipment, with pink noise playback media, as a direct input to the mixer or mixing console and set mixer levels to achieve a 0 dBu level at the mixer output. Repeat for each

system input individually where mixer inputs vary in input sensitivity. Settings for equivalent sensitivity inputs may be duplicated.

c. With any input set as specified above, adjust audio distribution amplifiers to provide levels of -10 dBu at each output.

2. Measure and record results.

U. Feedback Stability:

1. With required output levels set, measure and record the available gain before feedback. Feedback stability margin shall be 6 dB, minimum.

V. Intelligibility:

1. Using a TEF analyzer, measure the percent articulation loss of consonants (% ALcons) for at least 4 various locations in the room in the 2000 Hz octave band.
2. % ALcons shall be less than 10 for each location.
3. Record results.

W. Notification:

1. Once all of the above is complete, the system(s) is (are) ready for inspection. Formally notify the Owner/Consultant at least seven (7) days prior to desired inspection date.
2. Final adjustments and equalization will be conducted at the time of inspection.

## 3.5 CONTRACTOR MEDIA TESTING AND COMMISSIONING

A. Audio Video Switching

1. The AV switching system shall support at least 6.75gbps of data transfer on each input and output to support 1080p 36-bit (deep) color video resolutions without compression.
2. The AV switching system shall support 8 channel audio.
3. The AV switching system shall support audio breakaway from video.
4. The AV switching system shall have less than 5us of latency from av input to av output.
5. The AV switching system shall support the HDMI specification of less than 1 in 1x10-9 bit errors at 1080p 36-bit (deep) color.
6. The AV switching system shall downmix multi-channel audio into 2-channel audio so that the same audio content may be routed to both multi-channel and 2-channel sinks.
7. The AV switching system shall be able to dither between standard and deep color video signals on each input and output.
8. The AV switching system shall support the following av signal inputs:
   a. HDMI 1.3a (high definition multimedia interface)
   b. DVI 1.1 (digital visual interface)
   c. Displayport multimode 1.1
   d. Analog RGB
   e. YPBPR
   f. SPDIF
   g. Analog stereo audio

9. The AV switching system shall transcode the AV signals to a single signal type for distribution.

B. Audio Video Distribution
1. The AV distribution system shall use multimode fiber or shielded twisted pair for AV signal distribution.
2. The AV distribution system shall route AV signals from any input to any output with less than 1ms of latency.
3. The twisted pair structured cabling used to carry the AV signals shall be shielded.
4. The twisted pair structured cabling used to carry the AV signals shall be specified to 1.2ghz of bandwidth or greater.
5. The AV distribution system shall not require extra cabling to transmit the following control signals for AV sources and sinks:
   a. RS-232
   b. Infrared
   c. Ethernet
   d. USB human interface device-class devices
   e. Contact closure

C. EDID Management
1. The AV switching system shall allow configuration of the EDID presented to sources on each AV input.
2. Each input on the AV switching system shall be configured independently.
3. The AV switching system shall by default present an EDID to each input that includes only the video timings and audio formats common all sinks connected to the outputs.
4. The AV switching system shall allow the user to enter each input's EDID video timings individually.
5. The AV switching system shall allow the user to enable and disable support for the following items in each:
   a. Deep color
   b. 3D support

D. HDCP Management
1. The AV switching system shall support HDCP 1.1 or greater.
2. The AV switching system shall detect the number of keys supported by each source.
3. The AV switching system shall not send a source more keys than it supports.
4. The AV switching system shall cache the keys from each connected sink.
5. The AV switching system shall authenticate all cached keys with each source up to the source's key limit, so that authentication does not need to be re-started each time content is routed to a new output.

E. Signal Detection
1. The AV switching system shall report the following incoming signal information to an AV control system:
   a. Signal detect
   b. Horizontal and vertical resolution
   c. Signal refresh rate

d. Presence of HDCP

2. The AV switching system shall report the following information to an AV control system:
   a. HDCP authentication status for each source and sink
   b. EDID preferred video timing for each sink
   c. Maximum number of keys supported by each source

F. Troubleshooting
1. The AV switching system shall report the following information for troubleshooting:
   a. Maximum number of keys supported by each source
   b. The number of keys sent to each source
   c. EDID indicated video timings and audio formats supported for each sink
   d. EDID presented to each source
2. The AV switching system shall support off-site remote troubleshooting via Ethernet.

G. System Design
1. The contractor shall provide AV source equipment with support for enough keys so that it can be routed to all sinks simultaneously.
2. If a particular AV source cannot be found to support enough keys to route to all sinks simultaneously, the contractor shall:
   a. Notify the engineer
   b. Configure the AV switching equipment so that it shall not send an AV source more keys than it supports.
3. The contractor shall configure the EDID presented to each AV source to indicate only the video timings supported by all sinks used for viewing and distributing video.
4. The contractor shall configure the EDID presented to each AV source to indicate support for only the audio formats actually supported by all the sinks used for distributing audio.
5. The contractor shall verify the data rate supported by each shielded twisted pair cable used for AV distribution.
6. The contractor shall provide display equipment that does not overscan the video signal when full-pixel sources are routed.

H. Demonstration and Acceptance Testing
1. The demonstration and acceptance tests shall be done by an Extron DTP certified engineer.
2. The contractor shall provide a copy of the following information in electronic format in order to verify the AV switching equipment has been installed and configured correctly:
3. The number of HDCP keys supported by each source.
   a. The video timing, HDCP use and audio format of each source when operating (not needed for walk-in equipment).
   b. The video timings and supported audio formats for each connected sink.
   c. The video timings and supported audio formats presented in the EDID to each source– the preferred video timing shall be indicated.
   d. The length of cable used on all shielded twisted pair cable used for AV distribution.

e. The data rate supported by each shielded twisted pair cable used for AV distribution.

## 3.6 GENERAL VIDEO SYSTEMS

A. Video signals shall be scaled or scan converted as necessary to provide the native resolution signal to display and video capture devices.

B. Whenever possible a common native resolution shall be determined for each space and shall be provided to every display in the system.

## 3.7 COMPUTER INTERFACES

A. Review all locations with the Owner prior to installation and provide according to Approval of the Owner. Low voltage power shall be provided at the interface.

B. Provide audio and video breakout cables for each computer interface provided as specified herein unless noted otherwise.

C. Provide manufacturer's adapter plates for pass-through connections as specified herein unless noted otherwise.

D. Adjust peaking, horizontal and vertical position for system native resolution.

## 3.8 SIGNAL PROCESSING EQUIPMENT

A. Signal processing equipment shall be mounted in the equipment racks and/or control consoles, as specified herein unless noted otherwise.

B. Configure and adjust signal processing equipment to produce the native resolution of the primary display devices within each separate system for each potential source resolution, unless specified otherwise herein. RGBHV sources shall be tested from 640 x 480 at 60 Hz through 1600 x 1200 at 60 Hz. NTSC composite video and NTSC S-video shall also be tested.

## 3.9 VIDEO MONITORS/RECEIVERS AND ASSOCIATED EQUIPMENT

A. Video monitors/receivers shall be selected to match the native resolution of the system, unless otherwise specified herein.

B. Configure monitors to provide full images at the monitor’s native resolution. Verify color timing.

C. Review all locations with the Owner prior to installation and provide according to Approval of the Owner.

## 3.10 VIDEO SYSTEMS

A. General
   1. Adjust, balance, and align equipment for optimum quality and to meet the manufacturer's published specifications.

B. Performance Standards
   1. Unless restricted by the published specifications of a particular piece of equipment, or unless specified otherwise herein, the following performance standards shall be met by each system.

C. Video images shall be:
   1. Free from banding where bands of the video image are at incorrect intensities.
   2. Free from bending at the corners due to synchronization problems.
   3. Free from outlining due to timing issues and component signals being out of convergence.
   4. Free from ghosting or reflections due to improper termination and impedance mismatching.
   5. Free from video roll due to ground loops and improper grounding.
   6. Free from visible jitter due to an instable synchronization signal.
   7. Free from double images due to improper scan rates.

D. Video, Signals
   1. S/N (peak-to-rms) unweighted dc to 4.2 MHz: 55 dB minimum.
   2. Crosstalk, unweighted dc to 4.2 MHz: 55 dB minimum.

E. Video Signal Strength
   1. Composite video: 1V peak-to-peak, nominal.
   2. S-video: 0.7V peak-to-peak, nominal.
   3. Component video: 0.7V peak-to-peak, nominal.
   4. Computer: RGB 0.7, peak-to-peak, nominal, H and V, 5V (TTL).
   5. Receptacle voltage level for RF signal outlets: 6.0 dBmV, ±3.0 dB.
   6. Line and field tilt: 2% maximum.
   7. Differential gain: 3% maximum.
   8. Differential phase: 2° maximum.

F. Video, Timing
   1. System synchronization coincidence shall be within 50 nanoseconds.
   2. NTSC color timing shall be within 2° at 3.58 MHz.
   3. Computer (RGBHV) color timing shall be within 1 pixel at system resolution.
   4. Video timing shall be achieved without readjustment of source phasing.
   5. Delay units, active or passive, shall be provided, if necessary, to achieve proper timing.

G. Video Displays
   1. Review all locations with the Owner/Consultant prior to installation and provide according to Approval of the Owner/Consultant.
   2. For the following tests and adjustments, test signals provided by the signal generator shall be injected into the system from the primary presentation location

and displays optimized from this location.

a. Image Sizing:
    1) Using a crosshair or crosshatch pattern, adjust display device to show full image at system resolution.

b. Black Level:
    1) Use a signal generator to provide a picture line up generating equipment (PLUGE) test pattern on the display to be adjusted.
    2) Adjust the brightness control upward until the "blacker-than-black" bar is visible on the screen.
    3) Decrease the brightness control slowly until this bar becomes fully extinguished. Continue until the test pattern background reaches the same point, i.e. no light output.
    4) The remaining vertical bar should be dimly visible. Record the value of the onscreen display.

c. System Gain:
    1) Use a signal generator to provide a PLUGE test pattern on the display to be adjusted.
    2) Adjust the contrast control until the 100% white bar begins to bloom or distort in size or stops getting brighter.
    3) Decrease the contrast control until the white bar is at the threshold of maximum brightness without any of these distortions.
    4) Record the value of the onscreen display.
    5) Perform Black Level and System Gain tests until there is no additional interaction between contrast and brightness control adjustments and record the final onscreen values for contrast and brightness.

d. Color Level or Gain
    1) Use a signal generator to provide a SMPTE color bars test pattern on the display to be adjusted.
    2) Adjust the color level, individually if possible, until each channel's large bar blends with the small patch underneath.
    3) Record the onscreen value for color level(s).

e. Color Phase:
    1) Use a signal generator to provide a SMPTE color bars test pattern on the display to be adjusted.
    2) While viewing the blue channel information only, adjust the tint control until the large internal bars blend with their patch below.
    3) Perform Color Level and Color Phase tests until there is no additional color or tint control interaction and record the final onscreen values for color and tint.

H. Cabling
1. Upon completion of the installation of each area, the Contractor shall test all elements of the system. This testing shall include as a minimum:
    a. Continuity of all circuits.
    b. Operation of all circuits.
    c. Phase checking of all circuits.
    d. Operation of all equipment in all modes

2. During and/or after installation, as appropriate, the Contractor shall test all cabling for continuity, phase, shielding, and unreasonable signal loss. The testing shall be conducted according to the submitted and approved test plan.

## 3.11 SPARE PARTS

A. Provide replacement fuses, lamps, batteries and connectors in sufficient quantities to last one (1) year.

## 3.12 QUALITY CONTROL

A. Provide and maintain an effective Quality Control program and perform sufficient inspections, surveys and tests of all items of work, including those of other trades, to ensure compliance with the contract documents. Furnish appropriate facilities, accurately calibrated instruments and testing devices required to perform the quality control operations and with sufficient work forces to cover the installation operations within the actual installation sequences. Coordinate this work with the quality control requirements of other technical Sections of the Specifications and with requirements of the Contractor and governing authorities having jurisdiction.

## 3.13 PRE-INSTALLATION MEETING/SCHEDULE

A. Prior to the start of the work, and at the Owner/Consultant's direction, meet at the project site to review methods and sequence of installation, special details and conditions, standard of workmanship, testing and quality control requirements, job organization and other pertinent topics related to the work. The meeting shall include the Contractor, Contractor's Project Manager, the Owner/Consultant, and the General Contractor. Inspection and testing services (if any) and any other subContractors whose work requires coordination with this work shall be coordinated.

B. A Conduit/Wiring Analysis shall be conducted at the Pre-Installation Meeting. The Contractor shall submit “as-built” drawings locating all existing conduit runs, junction boxes, and electrical outlets. Show location and type of all special receptacle boxes and plates to be supplied and/or modified by the Contractor. Verify and inspect all necessary conduits and outlets. Provide with the submittals, a list of all conduits, boxes, and power changes necessary for installation of systems in each location.

## 3.14 APPLICABLE FEDERAL SPECIFICATIONS

A. The list below forms only a part of this specification.
1. J-C-30A &Am-1 Cable and Wire, Electrical (Power, fixed installations)
2. W-C-3735B Circuit Breakers, Molded Case, Branch Circuit, and Service
3. W-C-586C Conduit outlet boxes, bodies, and entrance caps, electrical: cast metal
4. W-C-596E/Gen Connector, Electrical, Power, General Specifications
5. W-F-406B Fittings for Cable, Power, Electrical and Conduit, Metal, Flexible
6. W-F-408C Fittings for Conduit, Metal, Rigid, (Thick wall and EMT)
7. W-J-800D Junction Box: Extension, Junction Box; Cover, Junction Box (Steel, Cadmium, or Zinc Coated)

8. HH-I-553C Insulation Tape, Electrical (Rubber, Natural, or Synthetic)
9. HH-i-595C Insulation Tape, Electrical, Pressure Sensitive Adhesive, Plastic
10. WW-C-0054OC Conduit, Metal, Rigid: and Coupling, Elbow, Nipple, Electrical Conduit: Aluminum
11. WW-C-566C Conduit, Metal, Flexible
12. WW-C-581 E Conduit, Metal, Rigid, and Intermediate: and Coupling, Elbow, and Nipple Electrical Conduit: Steel Zinc Coated
13. C2-1990 National Electrical Safety Code
14. C97.1-1972 Low Voltage Cartridge Fuses 600v or less
15. Institute of Electrical and Electronic Engineers (IEEE)
16. 142-1982 Recommended Practice for Grounding of Industrial and Commercial Power Systems

**END OF SECTION**

# SECTION 275119 - SELF-CONTAINED SOUND-MASKING SYSTEM

## PART 1 - GENERAL

### 1.1 APPLICABLE PROVISIONS OF THE CONDITIONS OF THE CONTRACT AND DIVISION #1, GENERAL REQUIREMENTS, GOVERN WORK IN THIS SECTION.

### 1.2 SUMMARY

A. This specification includes all components required for a fully functional Sound Masking System for the purpose of increased speech privacy, freedom from distraction, and/or sleep disturbance-reduction in the treated areas. Speakers, wiring and headend equipment will be shared. Areas will be zoned and field selectably tuned for Sound Masking, along with local volume controls. Manufacturer to provide sound masking generator. Contractor shall provide all the necessary wiring, equipment, interfaces, converters, adapters, mixers, amplifiers, etc. for a full functioning system.

### 1.3 DEFINITIONS:

1. Sound Masking System: The electronic equipment and loudspeakers used to generate, distribute, and control masking sound throughout a treated area.
2. Loudspeaker: These terms are used interchangeably in this document to indicate a device in the Sound Masking System which emits masking sound.
3. Zone: One or more Loudspeakers assigned to a Control Module and operating as a group.
4. Spatial Uniformity: A condition where the sound pressure levels throughout a defined space do not vary significantly from a specified sound pressure level.
5. Spectral Uniformity: A condition where the sound pressure in each one third octave band, does not vary significantly from the specified one third octave sound pressure level.
6. Temporal Uniformity: At a given position a condition where the average sound pressure level measured over a short time interval does not differ significantly from the average sound pressure level measured over a long time interval.
7. SPL: Sound pressure level in dB re 0.00002 Pa (0.0002 microbar).
8. Project Manager: The architect, owner's representative, general contractor, or other project manager in charge of the construction and site.
9. Sound Masking System Designer: The person or team responsible for design of the Sound Masking System.
10. Manufacturer: That company which produces the Sound Masking System products.
11. Contractor: That company chosen to install the Sound Masking System. Contractor must meet the qualifications described in Section 1.08.
12. Authorized Dealer: That company chosen to provide all Sound Masking System products described in Part 2. This dealer must be an authorized dealer of Manufacturer's products.

## 1.4 REFERENCES:

1. ASTM E1130-08 – Standard Test Method for Objective Measurement of Speech Privacy in Open Offices Using Articulation Index.
2. ASTM E1374-11 – Standard Guide for Open Office Acoustics and Applicable ASTM Standards.
3. ASTM E2638-10 – Standard test method for objective measurement of the speech privacy provided by a closed room.
4. ASTM E1573-09 – Standard Test Method for Evaluating Masking Sound in Open Offices Using "A"-Weighted and One-third Octave Band Sound Pressure Levels.
5. ANSI S1.6 – Preferred Frequencies, Frequency Levels, and Band Numbers for Acoustical Measurements.
6. ANSI S1.4 – Specification for Sound Level Meters. Calibrated Type 1 or Type 2.
7. ANSI S1.11 – Specification for Octave Band and Fractional Octave Band Analog and Digital Filters.
8. UL 2043 – Standard for Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air Handling Spaces.
9. ISO - International Standards Organization
10. NEC - National Electrical Code 2014 Edition
11. CSA-Canadian Standards Association
12. CE Code – Canadian Electrical Code as Published by the Canadian Standards Association referencing 24$^{th}$ Edition / 2018.

## 1.5 DESCRIPTION OF WORK

A. The work of this Section consists of the provision of all plant, materials, labor and equipment and the like necessary and/or required for the complete execution of the Sound Masking System and related work for this project, as required by the schedules, and keynotes and drawings.

## 1.6 FUNCTIONAL REQUIREMENTS OF SYSTEMS:

A. Distribute sound masking to all areas as indicated on the project drawings.

B. All active electronic components shall be conveniently accessible for service.

C. All systems components shall be supplied from a single manufacturer.

## 1.7 SYSTEM DESIGN, COMMISSIONING AND EQUIPMENT SUPPLY

A. Sound Masking System commissioning shall be performed by:

1. An Authorized Dealer Trained and Certified by the Manufacturer.

B. Equipment and accessories, including such things as cabling where applicable, shall be supplied by a dealer authorized by the equipment manufacturer.

C. Utilize a sound meter to measure sound levels and tune system according to chart below.

## 1.8 INSTALLING CONTRACTOR QUALIFICATIONS

A. Sound Masking System shall be installed by a qualified Contractor.

B. To be considered qualified for this work, the Contractor must be experienced in the provision of low-voltage electronic systems similar in complexity to those required for this project, and meet the following:

1. The Contractor's primary business is the provision, fabrication, and installation of integrated audio and video systems including distributed sound systems, structured cabling, and/or related systems in the commercial environment.
2. The Contractor is an authorized dealer for the major product components and is certified by the manufacturer to perform their installation and setup.
3. The Contractor has a verifiable history of successful installations of at least three projects of similar scope and size.
4. The Contractor has all applicable business and regulatory licenses and certifications.
5. The Contractor has verifiable financial capability to satisfy project and bonding requirements.
6. When so directed by the Sound Masking System Designer, the Contractor must have obtained the necessary personnel expertise and test measurement equipment outlined herein to configure, test, and calibrate the sound masking system.

## 1.9 SUBMITTALS

A. Contractor shall refer to Division 00 of this Article.

B. Examinations: Carefully examine the contract documents and, when possible, the construction site to obtain first-hand knowledge of existing conditions. Contractors will not be given extra payments for conditions that can be determined by examining documents or by making on-site examinations, and will not be relieved of any obligations with respect to bid.

C. Submittal Documents

1. Contractor shall adhere to Article 01 30 00 for these requirements.
2. In keeping with the practices of LEED™, all submittals shall be delivered in electronic format as combined PDF files via FTP posting, CD-ROM, DVD, or e-mail.
3. CAD drawings will be in AutoCAD 2018 dwg format and portable document format (PDF). All other submissions unless otherwise stated will be provided as PDFs.
4. Submit a list of proposed major components along with manufacturer's detailed technical data sheets.
5. Unless otherwise directed by contract, do not order equipment until the bill of materials has been reviewed and approved by the Project Manager.
6. Coordinate all submittals with requirements set forth in Section 01 30 00.
7. A floorplan and/or reflected ceiling drawing denoting at minimum: all equipment and device locations, all cabling types and quantities via riser diagrams, coordination with other items in the ceiling per the architectural RCP plans, all ethernet and power requirements, to be prepared by the sound masking manufacturer.

## 1.10 INSTALLATION AND QUALITY ASSURANCE

A. Required Permits: Installing Contractor or Project Manager shall obtain all necessary permits for installation work.

B. Project Management: Contractor shall assign a qualified person to manage the installation and maintain the same person in charge of work throughout installation.

C. Contract Documents: Contractor shall maintain a complete set of system drawings and specifications on the job site.

D. All equipment, cabling, accessories and associated hardware shall be installed in accordance with manufacturer's instructions and according to standards of good engineering practice and other conditions as specified by the Project Manager.

E. Workmanship shall be of professional quality, best commercial practice, and shall be accomplished by qualified personnel.

F. Coordinate items in ceiling with all other items in ceiling.

G. Provide pendant lengths as required by the architect/engineer.

H. Confirm colors of all equipment with architect prior to release.

## 1.11 JOB CONDITIONS

A. Contractor shall refer to and adhere to Division 02 of this Article.

B. Sequencing and Scheduling:

1. Coordinate work with Project Manager and other trades to facilitate construction and prevent conflicts.
2. Afford other trades reasonable opportunity for installation of work and for the storage of materials.
3. Staff the job to keep pace with the other trades; otherwise, the Project Manager will require an increase in force or overtime work without additional expenses to the Owner.
4. Abide by the decision of the Project Manager in case of conflict or interference by other trades.
5. Refuse: Remove all refuse from the job site to the satisfaction of the Project Manager and Owner.

C. Insurance on the work of this specialty trade shall be provided if specified in Section 00 81 00.

## 1.12 INSPECTION

A. Notify the Project Manager of any defects in work by other trades affecting system installation, operation, or performance.

## 1.13 WARRANTY

A. Warrant the installation of all equipment, cabling, and labor for an initial period of one year from the date of final acceptance.

B. Owner requested services, including telephone support, shall be at no charge during the duration of the initial one year warranty period.

C. During the initial warranty period, services shall include two semi-annual visits to the site for routine adjustment and maintenance of all equipment. Provide a preliminary schedule for the semi-annual visits.

D. Warrant all equipment to be free of faulty workmanship and defects for a minimum period of five years from date of final acceptance.

## 1.14 TRAINING

A. Provide sufficient training to personnel selected by the Owner on operation and basic maintenance of all systems, software, and equipment. Explain operation of control systems, set-up and operation of individual pieces of equipment, and functions of overall systems.

B. Provide manufacturer's operation manuals for all products used in the system.

C. Provide an overall system operation manual for use by the Owner's maintenance personnel.

# PART 2 - PRODUCTS

## 2.1 MANUFACTURER

A. Shall be by Lencore, Biamp or Atlas IED.

## 2.2 GENERAL

A. Product requirements include all masking, signal generation, signal processing, amplification, and loudspeakers with associated wiring, software, and controls.

B. Only complete, integrated Sound Masking Systems from a sole manufacturer shall be acceptable.

C. Sound Masking System shall be capable of multiple Zones as depicted on the project drawings in order to adjust for unique architectural spaces and facility uses.

D. The Sound Masking System shall be capable of automatically scheduling system parameter adjustments, including initial acclimatization, on a per Zone basis.

E. Means of control may be facilitated through any combination of front panel hardware interface, wall mounted controls, and/or web browser based software interface.

F. Sound Masking System shall be capable of generating, amplifying, and distributing a minimum of four non-correlated sound masking signals on adjacent loudspeakers. Adjacent loudspeaker devices may not reproduce coherent sound masking signals.

G. Sound Masking System shall be capable of accepting at minimum one external line level audio source from ancillary audio equipment with control on a per Zone basis.

H. Sound Masking System Zones shall be determined by the functional requirements of each area(s) with separate independent level control for each Zone as indicated by the project documents.

I. A separate level control Zone shall be required in instances where a change in loudspeaker mounting / ceiling height varies by more than 6” throughout a functional space.

J. Provide telephone input module or as required for full and simple to use integration with Owner provided IP phone system.

## 2.3 INDOOR LOUDSPEAKERS

A. The loudspeakers shall be direct field, radiating directly into the occupied space. Plenum based loudspeaker systems are not acceptable in this specification.

B. Indoor direct field loudspeaker drivers shall be no more than 6” in diameter and be capable of mounting directly into acoustic ceiling tile materials, drywall ceiling mounted, surface mounted, pendant mounted, structural beam mounted, or hard surface ceiling mounted utilizing optional manufacturer supplied accessories. Provide seismic rated mounting where required by jurisdiction.

C. Place loudspeakers where indicated on project drawings. Space evenly as recommended by the product manufacturer based on site conditions and ceiling heights and below finished ceiling obstructions to meet the performance requirements stated in Part 3 of this specification.

D. Loudspeakers as driven by control processor/module shall be capable of producing minimum sound pressure levels and frequency spectrum as required in Part 3 of this specification and as measured at an above finished floor height of 4ft (1.2 meters) regardless of ceiling type, height, or presence.

E. Loudspeakers and accessories mounted in air handling spaces shall be UL 2043 compliant.

F. DC power for active loudspeakers must be combined with masking and audio input signal in a single, multi-conductor, low-voltage cable meeting NEC Class 2 requirements for low-voltage distribution and suitable for use in plenum spaces.

G. For indoor speakers, 70-volt / 25 volt or other high-voltage distribution is not allowed in this specification. All wiring shall use CAT5 type cable with RJ45 connectors.

## 2.4 CONTROL PROCESSOR/MODULES

A. Provide DSP-based masking sound generation with a minimum of four (4) uncorrelated masking signal outputs per Zone.

B. Provide a factory default sound masking spectrum as defined in Table 1 - PART 3 of this specification.

C. Multi-Zone processing shall provide adjustment of the masking level on a per Zone basis with adjustment in .5 dB increments.

D. Multi-Zone processing shall provide per Zone scheduling function via internal clock source and/or network NTP server, which is capable of adjusting the masking signal levels. Scheduling shall at a minimum adjust for separate weekday and weekend level settings.

E. Multi-Zone processing shall provide an automatic, incremental level adjustment feature, allowing a gradual, one-time change of masking levels to commence upon completion of system commissioning, acclimating occupants to a newly sound masked environment (initial acclimatization).

F. Multi-Zone control processor shall be capable of TCP/IP network connectivity via DHCP or Static IP address.

G. Each masking Zone, when multiple Zones are required, shall be separately capable of one third octave equalization adjustment of the sound masking spectrum as defined in Table 1 - PART 3 of this document. Equalization shall be set at the factory. No field equalization shall be necessary under this specification.

H. Control Processor shall have at least one line level audio input accepting a nominal signal level of +4dBu. A separate one octave band equalizer, independent from the sound masking equalizer, shall be provided for adjustment of the audio input.

I. Control Processor shall have the capability to mute or otherwise disable the sound masking signal and minimal one line-level audio input(s) using a dry contact closure from a third party source.

J. Fault reporting of trouble conditions to cabling and ancillary devices shall be incorporated at the Control Processor level.

K. Control Processor shall feature a nonvolatile memory, capable of storing all system settings in the case of power disconnect.

L. System shall include a UL/CUL/CE -listed 120-240VAC 50/60Hz power supply. Remote power supplies when mounted in air handling spaces shall be plenum rated pursuant to local codes and jurisdictions.

## 2.5 SOFTWARE AND CONTROL

A. The multi-Zone Sound Masking System shall be capable of software control via a TCP/IP local area network connection to the Owner's local area network (LAN Infrastructure).

B. Coordinate connection to local area network with Owner's network administrator to include IP Addressing, MAC address, and switch port assignments.

C. The software interface may consist of one or more of the following types:

1. Client Based Control - Windows 7/10
2. Web - Internal web server using browser client
3. Mobile - Internal web server using browser client or software applications for Apple IOS/ Android OS devices.

D. Software control of multi-Zone sound masking shall include password-protected adjustment and configuration of the following minimum features to include:

1. Sound masking levels on a per Zone basis.
2. Audio input levels on a per Zone basis.
3. Equalization adjustment on a per Zone basis.
4. Zone naming on a per Zone basis.
5. Time of day scheduling on a per Zone basis.
6. Network / clock management.
7. Three step incremental level adjustment on a per Zone basis.
8. Error notification / monitoring.

E. A hardware interface will be capable of basic level adjustment on a per Zone basis using either or both of the following methods.

1. Wall Level Control – A single gang flush mounted device capable of adjusting the overall sound level up to eight loudspeakers. Locations of wall controls shall be indicated on the project drawings.
2. Control Processor Front Panel Menu – A hardware interface that allows, at minimum, operation of both sound masking and audio input levels on a per Zone basis.

F. Control via a third party appliance/software shall allow adjustment of the sound masking and audio input levels on a per Zone basis.

1. A third party API shall be published by the sound masking product manufacturer to allow programming by building wide / room control system providers.
2. Third party control shall be via either wired Ethernet or contact closure control.

## 2.6 CABLE ASSEMBLIES

A. All cable assemblies shall consist of the proper number of conductors, wire gauge, and type, as approved by the system manufacturer based on the system design.

B. Cabling flammability rating shall meet the installation conditions as required by NFPA/NEC/CSA or local codes/ jurisdiction as follows;

1. Type CM – General Purpose for Commercial Installation. Meets UL-1581 requirements for smoke and flammability testing.
2. Type CMR/FT4 – Commercial Installation for vertical risers. Meets UL-1666 requirements for smoke and flammability testing.
3. Type CMP/FT6 – Commercial Installation for plenum airspaces. Meets UL-910 requirements for smoke and flammability testing.

C. Terminations shall be completed utilizing the appropriate connector type, method, and tooling as recommended by the product manufacturer.

1. Field terminations shall be permitted in cases only where approved by the product manufacturer.

D. Ethernet cabling shall be a single jacket UTP Category 5e, Category 6, or Category 7.

E. All speaker cabling shall be a single jacket UTP Category 3, Category 5e, Category 6, or Category 7 cable with 8 conductor TIA/EIA568B modular plug connectors.

F. Each Ethernet cable shall be verified by the Installing Contractor to 10/100 MB/sec standards.

G. Factory supplied UTP Category interconnect cables will be utilized whenever feasible based on available cable length.

H. Provide shielded cabling if recommended by the manufacturer.

## 2.7 LABELS

A. Except where otherwise specified, label each item of control equipment as shown on drawings.

B. Identify all wires and cables at every connection point to controllers with reference number keyed to the as-built wiring diagrams.

C. Room numbers appear on the contract documents for reference only. All labels shall reflect the Owner's final room designations.

D. Cable Markers:

1. High-grade PVC clip-on or permanent-type cable markers with permanent markings, or printed vinyl tape protected by clear shrink tubing or adhesive wrap.

## 2.8 SAFETY LISTINGS

A. General

1. Products and system shall comply with all applicable local, regional and national safety codes.

B. Electrical Safety

1. All electronics shall be UL Listed or listed by an equivalent body such as Intertek ETL. Outside the USA, the electronics shall be certified by an equivalent certification body to meet local and/or national safety standards.

C. Seismic Safety

1. Loudspeaker seismic support must be provided by manufacturer-certified electronic input cable supported by a copy of manufacturer's test report. Alternate seismic support system(s) must be approved by authorities having jurisdiction and based on local code requirements.

D. Fire Safety

1. Control Processor shall have the capability to mute or otherwise disable the sound masking signal and any line-level audio input(s) using a dry contact closure from a third party source such as a fire alarm panel.
2. The Sound Masking System shall not be a primary means of emergency voice evacuation or ECS. For this reason, UL2572 compliance is not required under this specification.

## 2.9 ENVIRONMENTAL CERTIFICATION

A. Sound Masking System cabling shall be plenum, except where used outdoors where it shall be wet location rated.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. Prior to installation, ensure the site is suitable for system installation.

B. Verify all locations where system components are to be installed are free of conflicts with other trades prior to installation.

C. Verify that site building conditions match the system design plans including ceiling finishes, wall locations, and obstructions. Immediately notify the Project Manager of any discrepancies prior to the commencement of work.

D. Ensure system power requirements, network connectivity, and any other third party infrastructure requirements for the system have been provided and installed prior to installation.

## 3.2 DELIVERY, STORAGE AND HANDLING

A. Protect all system components from moisture, dust and damage during shipping, storage and handling.

B. Deliver in manufacturer's original unopened and undamaged packages with manufacturer's labels legible and intact.

C. Inspect all system components upon receipt and upon unpacking.

## 3.3 INSTALLATION

A. General

1. Comply with all applicable electrical and other safety codes.
2. Install Sound Masking System in compliance with manufacturer's recommendations and published documentation.
3. All equipment shall be installed by competent workers at locations shown on the drawings in strict accordance with approved shop drawings. Record any and all necessary changes to the system design in cases where different from the submittal documents.
4. All equipment shall be firmly held in place including loudspeakers, enclosures, amplifiers, processors, cables, etc. Fastenings and supports shall be adequate to support their loads with a safety factor of at least six unless otherwise stated.
5. All system components shall be mounted in a level and plumb fashion utilizing the dimensions indicated on the associated drawings.
6. User controllable devices shall be mounted at a location and height which allows for normal adjustment and operation.
7. Electronics shall be conveniently accessible for service.
8. Above-ceiling inline power injector equipment shall be UL2043 rated for air handling environments.
9. Systems using above-ceiling sound masking generators are not permitted under this specification.

B. Loudspeakers

1. Locate loudspeaker assemblies as indicated on project drawings and as required to meet the spatial uniformity requirements of this specification.
2. Loudspeakers must be installed no more than 21 feet (6.4 meters) above the floor.
3. Ensure loudspeaker coverage pattern is not obstructed by building systems or structures which may impede performance of the Sound Masking System.
4. Ensure minimum distance between the top of loudspeaker and structure/obstacles are maintained to allow adequate clearance of cabling and connectors.
5. When mounted in other substrates, ceiling types and or building structures, loudspeakers shall be installed using manufacturer supplied accessories. Mount loudspeaker assemblies to structure in an approved method as required by local codes and jurisdiction, and indicated by the project submittals.
6. Follow manufacturer recommendations for individual loudspeaker level controls/taps. Adjust as necessary.

C. Cabling

1. All cable installation shall be done in professional workmanlike manner with adequate service loops where applicable. Dress cabling in a neat and consistent fashion using appropriate methods and materials.
2. Test all field fabricated and manufacturer supplied cables, before installation, for open circuits, shorts, crossed pairs, reversed pairs, split pairs and proper pin-out.
3. Refer to manufacturer recommendations as to maximum cabling distances and types to support control processor unit(s), controls, and loudspeakers. Never exceed manufacturer's cable distance limitations and quantity of devices per cable run.
4. Cabling pathways shall be configured to prevent conflict with other building systems. Care should be taken to minimize and eliminate all RFI and EMI interference sources.
5. Maintain appropriate separation between dissimilar signal types, voltages, and electrical devices.
6. Cabling to be installed/supported in a manner and frequency utilizing approved methods and materials as required by the local AHJ (authority having jurisdiction).
7. Cabling shall be concealed behind structure and as high as possible. Route at parallel and right angles to structure.
8. All cabling shall be supported from structure with contractor provided j-hooks or similar method. Cabling shall not contact ceiling tiles or inhibit their removal for access to the plenum. Zip ties are not allowed. Drooping cable is not allowed.

## 3.4 SITE QUALITY CONTROL

A. Ensure that loudspeaker spacing is correct, consistent, and follows design guidelines set forth by the product manufacturer.

B. Securely terminate all cables.

## 3.5 SYSTEM STARTUP

A. Coordinate with building network administrator for an Ethernet connection to building LAN where required.

B. Perform the entire product manufacture's recommended testing and startup procedure as outlined in the manufacturer's product manual(s).

C. Ensure functional operation of all ancillary devices to include front panel controls, audio inputs, contact closures, wall controls, software control and third party controllers. Test each setting and confirm expected results from actions taken. Correct all deficiencies in operation.

D. Perform system startup at a time when each Zone / space is completely vacant and free of any noise contamination.

## 3.6 SYSTEM TESTS AND ADJUSTMENTS

A. Qualifications of Testing Party

1. Testing, calibration and setup shall be performed by a qualified manufacturer's employee or an authorized dealer or consultant who has been trained by the manufacturer.

B. Prior to Test and Adjustment: Ensure the site conditions are suitable for adjustment of the Sound Masking System. Adjustment can only be made when the following site conditions exist:

1. All ceiling assemblies are currently installed and completed.
2. All interior furnishings are assembled and in place.
3. Mechanical systems have been previously optimized to final operational conditions and are active in areas served by sound masking signals.
4. No occupants are present at the time of adjustment.
5. External noise sources (i.e. construction activities) are not present during testing.
6. Final testing shall be scheduled at least 30 days in advance of owner occupancy.
    a. Notify the party listed under Section 1.07, Paragraph B of this document of the testing and adjustment schedule.

C. Initial Test and Adjustments: Perform and record results of the following tests:

1. Loudspeaker Operation: Near field output of each loudspeaker shall match the Zone average within +/- 1.5 dB. Listen directly below each installed loudspeaker to confirm it is operating. For any loudspeakers found to be inoperative, or possibly operating at an incorrect level, use a calibrated sound level meter set to A-weighting and slow response to check the output. Place the microphone so as to contact each grille and measure the variation between a minimum of 2 adjacent loudspeakers of the same zone.
2. Replace any defective loudspeakers or cabling, or otherwise correct cause for any loudspeakers found to be operating outside the range stated.
3. Buzzes, Rattles, and Distortion: With system operating at maximum level, listen for any buzzes, rattles, and objectionable distortion in all areas covered. Correct all causes of these defects.

D. Final Test and Adjustment: Perform and record the results of the following tests:

1. Control Settings: Adjust all masking spectrum levels and audio level controls for initial operation using manufacturer recommended procedures. Document setting for each user control.
2. Adjustment of Audio Input Levels: Adjust background sound levels for clarity between 45-50dBA. Adjust frequency spectrum of each input as necessary to achieve accurate reproduction of the intended signal source.
3. Adjustment of Sound Masking Levels: With the masking system active, measure the A-weighted sound pressure level of each Zone independently. Use an ANSI S1.4 approved and calibrated Type 1 or 2 sound level meter and/or calibrated real time acoustic analyzer with 1/3 octave filters per ANSI S1.11. Perform all SPL measurements at a typical seated height of 4ft AFF (1.2 meters). Adjust the sound masking frequency spectrum in each Zone to correspond with the A weighted average level and frequency levels (non-weighted) shown in Table 1. Document at minimum, one measurement per 1000sq ft. in open offices, one measurement in 50% of private offices, and one measurement in 50% of all other spaces where sound masking is present. All documented measurements shall meet the maximum level variation column criteria of Table 1. Correct any Sound Masking

System deficiencies such as loudspeaker placement or loudspeaker tap settings to meet this performance criteria.

TABLE 1

| Frequency | Open Office | Private Office | Corridor / Conference Room | Max Variation |
|---|---|---|---|---|
| *125 Hz | 48 dB | 43 dB | 46 dB | +/- 3dB |
| *160 Hz | 47 dB | 42 dB | 45 dB | +/- 3dB |
| 200 Hz | 45 dB | 40 dB | 43 dB | +/- 3dB |
| 250 Hz | 44 dB | 39 dB | 42 dB | +/- 2dB |
| 315 Hz | 42 dB | 37 dB | 40 dB | +/- 1dB |
| 400 Hz | 41 dB | 36 dB | 39 dB | +/- 1dB |
| 500 Hz | 40 dB | 35 dB | 38 dB | +/- 1dB |
| 630 Hz | 39 dB | 34 dB | 37 dB | +/- 1dB |
| 800 Hz | 38 dB | 33 dB | 36 dB | +/- 1dB |
| 1000 Hz | 37 dB | 32 dB | 35 dB | +/- 1dB |
| 1250 Hz | 36 dB | 31 dB | 34 dB | +/- 1dB |
| 1600 Hz | 34 dB | 29 dB | 32 dB | +/- 1dB |
| 2000 Hz | 32 dB | 27 dB | 30 dB | +/- 1dB |
| 2500 Hz | 30 dB | 25 dB | 28 dB | +/- 1dB |
| 3150 Hz | 27 dB | 22 dB | 25 dB | +/- 1dB |
| 4000 Hz | 24 dB | 19 dB | 21 dB | +/- 1dB |
| 5000 Hz | 19 dB | 14 dB | 17 dB | +/- 1dB |
| *6300 Hz | 14 dB | 9 dB | 12 dB | +/- 1dB |
| *8000 Hz | 11 dB | 6 dB | 9 dB | +/- 1dB |
| Average “A” Weighted Sound Pressure Level (dB A) | 47 dBA | 42 dBA | 45 dBA | +/- 2 dBA |

* Denotes additional frequency bands to be used when specifying active (self-powered) direct-field loudspeakers.

4. Configure time of day sound masking level adjustment following the final adjustment of sound masking levels. Coordinate with Owner to determine activity times and levels of occupancy. Adjust the Sound Masking System based on the target “Average A-Weighted Sound Pressure Level” in Table 1 as the final sound masking levels used for high activity/occupancy times. Adjust the Sound Masking System based on the targeted “Average A-Weighted Sound Pressure Level” in Table 1 with adjustment -3 to -9 dBA lower at times of inactivity/lower occupancy per product manufacturer’s recommendations.
5. When integrating the Sound Masking System in a space previously occupied by workers, configure the incremental level adjustment feature of the control processor. Following the initial adjustment of sound masking levels, adjust each Zone’s initial sound masking level to a level 1.5 dBA above the average ambient noise level of the space. Engage the

incremental level adjustment feature to automatically increase the sound masking level until reaching the "Average A-Weighted Sound Pressure Level shown in Table 1 for each type of space listed. Use a minimum time frame of five days for the incremental level adjustment to reach the final target levels.

6. Provide a final testing report which states that the performance requirements of the Sound Masking System have been met.

E. Automatic Real-Time Masking Level Adjustment: Automatic adjustment of masking level based on ambient noise conditions shall not be permitted under this specification. Only scheduled adjustment of sound masking levels may occur at times when each Zone is vacant of occupants.

F. Sound Masking Equalization: Sound masking equalization shall be set by the manufacturer at the factory. On-site project sound masking equalization shall not be required under this specification unless the System Designer specifies values other than those in Table 1.

G. Proof of Performance Testing: If requested, demonstrate to the Owner's Representative that the system is fully operable and installed in compliance with the terms of the performance specifications hereunder.

1. Test the system to demonstrate that the design goal of Privacy Index (PI) = 80% (Normal Privacy) or better is met between representative workstations separated by partitions of 66" or greater height. For this test, select adjacent workstation pairs without direct line of sight or significant sound reflecting ceiling or wall elements between, and with a ceiling material rated at NRC of 0.85 or higher. Tests shall be in accordance with ASTM Standard E1130 except that the octave band calculation method of ANSI Standard S3.5 may be used. Lower levels of PI are acceptable only if the ceiling or partition requirements described herein before are not met. Document the results of this test.
2. Test the system in each open plan area Zone served to demonstrate that the design goal for spatial uniformity is met. Tests shall be carried out per ASTM Standard E1573 as measured in the 2,000 Hz octave band. At each location, the average sound pressure levels shall be measured over an interval of at least 4 seconds at four positions at 90° intervals around a circle of 0.3 m (1 ft.) radius centered on the location. The arithmetic mean sound pressure level shall be calculated from the four measured values. For at least 75% of the test locations, the arithmetic mean sound pressure level in the 2,000 Hz octave band shall not vary by more than +/-1 dB from the average of the arithmetic mean sound pressure levels measured at all locations. Document the results of this test.
3. Test the system to demonstrate that the Speech Privacy Class (SPC) is at least 75 (Standard Speech Privacy) between representative private (enclosed) offices served by the system. For this test, select adjacent offices with closed doors free of air gaps. Tests shall be in accordance with ASTM Standard E2638-10. Test 10% of all similar sized offices and meeting spaces utilizing the same basic construction methods. Lower levels of SPC are acceptable if the common walls between the offices are comprised of assemblies <=STC 40 and which do not extend to the deck above -or- in cases where the common wall <=STC40, does not extend to the deck, and the ceiling attenuation class of the ceiling material is less than 45 (<=CAC 45). If the SPC achieved is lower than 75 due to architectural factors, bring this to the attention of the Owner or General Contractor. Document the results of this test.
4. The sound masking contractor will make all necessary modifications to the system design, integration, tuning, and/or settings, as specified by the Engineer or Certified

Manufacturer's Technical Representative, to achieve the performance testing goals contained herein at no additional expense to the Owner.

## 3.7 CLEANING AND WASTE MANAGEMENT

A. Remove empty packaging and other material waste.

B. Clean all debris created by installation of components.

C. Clean system components where required.

## 3.8 FINAL CLOSEOUT AND AS-BUILT DOCUMENTATION

A. The Contractor shall document, prepare and submit all final control processor settings, loudspeaker Zone maps, loudspeaker tap settings, one line diagrams, operational instruction, and testing results in PDF format. Submit three copies to the System Designer, the Project Manager and, if required, the Owner's representative for final review and acceptance.

B. Indicate the location of each sound pressure level measurement, privacy index measurement, and spatial uniformity measurement referenced within the final documents on the Zone map.

C. In cases where the Sound Masking System utilizes client control software for adjustment and operation, provide a copy on media with each documentation set utilizing the same software version as currently installed and operating.

D. With thirty day advance notice, train Owner's designated representative on Sound Masking System maintenance and proper operation.

1. Provide User Instruction on Operation
2. Discuss potential for mis-adjustment of sound masking levels and deterioration of both comfort / speech privacy performance.
3. Demonstrate all software features, controls, and configuration.

**END OF SECTION**

# SECTION 28 13 00 - ACCESS CONTROL SOFTWARE AND DATABASE MANAGEMENT

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Description of architecture and functionality for a cloud-managed personal-credential-centered Cloud-Based Physical Access Control System (or just “system” for short) for use in single-site LAN-based to multi-site WAN-based deployments utilizing private business networks, wireless IP-based cellular networks, and the Internet, with optional integrations to video surveillance, intrusion detection, perimeter protection and other physical security systems and devices, building automation systems, single and multi-tenant residential automation systems, on-site video recording platforms, plus networkable IoT sensors and sensor systems.

2. Design criteria for capabilities that the system must provide.

3. Design requirements for performance, functionality, and system characteristics that the system be designed to meet.

4. Detailed specifications for the system software that is being provided as a service.

B. General:

1. “System” or “system” refers to the entire Cloud-Based Physical Access Control System and is also used separately as a qualifier like “system manufacturer”, “system requirements”, “system software”, system hardware”, “system Web App” and “system Mobile App.”

2. Section 28 14 00 that follows provides System hardware specifications.

C. Specifications Language and Terms:

1. Imperative language is directed to Manufacturer and specifies required product design requirements, functionality or performance capabilities, unless otherwise noted.

2. “Customer” is used to refer to the Owner and Owner’s personnel is not capitalized as it is used in a business operational context rather than the owner-contractor or owner-architect contractual context.

## 1.2 RELATED SECTIONS

A. 28 14 00 – Access Control System Hardware.

## 1.3 REFERENCES

A. Abbreviations and Acronyms:

1. AES: Advanced Encryption Standard.
2. BLE: Bluetooth Low Energy.
3. DHCP: Dynamic Host Configuration Protocol.
4. DNS: Domain Name System.
5. HTTP: Hypertext Transfer Protocol.
6. IP: Internet Protocol.
7. IAM: Identity and Access Management.
8. IDM: Identity Management.
9. IPAC: Internet Protocol Access Control.
10. ISO: International Standards Organization.
11. LAN: Local Area Network.
12. NIST: National Institute of Standards and Technology.
13. PACS: Physical Access Control System.
14. PII: Personally Identifiable Information.
15. PoE: Power over Ethernet.
16. SaaS: Software as a Service.
17. SDC: Single Door Controller.
18. SIA: Security Industry Association.
19. SSO: Single Sign-on.
20. SSH: Secure Shell.
21. TLS: Transport Layer Security.
22. UI: User Interface.

23. UL: Underwriters Laboratories.

24. ULC: Underwriters Laboratories of Canada.

25. WAN: Wide Area Network.

B. Definitions:

1. *Antipassback:* Antipassback controls are intended to prevent an authorized user from bypassing access control for another individual, by passing back an access credential (card or mobile device) after using it to allow an accompanying individual to present the same credential and gain access.

2. *Application Programming Interface (API):* Documented set of definitions and protocols for developing integrations between networked software applications, including software running on IoT devices.

3. *Availability Zones:* Physically separate datacenter locations within each data center geographical region that are tolerant to local failures. Failures can range from software and hardware failures to events such as earthquakes, floods, and fires. Availability zones must be designed so that if one zone is affected, cloud services, capacity, and high availability are fully supported by at least two other zones within the geographical region.

4. *Biometric:* Unique identifying physical or physiological characteristic of an individual that can be used to identify that individual, such as a facial image or fingerprint.

5. *Brivo Hardware*: Hardware manufactured by or on behalf of Brivo, branded with Brivo's trademarks and sold by Brivo or a Brivo Reseller for use in connection with the Brivo System.

6. *BUS:* Short for communication bus, a collection of wires forming a communication system that transfers data between components inside a computer, or between computers.

7. *CAN BUS:* Controller area network (CAN) communication bus standard designed to allow microcontrollers and devices to communicate with each other's applications without a host computer.

8. *Cloud-Native Software:* Web application developed specifically for deployment as a cloud service, designed per the NIST five essential characteristics of cloud computing.

9. *Container*: A discrete computing environment for running software code, typically set up with only those parts of an operating system and other code libraries that are necessary for the software code to run correctly. A container may hold a complete application, a set of software functions, or a single function that performs just one task – such as responding to an access control system event. Each container is autonomous, can be launched in milliseconds, and runs in its own isolated environment, ensuring it does not disrupt other running applications or its underlying system. For example, in a physical access control cloud application supporting tens of millions of users and millions of card reader events per day, parallel processing using containers is a critical element of high performance.

10. *Credential:* Piece of information, usually digital, which serves as a means of identifying a user to an access control system for the purposes of authenticating the user and determining what that user's permissions are within the system. In a physical access control system, credentials are typically PIN codes, smart card encoded values, biometric data, mobile credentials, etc.

11. *Destination Dispatch:* Destination dispatch is an optimization technique used for multi-elevator installations, in which groups of passengers heading to the same destinations use the same elevators, thereby reducing waiting and travel times. Using destination dispatch, passengers request travel to a particular floor using a keypad, touch screen, or electronic credential prior in the lobby and are immediately directed to an appropriate elevator car.

12. *Digital Certificate:* Electronic document, issued by a Certificate Authority, for uniquely identifying a party (such as a software application or hardware device) in a networked communication session.

13. *General Data Protection Regulation (GDPR):* Regulation in European Union (EU) law on data protection and privacy in the EU and the European Economic Area (EEA). It also addresses the transfer of personal data outside the EU and EEA areas.

14. *IOT-Native Device:* Networkable cybersecure device specifically engineered to operate independently and communicate via local network and/or continuous, periodic or ad-hoc Internet connection.

15. *LEAF Consortium:* Association of industry manufacturers whose purpose is to foster interoperability in the access control and identity credentials markets.

16. *National Institute of Standards and Technology (NIST):* U.S. federal technology agency that works with industries to develop and apply technology, measurements, and standards.

17. *Principle of Least Privilege:* Information security concept in which a user is given the minimum levels of access – or permissions – needed to perform the user's job functions.

18. *Representational State Transfer (REST):* Set of architectural guidelines for the design and development of HTTP-based communications between computer systems on the web.

19. *Reader:* One of the several types of devices, mounted at a facility door or gate, or in an elevator cab or elevator lobby, which serves as an input device for credentials such as smartcards, PIN codes, biometrics, mobile credentials, etc.

20. *RESTful API:* API that conforms to the constraints of REST architectural guidelines.

21. *erverless:* Serverless is a cloud-native development model that allows developers to build and run applications without having to manage individual virtual or physical servers directly, which are managed by the cloud service provider, chiefly through highly cost-effective automation. Serverless apps may be deployed in containers (see definition above) that automatically launch on demand when called.

22. *Single Sign-On (SSO):* Single Sign-On occurs when a user logs in (signs on) to one application or system and is then automatically logged in to other applications or systems during the same session, regardless of the application, system, domain or network the user accesses during the session.

23. *System Administrator:* Individual who has the ability to login to an account and, based on assigned roles, view or change account information and perform manual access control actions.

24. *User:* Individual to whom a system access credential is provided that the access control system uses to perform authentication of the user and provide authorized access.

25. *X.509:*Standard for a public key infrastructure (PKI) to manage digital certificates and public- key encryption.

C. Reference Standards:

1. NIST Special Publication 800-145, The NIST Definition of Cloud Computing.

2. UL294 Underwriter Laboratory Safety Standard 294 for Access Control System Units.

## 1.4 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer shall be Brivo, Brunswick County's standard PACS solution:

   a. Regularly and presently provide, as the manufacturer's principal cloud-based service, the Cloud-Based Physical Access Control System Software specified for this project.

   b. Have at least 15 years of deployment experience in providing Physical Access Control Software as a Service per the NIST Definition of Cloud Computing.

   c. Be a multi-national company with Cloud-Based Physical Access Control System deployments in at least 30 countries, with over 20 million active users, and over 50,000 deployments.

   d. Have at least 10 years of successfully-passed independent cybersecurity audits of its cloud- based system software platform, including SOC 2 Type 2 audits.

   e. Have an authorized dealer network consisting of at least 1,000 companies with technical certification from the Manufacturer, operating in all fifty US States, Europe, Latin America, and Asia.

2. Contractors shall:

   a. Provide evidence that installing service provider is an authorized dealer in good standing for the product's manufacturer, and that service provider meets the manufacturer's technical certification requirements.

   b. Have at least 5 years of experience deploying and maintaining installing and servicing systems of similar scope and complexity.

c. Ensure installing/servicing technicians have minimum of five continuous years of technical experience in electronic security systems.

d. Provide four current client references for systems of similar scope and complexity which became operational in past three years.

1) References shall include current point of contact, company or agency name, address, telephone number, complete system description, date of completion, and approximate cost of the project.

2) Owner reserves option to visit the reference sites, with the site owner's permission and representative, to verify the quality of installation and the reference's level of satisfaction with the system.

e. Be properly licensed to install and service physical access control system equipment as required by the authorities having jurisdiction in the location where customer's physical access control system will be installed.

f. Maintain service facility local to site where customer's physical access control system will be installed ("project site").

1) Facility shall:

a) Be located within 60 miles of project site.

b) Maintain sufficient spare parts inventory to support the service requirements associated with project site.

c) Include appropriate diagnostic equipment to perform diagnostic procedures.

2) Owner's Representative reserves option to survey service facilities to verify the service inventory and presence of a local service organization.

## 1.5 PRODUCT STANDARDS

A. Provide at time of installation, latest version of all equipment and software.

1. Discontinued equipment shall not be acceptable.

## 1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's labeled packages**.** Store and handle in accordance with manufacturer's requirements**.**

## 1.7 CODE REQUIREMENTS

A. System shall be installed in accordance with all applicable national, state, provincial, regional and local codes and standards. All equipment shall be U.L. listed or meet U.L. requirements for its intended use.

## 1.8 COMPLETION

A. Contractor shall substantially complete system installation by target date established by Owner.

## 1.9 SITE CONDITIONS

A. Ambient Conditions

1. Operating temperature range: 32°F to 122°F (0°C to 50°C), unless otherwise specified by hardware manufacturer.

2. Relative humidity: Up to 85% non-condensing.

3. Equipment shall be rated for indoor commercial use unless otherwise specified for outdoor use.

B. Existing Conditions

1. Prior to installation, Contractor shall survey site conditions and infrastructure.

2. Any deficiencies in power, grounding, network connectivity, or physical mounting conditions shall be reported to the Owner for resolution.

3. Installation shall not proceed until existing conditions are suitable for compliant system installation.

## 1.10 WARRANTY

A. Manufacturer shall warrant that its branded hardware products are free from defect in materials and workmanship for at least one year from the date of shipment.

## 1.11 SUPPORT

A. Manufacturer Support:

1. For the duration of the System subscription, automatically provide documented feature and security updates to cloud-based System software and Mobile Apps at no additional charge. Software, Mobile App and firmware updates shall be provided on a continuous basis.

2. Provide direct live telephone technical support free of charge both to end users and installing/maintaining security services contractors.

3. Provide optional additional-cost professional services for on-site deployment support to installing/maintaining services firm.

B. Maintenance and Service: Servicing firm shall:

1. General Requirements:

   a. Provide all services required and equipment necessary to maintain the entire integrated electronic security system in an operational state as specified for a period of one year after formal written acceptance of the system. Provide all necessary material required for performing scheduled adjustments or other non-scheduled work. Minimize impacts on facility operations when performing scheduled adjustments or other non-scheduled work.

2. Description of Work:

   a. Provide adjustment and repair of the Cloud-Based Physical Access Control System on-site equipment consistent with Manufacturer guidance and instructions.

3. Personnel:

   a. Ensure service personnel are certified in the maintenance and repair of the selected type of equipment and qualified to accomplish all work promptly and satisfactorily.

4. Schedule of Work:

   a. Perform work during regular working hours, Monday through Friday, excluding federal holidays.

5. Emergency Service:

   a. Provide staffed emergency service center service 24 hours a day 365 days a year. Provide emergency service center telephone number for the Owner to request service when system is not functioning properly. Owner has sole authority for determining catastrophic and

      non-catastrophic system failures within parameters stated in General Project Requirements.

   b. For catastrophic system failures, provide same day eight-hour service response with a defect correction time not to exceed eight hours from notification. Catastrophic system failures are defined as any system failure that Owner determines will place the security of one or more sites at increased risk.

   c. For non-catastrophic failures, provide eight-hour service response with a defect correction time not to exceed 24 hours from notification.

6. Operation:

   a. In performance of scheduled adjustments and repair, at completion of work document the following:

      1) For routine maintenance, briefly describe the work done.

      2) For problem resolution, describe the problem, the troubleshooting work done, root cause discovered, and remedial action taken.

      3) Verify operation of the system relative to any changes, repairs or part replacements made.

## PART 2 - PRODUCTS

### 2.1 CLOUD-BASED PHYSICAL ACCESS CONTROL SYSTEM

A. Manufacturer:

1. Brivo Systems, LLC

   a. *Headquarters:* 7700 Old Georgetown Rd, Suite 300, Bethesda, MD 20814.

   b. *Telephone:* EU - (+44) 2081 329 232, Americas – 1-866-274-8648

   c. *Website:* www.brivo.com.

2. Substitution Limitations: No Substitutions.

3. Product Brand Name: Brivo Access.

4. Certifications:

   a. MET Labs: UL294.

   b. Additional hardware certifications included in each hardware SECTION.

B. *System Overview:* There are eight major components to the Brivo Access system, as numbered below and depicted in Figure 1 below, with descriptions included in the System Architecture paragraph that follows.

1. Brivo Access application (available via web browser and mobile application).

2. Brivo Mobile Pass credentials (optional).

3. Access control hardware installed on customer network used with physical or digital credentials.

4. Connections to other devices and IT systems.

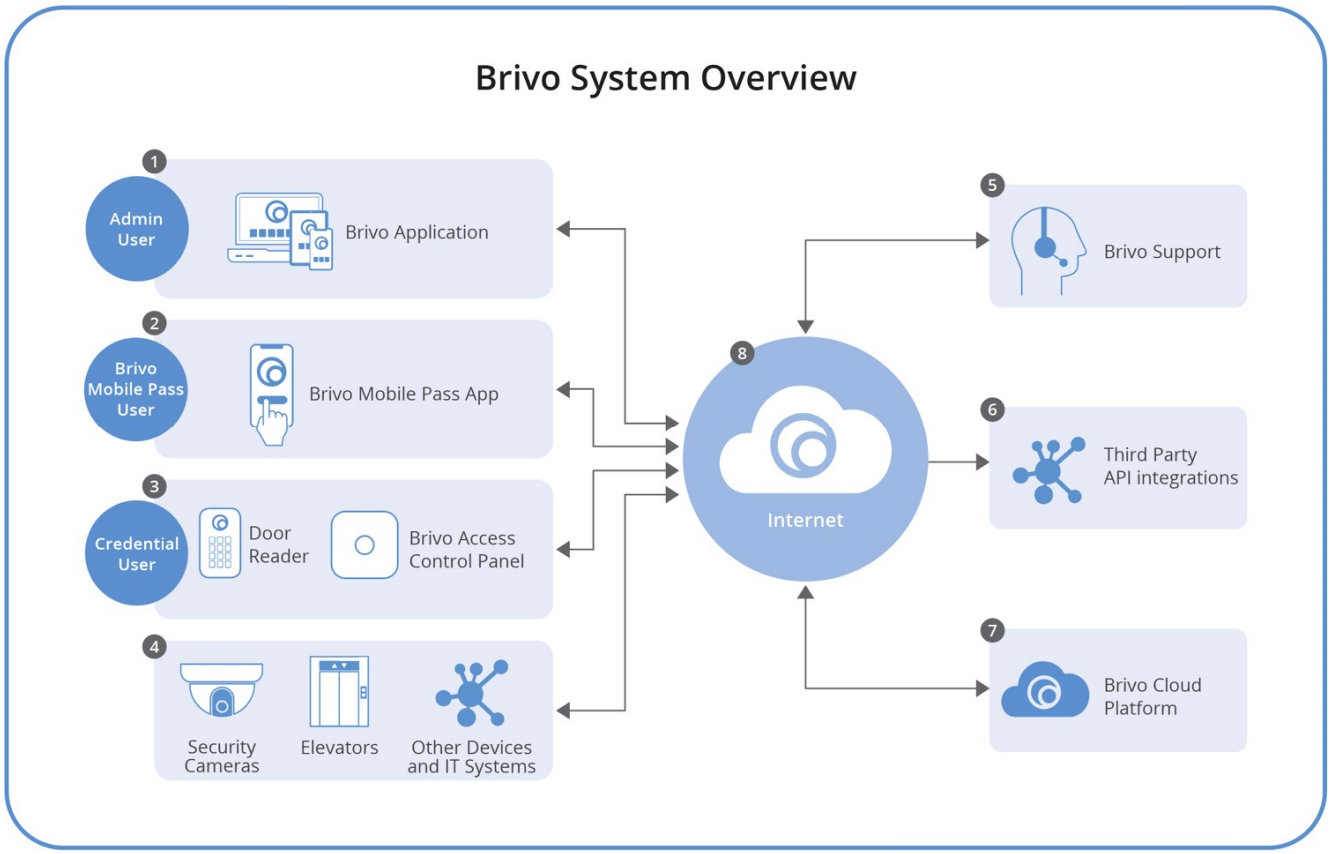
5. Brivo employees provide support, maintenance, and continuous cloud application infrastructure monitoring.

6. Third party API Integrations.

7. Brivo services are hosted with major cloud service providers.

8. Network communications via Internet.

Figure 1. System Overview diagram




C. *System Architecture:* System contains the architectural elements described below and illustrated in Figure 1. System design supports legacy readers and sensors for backwards compatibility with in- place access control device infrastructure but provides higher levels of systems security and modern user experience, such as hands-free use of mobile device-based credentials.

1. Cloud-Based Physical Access Control System Applications:

a. *Brivo Web Application (Web App):* Primary system software application named Brivo Access and is the software commonly referred to as “Brivo” for short. Full-featured web browser-based cloud native application for system and device management and control functions. See 2.3 CLOUD-BASED PHYSICAL ACCESS CONTROL SYSTEM SOFTWARE for specifications.

b. *Partner Portal:* Web application for use by licensed dealers to perform subscriber account setup and installation and service actions.

c. *User Mobile Applications (Mobile Apps):* Optional iOS and Android app, providing a subset of Web App user functionality.

d. *Installer Mobile Applications:* iOS and Android native applications for setting up system hardware.

e. *Mobile Credential Application:* iOS and Android native applications for use of Brivo mobile credentials instead of physical credential to gain access, with optional mobile device face or fingerprint biometric for multi-factor authentication. Biometric authentication at the moment of door access will still be required even if the user already logged into the mobile device biometrically.

f. *Open API:* Open RESTful API used by the system and made available to systems integrators, developers and customers for purposes of business system, third-party services and device integration.

g. Third-Party Custom Integrations:

1) All custom integrations are based on Brivo open API.

2) *Existing Third-Party Integrations:* Including, for example, elevator destination dispatch systems and IDM and IAM systems with single sign-on functionality.

3) *Customer Custom Integrations:* Typically to customer business systems and developed by Brivo technology partners, licensed dealers or customer IT personnel or service providers.

2. On-Premise Hardware:

a. *Brivo Hardware:* Hardware made by Brivo, or for Brivo and branded as a Brivo product.

1) *Control Panels:* Provides local connectivity to readers and I/O boards.

2) *Cellular Modules:* Provides cloud system Internet connectivity where a LAN is not available.

3) *I/O Expansion Boards:* Provides additional low voltage inputs and relay outputs.

4) *Reader Expansion Boards:* Provides control for additional readers.

5) Readers:

a) Legacy Wiegand/Proximity Wired Readers.

b) Smart Card Readers.

c) Wireless Locksets.

d) Brivo Door Stations

b. *Third-Party Hardware:* Compatible hardware devices and systems manufactured and sold by others:

1) *Mercury Access Control System Hardware:* Control panels, I/O and reader boards by Mercury Security Corporation.

2) *On-premises Integration Servers:* Such as for elevator destination dispatch system integration.

3) *Security Systems and Devices:* Such as intrusion detection and perimeter protection systems, alarm management systems, detection sensor systems, devices for motion, smoke and water detection, etc.

4) *Smart Locks:* Commercial and residential smart door locks.

3. User Smart Mobile Devices:

a. Mobile Apps on mobile devices provide remote system administration and control.

b. Digital credentials on mobile devices replace credential cards and fobs.

4. On-Premise Ethernet Networks:

a. *Device LANs:* Connect on-premises equipment, provide Internet connection for cloud- managed devices.

b. *User LANs / Wi-Fi:* Provide Internet connection to for Web App use.

5. Secure Cloud Data Centers:

a. *Secure Distributed Data Centers:* Tier 4 data centers having at least 2,000 miles of separation for geographical redundancy.

D. Design Criteria.

1. Principle of Least Privilege Application:

a. *Role-Based System Administrator Privileges:* Provide a highly granular roles-based privilege scheme for system administrators, so that no administrators need be assigned more privileges than they need to perform the administrative access management job duties assigned to them.

1) Allow the scope of administrator privileges to be assignable to specific sites and user group, allowing administrator's permissions to vary across sites and user groups.

2) Allow delegation of administrative duties by allowing some administrators to assign roles to other administrators, allowing the delegation of the same or lesser privileges than the delegator has.

b. *Credential User Access Privileges:* Allow any number of access privilege groups (access groups) to be defined and allow credential users to be members of up to 32 access groups, to provide sufficient flexibility in access privilege assignment that no credential holder needs be assigned more access than is required per job duties.

2. *IoT Native Development:* The system shall be an IoT Native system, whose cloud and on-premise computing and communication components are designed from the ground up as secure cloud and cloud-connected system elements.

3. *Online Help:* Provide detailed online help at https://support.brivo.com

E. *System Capacities:* Provide the overall system capacities shown in Table 1 below. Capacities of on- site hardware components are provided in Section 28 14 00.

Table 1. System Capacities

| Item | Capacity |
|---|---|
| Doors | Unlimited |
| Elevator Floors – Destination Dispatch | 118 per elevator |
| Elevator Floors – Relay Interface | 116 per controller system |
| Readers | Unlimited |
| System Administrators | Unlimited |
| System Administrator Roles | Limited only by practicality of Role usefulness |
| Users (Credential Holders) | Unlimited |
| Credentials in System | Unlimited |
| Credentials per User | Unlimited |
| Bulk Card Entry | 1000 per batch of Cards to add |
| Bulk Card Deletion | 20,000 per batch of Cards to delete |
| Badges per User | Unlimited |
| Maximum Access Groups Membership per User | 32 |

| Item | Capacity |
|---|---|
| Custom Data Fields per User | 60 |
| Time Zones | Unlimited |
| Door Lock/Unlock Schedules | Unlimited |
| Access Groups | Limited only by practicality of Access Group usefulness |
| Schedules | Limited only by practicality of Schedule usefulness |
| Holidays per Schedule | Limited only by practicality of Holiday usefulness |
| Exceptions per Schedule | Limited only by practicality of Exception usefulness |

## 2.2 CLOUD-BASED PHYSICAL ACCESS CONTROL SYSTEM SOFTWARE

A. *Description:* Cloud-based Software-as-a-Service offering (system software) for configuration, management and monitoring of physical access control for buildings and properties. System software interacts with cloud-managed on-site access control system hardware and other systems and devices, with integration options for video surveillance, intrusion detection, perimeter protection and other physical security systems and devices, building automation systems, single and multi-tenant residential automation systems, plus networkable IoT sensors and sensor systems. Functionality includes AI deep-learning based activity anomaly detection.

1. System software is compatible with Microsoft Edge and recent versions of Firefox, Chrome, and Safari browsers.

2. System supports a variety of credential types including proximity cards, smart cards, PINs, license plates, biometrics and mobile digital credentials.

3. Native mobile applications (Mobile Apps) for Android and iOS devices are provided.

B. *System Software Functionality:* System software functionality is accessed from starting with the software's Main Menu. The software's required functionality, as well as the main menu used to access it, are described below.

1. *Data Filtering System:* Comprehensive filtering capability that allows administrators to narrow down data record listings for reports and data displays using a variety of data field criteria, including support for partial data matches where appropriate. See the Brivo Access Online Help topic "Event Tracker" for filtering specifics.

2. *Navigation Bar:* The Navigation Bar is a menu bar on the left-hand side of each page. It presents a two-level menu of main items and subitems. Clicking on a main menu item presents a page for that item, or (if a small arrowhead is present on the right side of the menu item) presents two or more submenu item tabs below it. Local tabbed menus are provided on some pages, as needed.

3. *Dashboard:* In Brivo Access, the Dashboard is a powerful feature designed to provide administrators with a single, customizable view of security trends, events, and video feeds. The Dashboard helps improve response times and increases team productivity by centralizing critical information and insights in one place.

4. *Floor Plans:* Floor Plans displays an imported image on which users can place icons representing devices in the account, allowing for a visual representation of the site and the locations of those devices.

5. *Accounts:* Accounts define software user access to system configuration, management, monitoring and control capabilities.

6. *Span of Control:* Accounts establish spans of system administrator control, with each account exclusively assigned a group of affiliated control panels under the management of a single Primary Administrator.

   a. *No System Size Limitation:* Any number of control panels may be added to an account, so span of control may comprise a small building with single control panel, a large building with multiple control panels, or multiple buildings located in different cities or countries.

   b. *Flexible Time Information Management:* To accommodate the management needs of different types and scopes of administrator work, there are two ways to display Activity time information, Site Time and My Time.

      1) *Site Time:* Time stamps throughout an account reflect each site's time zone.

      2) *My Time:* Time stamps throughout an account reflect a single selected time zone.

3) The Time Zone setting is administrator-specific. When logged in, administrators will see Activity time information presented based on their own specific selection.

4) Show both time stamps in the Event Log display.

7. *Administrators:* According to role-based permissions, administrators can access and manage all or some of an account's data and perform administrator actions such as initiating a lockdown and locking, unlocking a door, and managing users.

   a. *Role:* Set of permissions which provide authority for administrators to perform certain functions within an account.

      1) *Default Administrator Roles:* Two administrator roles are predefined and cannot be deleted, Primary Administrator and Super Administrator.

      2) *Custom Administrator Roles:* Additional roles that may be defined to provide a specific set of administrative privileges that match the job duties being assigned to one or more administrators.

   b. *Primary Administrator Role:* Each account must have one and only one individual assigned the Primary Administrator role. The Primary Administrator can operate on all account data, as well as view, create, edit and delete any number of administrators.

   c. *Super Administrator Role:* May operate on all account data and may also create custom administrator roles and assign them to new or existing administrators.

8. *Events:* Near real-time logging, display and reporting of events as described below.

   a. *Activity Record:* The following event information is included in an activity record:

      1) Site name.

      2) Date and time.

      3) Door or device Name, or control panel ID if the event is not device-specific.

      4) User name, Operator name, or nature of event description.

         a) For Failed Access events, in the event description, include Card values and Card/PIN number values as masked numbers.

   b. *Firmware Version Dependencies:* Some events are provided based on the control panel firmware version as noted below.

   c. *Event Categories:* Sixteen categories of events.

      1) Account Events

      2) Administrator Events

      3) Badge Events

      4) Control Panel Events

      5) Credential Events

      6) Custom Field Events

      7) Device Events

      8) Group Events

9) Holiday Events
10) Notification Events
11) Permission Template Events
12) Report Events
13) Schedule Events
14) Site Events
15) User Events
16) Video Events

d. *Anomaly Detection:* Brivo AI continuously learns patterns across people and places and detects anomalous activities. Anomalies flag activities based on individual user behaviors.

1) *Anomaly Alerts:* When anomalous activity is detected, a Priority Alert is issued containing a description of the anomaly, such as, “It is unusual for [user name] to access North Office Storage at this time” or “It is very unusual for [user name] to access Side Door 1A at this time.” Anomaly alerts are accessible in the Event Tracker’s event log.

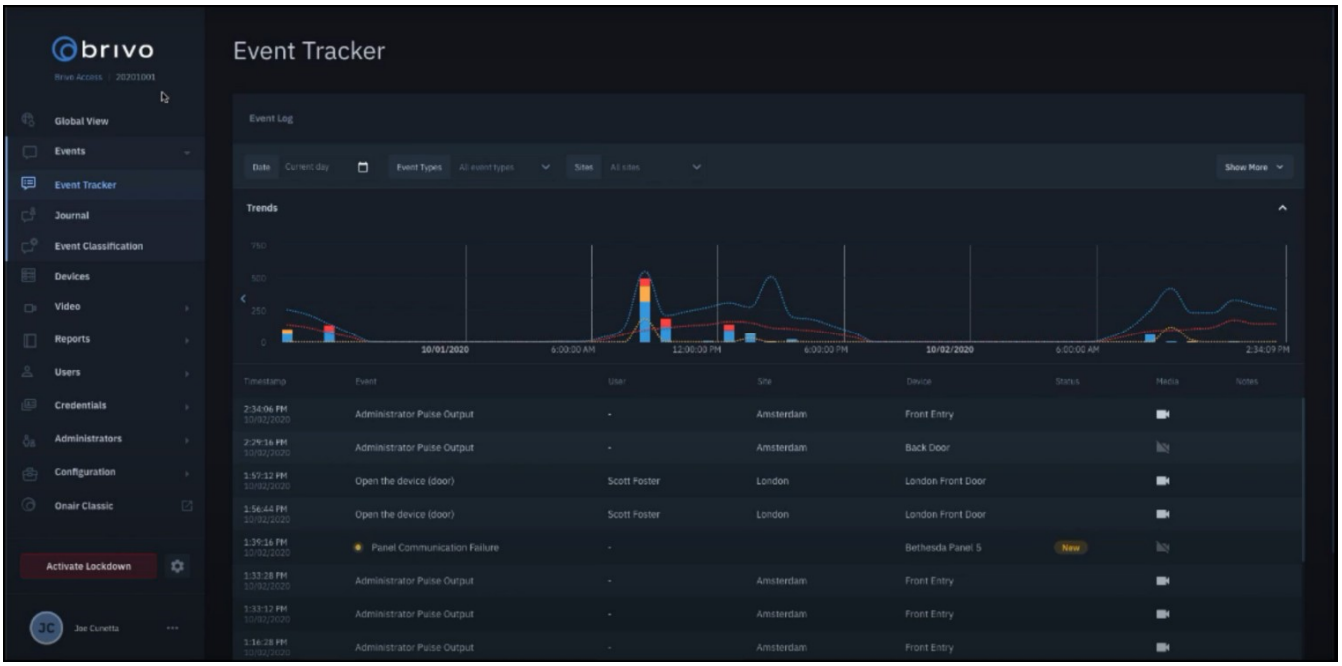
2) *Anomaly Event Video:* Video related to an access event flagged as anomalous is viewable through the event’s Event Details display.

9. *Event Tracker:* Event Tracker page, displayed upon administrator login, provides a listing of current day live events and past event data. It also displays a widget that can be toggled between a summary of the last user to enter or a trend graph for data analysis. See Figure 3 below.

a. *Event Log Listing:* On a single line, provide the following data items:

1) *Timestamp:* UTC time, local time to the workstation logged in.
2) *Site Time:* Local relative UTC timezone at the site location.
3) *Event Name:* Name of event.
4) *User:* Name of User if User-related event.
5) *Site Name:* Name of Site where event occurred.
6) *Device Name:* Name of device if Device-related event.
7) *Event Status:* New or Cleared (by an administrator).
8) Anomaly Detection: Blank, yellow, or red icon indicating an event to be anomalous based on the time and day the event occurred.
9) *Notes:* Blank or icon indicating administrator notes have been entered for the event.
10) *Media:* Icon indicating whether video exists for the event.

Figure 2. Event Tracker page




b. *Pop-Up Event Details Display:* Clicking on an event pops up the Event Detail box showing the event data, and four information sections below it.

   1) *Video Playback:* Display area for reviewing related video if it exists. Video may be viewed in the Event Details small display area or full screen.

   2) *User Details:* User name and photo, with a link to display the full User record.

   3) *Notes:* A section for reviewing and added time stamped note text.

c. *Filtering:* Provide event filtering by Date, Event Name, User, Site, and Device. Include options to exclude camera events and exclude events without video data from the event listing.

d. *Trends:* Provide graphical representations of trend data using stacked bar charts and graph curve lines to enable identifying trends or anomalies occurring over a 12-hour period.

   1) Bar colors indicate the event classification: red for Critical, yellow for Warning or blue for Information.

   2) Hovering the cursor over a trend line initiates a pop-up display of trend information (not shown in Figure 3):

      a) Date and Time of event.

      b) Current and previous week counts for Critical, Warning and Information events.

10. *Journal:* Journal page displays a 90-day record of all actions performed by administrators broken into 24 hour segments, including when each administrator logged on and off, and what actions were performed.

a. *Viewing Privileges:* The Primary Administrator and administrators with appropriate permissions can view all actions. Otherwise, administrators can view only their own actions.

b. *Viewing:* The Journal page displays the current 24-hour period. To switch to a different date, you can either filter or scroll down.

c. *Journal Records:* For each action, the Journal shows the Date/Time, details of the Action, and the first name, last name and email address of the person who performed the action.

1) *Data Audit Trail:* To support troubleshooting and error-correcting, action details show the before-change and after-change states of any data fields or settings items changed.

2) *Action Details Links:* As appropriate, the Journal shows links in the Action details for users, devices, schedules, holidays, sites, groups, reports, and control panels. Administrators may click on those links and be taken to a new journal page filtered for that particular link.

11. *Brivo Snapshot:* AI-based capability that speeds the review of visual event information using machine learning to pre-index a fused stream of video and event data. Reduce the time required to find images of interest by up to 20 times less than traditional search techniques in stand-alone video or access control systems.

a. *Snapshot Functionality:* Use machine learning to detect the presence of people by finding the video frame with the highest facial detection score around a specific entry event. Extract that video frame and present it along with the underlying video clip.

b. *Fastest Review:* Enable administrators to flip through a “photo album” of single frames derived from video associated with an access event, without having to watch a full 30-60 second recording.

c. *Visual Access Verification:* Enable fast visual entry confirmation.

1) Verify that credential-based access was performed by the actually credential-holder.

2) Identify instances of tailgating and piggybacking.

3) Review group entry, such as the arrival of visitors, vendors, customers, and tenants.

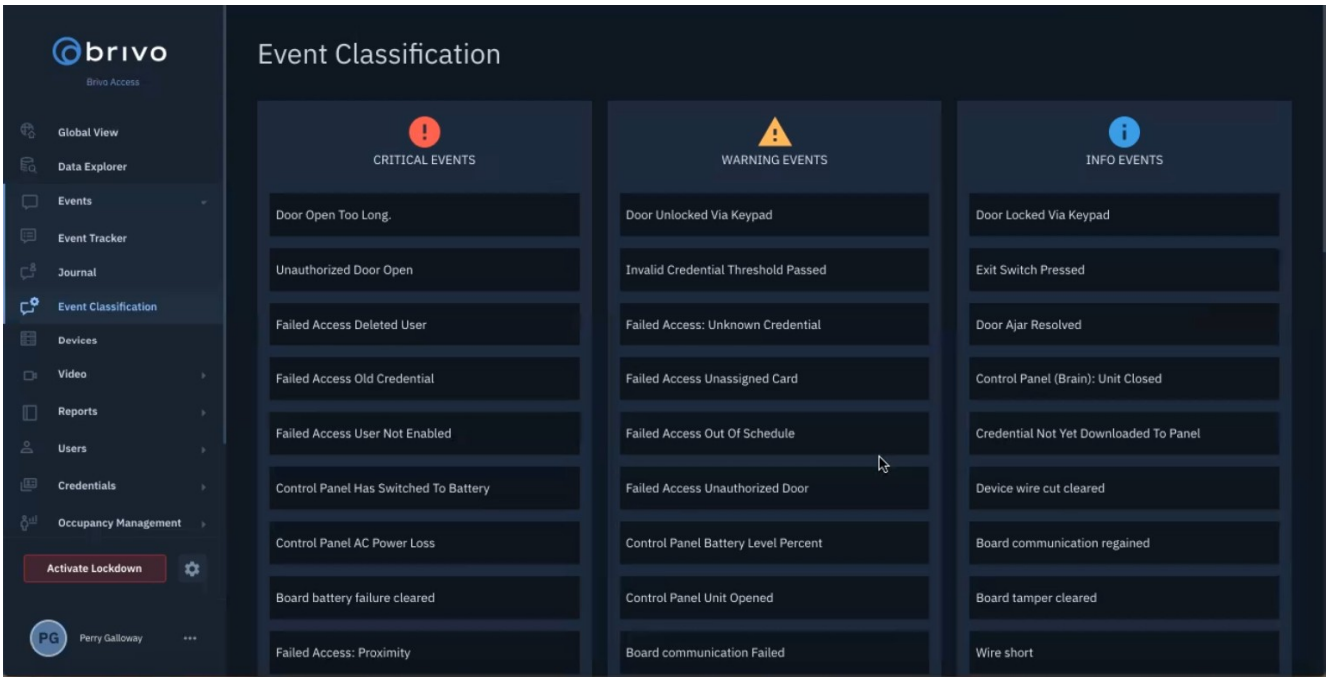
12. *Health Mask Presence:* Detects mask presence and usage to determine if masks are being worn properly, i.e., covering mouth and nose.

C. *Event Classification:* Events are classified as Critical, Warning or Information events, and are displayed in three columns according to their classification, on the Events Classification page. Each column is divided into two parts: the top part for active events, and the bottom part for inactive that are not of interest. See Figure 2 below (active events only are shown).

a. *User-Configurable:* Event classifications are user-configurable on the Events Classification page, by dragging and dropping an event from its current classification column to a different one

b. *Inactive Events:* Inactive events are not included for selection in event classification drop down lists, such as for filtering of event log displays in Event Tracker or reports, or in configuring Notification Rules.

Figure 3. Event Classification Page




13. Advanced Access Control Features:

a. A*ntipassback:* Hard and Soft antipassback controls.

1) *Hard Antipassback:* Requires two readers per door, one for entry and one for exit of the controlled area. Implemented on a per-credential basis, once a credential is presented for access in one direction (for example, entry), the credential must be presented for the opposite direction (for example, exit) before it can be used again for its previous use (in this example, entry). Thus, in addition to preventing credential passback, it also supports the integrity of access control entry and exit records, as it discourages tailgating by preventing two entries or exits in a row via credential.

2) *Soft Antipassback:* Requires only a single reader per door, typically used for entry control, but also allows dual-reader usage for entry and exit control. Soft antipassback allows re-use of the credential for entry or exit after a timed interval or a scheduled reset of passback in/out status.

a) *Antipassback Reset Interval:* Provides a time interval that prevents a user who enters or exits from doing so again before the specified time interval elapses. After interval elapse, the user is free to enter or exit.

b) *Antipassback Reset Time:* Option where a user group's status as inside or outside the passback-controlled area is automatically reset to being outside at a specific time of day, with the ability to enter the time on a 24-hour clock with minute-by- minute detail.

b. *Emergency Scenarios:* Emergency scenarios involve triggering devices (including doors) to follow a prescribed behavior which follows one of two methods: Lockdown or Egress.

1) *Lockdown:* There are two modes of lockdown implementation.

a) *User Group Lockdown:* For use with legacy hardware, an Administrator revokes access privileges of a large number of users, either for all users at all sites, or only for specific user groups. Group Lockdown has no specific hardware requirements.

b) *Door Lockdown:* Administrator-initiated and device-initiated door lockdown, available solely for customer accounts that contain only ACS6000, ACS300, SDC, ACS-SDC and ACS 100 control panels – no ACS5000 or IPDC control panels. Lockdowns can be initiated using duress buttons connected to system inputs. Wired Lockdown configuration is limited to the use of a single ACS6000, SDC, ACS300, ACS-SDC or ASC100 panel on a site. They can also be named scenarios that are defined for lockdown of specific doors. An administrator activates a lockdown via a Web App or Mobile App software button, selecting a lockdown scenario to be activated. User Groups may individually be configured for exemption from Door Lockdown.

2) *Egress:* Egress can be initiated using exit buttons connected to system inputs. Wired Egress configuration is limited to the use of a single ACS6000, SDC, ACS300, ACS- SDC or ASC100 panel on a site. They can also be named scenarios that are defined for egress of specific doors. An administrator activates an egress via a Web App or Mobile App software button, selecting an egress scenario to be activated. User Groups may individually be configured for exemption from Emergency Scenarios.

c. *Facility Personnel Safety Features:* COVID response personnel safety features.

1) *User Contact Reporting:* Generate targeted reports listing specific user access events and potential contacts.

2) *Personnel Control:* Suspend user access automatically until they go through a screening checkpoint.

3) *Mobile Self-Screening:* Use Brivo Mobile Pass to identify users with COVID symptoms before they enter a site.

4) *Brivo Visitor Enhancements:* Screen all visitors for COVID symptoms and notify hosts when their visitors may pose a risk.

14. *Notifications:* An email notification rule is a named set of conditions for routing email notifications to one or more recipients who should be notified about selected events that occur at a specific site according to the selected schedule, and in the selected language.

a. *Event Selection:* Checkboxes are provided for selection of Exception events, Device events, Control Panel/Board events and Camera events. User group selection option is provided for Successful Access Event notifications.

15. *Occupancy Management:* Capability to set site occupancy limits and monitor the current occupancy count of sites.

a. *Configuration:* Settings for site occupancy management.

1) *Occupancy Limit:* Used for tracking and notification purposes. Users will still be granted entry when the limit is reached.

2) *Timeout:* Amount of time in hours after which a user will be considered to be off-site. Each time users present a credential within the site; the user's occupancy status timer will be reset.

b. *Occupancy Dashboard:* Page that presents an occupancy status box for each site configured for Occupancy Management. The status box displays the current number of occupants in the center of the box. Selection of the User List option selection replaced theoccupancy count with a list of current occupants that includes each occupant's Entry Time, photo, and name.

16. *Reports:* Administrators can generate reports for a 90-day window using data from up to 365 days ago.

a. *My Reports:* Query tool for predefined commonly run immediate and scheduled reports, allowing these reports to be generated and parameterized depending upon administrator permissions.

b. *Report Use:* At the time of creation, administrators have the ability to mark a user or activity report as private. A private report can only be seen by the Primary Administrator of the account as well as the administrator who created it.

c. *Report List:* Below is a list of the available reports in My Reports. A "(C)" denotes the report allows the inclusion of custom field data. A "(D)" denotes a default report created at account creation.

1) *Account Activity Report (D):* An alphabetized list of all sites with summarized information (for the last 24 hours) that includes Access Events, Failed Access Events, Exception Events, Door Locked/Unlocked Events, Programmable Device Events, Wiring Events, and Control Panel and Board Events.

2) *Account Summary Report:* All sites sorted alphabetically (by site name) with Site Name, Address (City Name and State), Quantity of Doors, Quantity of Devices, Quantity of Users, and name of Unlock Schedule(s).

3) *Active Users Report (C) (D):* All active users sorted alphabetically by last name (for a 90-day window within the last 365 days) with Last Name, First Name, Cards, PIN Credentials, and Last Credential Use Date. This report can include and be filtered by custom field data.

4) *All Doors Report:* All doors sorted alphabetically (by site) with Door Name, Control Panel ID, Device Type, and Created Date.

5) *All Users Report (C):* All users sorted alphabetically by last name (for a 90-day window within the last 365 days) with Last Name, First Name, Cards, PIN credentials, Status, Expiration Date, and Last Credential Use Date. This report can include and be filtered by custom field data.

6) *Control Tracing Report (D):* Identifies a user's path of travel and all users with whom they may have come into contact during a given period of time.

7) *Control Panel Report (D):* All control panels sorted alphabetically by control panel name with Control Panel Name, Last Contact (Date/Time), Control Panel ID, Model Type, and current Firmware Version.

8) *Daily Summary Report (D):* Available in English, French, or Spanish, a list sorted alphabetically by site with summary information for the last 24 hours. Summary information includes: unique users on site, successful access events, failed access events, forced door events, door ajar events, too many invalid PINs, schedule override events, pulse door events, lockdown events, communication loss events, power loss events, control panel opened events, wire cut events, and wire short events.

9) *Door/Device Rights Report (C):* All doors and devices grouped by site showing all users (listed alphabetically by name) with rights to those doors and devices. This report can include and be filtered by custom field data.

10) *Elevator Report:* All elevators sorted alphabetically with the names of the floors being controlled and the output.

11) *First/Last Access Report (C):* A list of all users sorted alphabetically with First Access, showing credential used, device accessed, and time used, and Last Access, showing credential used, device accessed, and time used (since midnight in the report runner's time zone). This report can include and be filtered by custom field data.

12) *Group Directory Report (D):* All groups sorted alphabetically by group name with Group Name, Number of Users in Group, and the Created Date.

13) *Holiday Report:* A list of all holidays in the account sorted by date that includes Site, Holiday Description, and From and To Dates.

14) *Inactive Users Report (C) (D):* All inactive users sorted alphabetically by last name with Last Name, First Name, Cards, PIN Credentials, and Status. This report can include and be filtered by custom field data.

15) *Journal Report (C) (D):* A listing of journal entries for a particular event type. Displays the Date and Time, Action, Details, and who performed the action. This report can include and be filtered by custom field data.

16) *Schedule Relationship Report (D):* A list sorted alphabetically by site with Groups and Devices to which the selected schedule is applied.

17) *Site Activity Report (C) (D):* A chronological list of a selected site(s) and/or device(s) with summarized information for a selected time period that can include one of the following event types: Access Events, Failed Access Events, Exception Events, Door Locked/Unlocked Events, Programmable Device Events, Wiring Events, and Control Panel and Board Events. This report can include and be filtered by custom field data.

18) *Unique Users Report (C):* A list of all unique users sort alphabetically who have accessed a selected site(s) for a selected time period. This report can include and be filtered by custom field data.

19) *Unused Credential Report (C):* A list of all users sorted alphabetically who have never used their credentials within the specified time frame showing First

Name, Last Name, and Credential (card value or PIN). This report can include and be filtered by custom field data.

20) *User Activity Report (C) (D):* A chronological list of activity by group and/or user at selected site(s) and/or device(s) with summarized information for a selected time period. This report can include and be filtered by custom field data.

21) *User Image Quality Report (C) (D):* A report which displays which User images are suitable for use with Faceprint credentials. The score provided is either suitable or not suitable with a numerical score. It is recommended for a photo to have a score of 0.7 or higher for best results with the Brivo Door Station.

17. *Sites:* As defined within the system, a site is a logical group of doors, devices, and floors. An account can have one or more sites associated with it.

    a. *Door:* A named exterior or interior door with electronic means of door entry control, such as a keypad or card reader connected to the system via a door board and a main controller. See Section 28 14 00 for system control hardware information.

    b. *Floor:* A named or numbered building floor, the entry to which is access-controlled via an elevator interfaced with the system, so that floor access requires presentation of a valid access credential in an elevator lobby or inside the elevator.

    c. *Device:* There are two types of system devices.

        1) *Physical Device:* A named physical or electronic device connected physically or logically to the system to provide sensor or control functionality. Physical devices system control panel main boards, door boards, I/O boards and associated electronic devices. These are installed and configured to initial values by a licensed dealer. Physical device setup is performed through the system manufacturer's partner portal software, not specified in this document.

        2) *Logical Device:* Software logical devices are used to represent physical devices attached to the system. Logical devices are configured for operational use by an end user administrator and/or by a licensed dealer. See Devices below.

18. *Monitor Devices:* Software logical device categories that represent physical devices attached to the system. A device may have states (such as on or off) and/or actions (such as Latch, Unlatch or Pulse). Logical devices are used to simplify and add uniformity to the management of the great variety of available physical access control and monitoring devices.

    a. *Device Types:* There are four device types which are software logical device categories that represent physical devices attached to the system. A device may have states (such as on or off) and/or actions (such as Latch, Unlatch or Pulse). Logical devices are used to simplify and add uniformity to the management of the great variety of available physical devices.

        1) *Switch:* A logical device with one input point and 0 to N output points that has one of two states (On or Off). A switch device can have these behaviors: Latch, Unlatch, Pulse, or Follow. A schedule associated with the device causes it to be available for activation via its input point during the times defined in the schedule.

        2) *Timer.* A logical device whose input is a schedule and that has 0 to N output points associated with it. The timer's state is On during the times defined in its

schedule, otherwise it is Off. The device can have these behaviors: Latch, Unlatch, Pulse, or Follow.

3) *Valid Credential:* A credential logical device has one input that is a card reader and that has 0 to N output points associated with it. A valid credential device has no state, so its behaviors are limited to: Latch, Unlatch, and Pulse. Valid credential devices have permissions associated with them and appear in the group permissions area. Valid credential devices do not have state, nor do they have schedules. Lock/unlock schedules are defined for Doors, which can have credential devices associated with them, and for User Groups, which can include schedules that determine times members of the User Group are allowed to access doors associated with the User Group.

4) *Event Track:* A logical device whose input is the specific event associated with it from the door that the event track device is created to watch. An event track device can have 0 to N outputs associated with it.

a) The device can always have these behaviors: Latch, Unlatch, or Pulse.

b) If an event track device is watching for Door Ajar events, then it has state and can have a Follow behavior. If the Follow behavior is selected, then the device can have a Disengage message.

c) The schedule associated with an event track device defines when it is active because an administrator may want to respond to the event only during specific business hours or non-business hours.

b. *Device Management:* Administrator logical device management consists of device configuration, manual device control and device monitoring. Device management may be performed after the installer has completed hardware installation and configuration.

1) *Device Configuration:* Device configuration detail pages are accessed via the main menu Configuration item, and Door configuration page.

2) *Manual Device Control:* Device control is available throughout the application at appropriate points. Restrictions to manual device control are provided both by administrator privileges and by individual device configuration. Authorized administrators have door lock and unlock control available on Activity Log and Event Tracker pages, which allow for user photo comparison and offer event-based video playback. Door unlock capability is also provided on the Video page for each camera associated with a door.

3) *Device Monitoring:* The Devices page provides a display of Device Status information, categorized by site including site summaries, and filterable by device type and device status.

19. *Device Groups:* Device Groups have the specific purpose of facilitating the management of access privileges for Offline Locks – initially Allegion/Schlage Control Locks. A Device Group is similar to a User Group, except that a Device Group contains Offline Lock devices instead of Users.

a. A single offline lock can belong to up to 16 Device Groups.

20. *Schedules and Holidays:* A schedule is an editable, reusable, named time template that can be used to control such things as when a door is locked or unlocked, when a device is

activated, and when a system action is performed such as notifications or scheduled reports. A holiday is an alternate time template that overrides a schedule on a single day or on two or more consecutive days.

a. *Scope:* Schedules can be defined as account-wide or site-specific.

b. *Group Enabled Schedule:* A group enabled schedule is a site-specific schedule used to implement First-Person-In or Supervisor-on-Site functionality, by selecting a user group to serve as the enabling user group for the schedule.

1) *First-Person-In:* Requirement that the schedule controlling a specific door or elevator cannot be activated until a member of the enabling user group accesses it. For example, the main lobby door is scheduled to be unlocked at 9:00 AM, but only if a manager is present. If no member of the Manager user group arrives through the main lobby door until 9:15 AM, the door remains locked and can only be opened except by credentialed access.

2) *Supervisor-on-Site:* Performs the same function as First-Person-In, but in addition keeps readers and keypads inactive until a member of the Supervisor user group arrives.

c. *Schedule Relationships:* Once created, a schedule may be associated with various user groups, doors, floors, devices or notification rules. These relationships may be created by multiple administrators over time, and a single schedule may eventually become associated with numerous entities. At any time, administrators can generate a report that lists all the associations for a specific schedule.

21. *System Multi-Factor Authentication:* Provide multi-factor authentication using the Time-based One-time Password algorithm (specified in RFC 6238) and the HMAC-based One-time Password algorithm (specified in RFC 4226), for authenticating system administrator logins.

a. Require administrators to install the Google Authenticator mobile app.

b. Utilize the Google Authenticator barcode-based enrollment process to establish multi- factor authentication capability.

c. Require entry of a Google Authenticator code as part of the login process.

22. Users and User Groups:

a. *User:* An individual who requires access to one or more doors or floors at a given site or set of sites. A user has unique credentials, such as a card, PIN or Brivo Mobile Pass, that enable entry and exit at the specified doors and floors. A user may also be referred to as a credential holder.

b. *User Group:* A named set of users with the same access privileges to one or more sites within an account. A user may be a member of up to 16 user groups. User Groups specify the doors and/or floors for which its member are granted access.

c. *Bulk Delete, Suspend, or Reinstate Admin Actions:* An administrator can perform delete, suspend, or reinstate actions for users in groups of 100 at a time.

d. *Access Privileges:* Access privileges are defined at the user group level. A user inherits privileges from the user groups to which he or she belongs. User privileges

can be set to start and/or expire on specified dates. Special privileges can be assigned to selected user groups:

1) *Keypad Unlock-Hold Privileges:* When enabled, any member of user group can override a door unlock schedule by presenting his or her credentials and entering 99# at the door's keypad. To reactivate the door unlock schedule, the group member enters 00#.

2) *Excluded from Lockdown:* When enabled, members of the user group are excluded from all Door Lockdown restrictions.

3) *Immune to Antipassback:* When enabled, the user group members will not be affected by any antipassback settings in place.

4) *Antipassback Reset Time:* Selecting an Antipassback Reset Time enables soft antipassback for the user group members. Leaving it blank enables hard antipassback.

## 2.3 VIDEO SUPPORT

A. *Video Platforms:* Enable video integration via online video recording incorporated within the system as well as integration with third party video recording devices installed on the customer's premise. Use the timestamp of access events and a camera identifier to query the integrated platform for video clips related to access events.

1. Live Video:

   a. *Viewing:* Provide viewing of video using a 9-camera (3 x 3) scrollable viewing matrix, filterable by site, with option for full-screen viewing of any single camera's video.

   b. *Notifications:* Provide notification capability for video camera motion events.

   c. *Door Unlock:* Provide the ability to unlock a door while viewing video associated with the door.

2. Recorded Video:

   a. *Viewing:* Provide viewing capabilities similar to viewing live video.

   b. *Event-Related Video:* Provide viewing of event-related video from the Event Log display.

## 2.4 USER MOBILE APP FUNCTIONALITY

A. The Mobile App includes the following functionality, subject to the user's permissions:

1. Manage Brivo Access account from smartphone or tablet.

2. Suspend and/or reinstate users.

3. View live and recorded video across multiple sites.

4. Monitor activity logs across multiple sites.

5. Initiate or end a site lockdown.

6. Unlock doors remotely.

7. Create new users, assign user access privileges, issue credentials.

## 2.5 CREDENTIAL AND READER SUPPORT

A. *Card Bank:* Maintain a list of all cards associated with an account, with display and printing of card information listed below and the ability to assign, revoke or delete a card from the card bank list.

1. Card number.

2. Card Format.

3. Facility Code.

4. Agency Code.

5. User Assigned To.

B. *Card Reader and Keypad Operation:* Provide multiple options for granting access through doors via reader and keypad.

1. Card reader control only.

2. PIN control only.

3. Simultaneous control by either card presentation or PIN entry.

4. Combined control requiring both card presentation and PIN entry.

5. Different options in effect during different schedules.

C. Card and Key Fob Formats.

1. *Legacy Card Formats:* Support all Wiegand and HID formats up to 128 bits.

2. *Smart Card/Fob Formats:* MIFARE DESFire® EV2 with LEAF data structure.

D. Readers: It is understood that the County uses HID Signo series readers. Contractor to verify Owner's card credentials and coordinate the associated readers accordingly, with credential support as listed below.

1. Provide readers in the form factors and with the credential support described below.

a. Three Form Factors:

1) Mullion.

2) Single Gang.

3) Single Gang with Keypad.

b. Provide Credential Support based on the Owner's credential technology

c. Reader Colors:

1) Black.

2. Readers and Credential Support:

a. Readers:

1) HID Signo Series, mullion mount, wall mount prox and wall mount dual authentication as required.

E. *Credential Read Ranges:* Table 2 below shows the various credential read ranges from inches to unlimited range.

Table 2. Credential Read Ranges

| Range | Inches | About 1 to 6 Feet | Wi-Fi Range | Unlimited Range |
|---|---|---|---|---|
| **Credential** | RF to reader with Proximity, Smart Proximity Card or Smart Fob | Bluetooth to reader with Mobile Pass support | Mobile Pass to Brivo Access with Trusted Network option activated | Mobile Pass to Brivo Access with Trusted Network option deactivated |

## 2.6 MOBILE CREDENTIAL SUPPORT

A. *Coordinate with the Owner.*

1. *Trusted Network Policy:* Also referred to as the Trusted Network option or simply Trusted Network, it is a feature whereby Mobile Pass usage is allowed only when the Mobile Pass device is within the range of one or more authorized site Wi-Fi networks.

2. *Mobile Pass Credential Use Modes:* Mobile Pass may be used in any combination of three modes.

a. *Bluetooth Enabled Readers:* Readers with Bluetooth Low Energy enabled for Mobile Pass.

b. *Site Wi-Fi and Brivo-Controlled Doors:* Brivo-controlled doors and Mobile Pass device within range of a Wi-Fi network used with the Brivo Trusted Network Policy is activated.

c. *Internet Access and Brivo-Controlled Doors:* Brivo-controlled doors and Mobile Pass accessing Brivo via the Internet – on-site or remotely – with the Trusted Network Policy deactivated for the site.

## 2.7 OPEN INTEGRATION API

A. *Open API:* Provide an open RESTful API for custom integrations. Make the API documentation available at https://apidocs.brivo.com and provide developer support for integrations by customers and system integrator dealers.

## 2.8 AVAILABLE INTEGRATIONS AND INTERFACES

A. *Elevator Integration:* Elevator system integration is of two types: software-based Destination Dispatch system interfaces, and relay-based interfaces.

1. *Destination Dispatch:* Utilize an on-premises server to interface with elevator destination dispatch systems from multiple elevator manufacturers.

a. *Server:* On-premises server utilizing Steward software from braXos Security Software. Supported elevator systems include:

1) Fujitec.

2) KONE (Access, ELI, RCGIF).

3) Mitsubishi.

4) Motion Control Engineering (MCE).

5) Otis Compass.

6) Schindler PORT.

7) ThyssenKrupp (TK Elevator) AGILE.

2. *Relay-Based Interface:* Output relays interface to elevator system dry contact inputs to indicate which floors the user is authorized to access.

B. *Identity* Integrations*:* Identity integrations are of two types: Single Sign-On and User Provisioning.

1. *Single Sign-On*: Many IDM and IAM systems offer Single Sign-On. Using the Brivo Identity Connector, Brivo users and administrators can include access to the Brivo Web App in their Single Sign-On application list. Single Sign-On integrations include:

a. Microsoft Entra ID

b. Okta

c. OneLogin

d. Many other business single sign-on solutions.

2. *User Provisioning:* Brivo Access user provisioning can be performed in an integrated IAM by assigning and modifying Brivo user and administrator rights, and adding users to appropriate user groups, with the result that the user and administrator rights and user

group assignments automatically update in Brivo. Deleting the users or administrators in the IAM system results in their removal from Brivo Access. User provisioning integrations include:

a. Google Workplace (formerly G Suite).

b. Microsoft Entra ID

c. Okta

C. Intercom Systems: 2N IP Verso.

1. Administrators can configure one or more user groups to be downloaded to the touchscreen directory of an intercom.

a. Intercom directory list shall automatically be updated as users are added or removed from the associated groups in the access control system.

b. Fields downloaded include display name, phone number and other configuration information to dial up to 3 distinct phone numbers per user in the intercom directory.

c. No inbound firewall ports shall be necessary for proper operation. The intercom shall initiate an outbound connection to the access control system on an hourly, daily or weekly time interval.

D. *Intrusion Detection:* Alula.

1. Alula BAT Connect.

2. Alula Connect+.

E. Smart Power Systems:

1. Altronix Trove.

2. Life Safety Power (LSP).

3. Elmdene

F. *Video Surveillance:* Cloud-based video surveillance support is provided by cloud-based integration with Eagle Eye Networks Cloud VMS.

1. Cloud-Based VMS Integration:

a. On-Site Software: None.

b. On-Site Hardware: All Bridge and Cloud-Managed Video Recorder devices from Eagle Eye Networks are supported.

c. Camera Support: Eagle Eye currently supports over 3,000 makes and models of cameras.

1) *Camera Types:* Digital IP, Analog, HD over COAX, and Body Worn cameras.

2) *Makes and Models:* See the Eagle Eye Networks Camera Compatibility List.

d. Maximum Capacities:

1) Maximum Cameras per Account: 10,000.

2) Maximum Simultaneous Viewers per Camera: 100.

2. Brivo Wireless Cameras:

a. *On-Site Software:* Brivo Access Cam software for Windows or Mac.

b. Wireless Cameras:

1) Outdoor PoE Bullet.

2) Indoor & Outdoor PoE Dome.

3) Indoor Wireless Cube.

3. Additional Integrations:

a. Milestone Systems: XProtect.

b. Exacq Technologies: exacqVision.

G. *Visitor Management System:* Brivo Visitor and WhosOnLocation integration.

1. *Sync Users:* Upload users, perform list management, and sync staff lists between both platforms.

2. *Issue Credentials:* Issue visitor access credentials before they arrive on-site or after sign-in.

3. *Muster in an Emergency:* Identify who is on-site, off-site, and in the event of an emergency use the mustering app to verify the safety of every person on site.

H. Wireless Lock Integrations:

1. Allegion.

a. Allegion Online Locks:

1) Allegion/Schlage AD400 Wireless Locks.

2) Allegion/Schlage NDE/LE Wireless Locks.

b. *Allegion Online Lock Gateways:* An Allegion Gateway is Brivo's term for a device that allows a Brivo Access account to utilize certain types of Allegion Wireless door locks.

1) Once an Allegion Gateway is configured on a Brivo account, new doors added to the account may select the Allegion Gateway as a controller.

2) There are two types of gateways, both using RS485 communications to Brivo ACS6000 and ACS300 control panels:

a) *Allegion/Schlage AD400 Wireless Locks:* Panel Interface Module (PIM) PIM400- 485.

b) *Allegion/Schlage NDE/LE Wireless Locks:* Allegion ENGAGE™ Gateway.

3) Gateway Utilization:
   a) Up to 10 locks per gateway.
   b) Up to 4 gateways per control panel.
   c) Control panel determines maximum number of locks per panel.
4) Brivo Control Panel Maximum Readers/Locks:
   a) ACS6000-E or ACS6008-E control panel: 30.
   b) ACS300-E control panel: 2.

c. Allegion Offline Locks:
1) Allegion/Schlage XE360 Wireless Locks.
   a) The lock is programmed using an Allegion Schlage MT20W multi-technology enrollment reader and programmable credential.
   b) Each programmable credential may support up to 11 Brivo User Groups with variable access permissions.
   c) Each Allegion/Schlage XE360 Lock can be associated with 16 Brivo Device Groups.
   d) See the Brivo Configuration Guide for Allegion Offline Locks for additional details.
2) *Allegion/Schlage Control Locks:* The Brivo and Allegion Control lock integration is a data on card or "offline" topology. The locks do not communicate with either Brivo controllers or services. The cards contain all of the user's permissions.
   a) The lock is programmed using an Allegion Schlage MT20W multi-technology enrollment reader and programmable credential.
   b) Each programmable credential may support up to 11 Brivo User Groups with variable access permissions.
   c) Each Allegion/Schlage Control Lock can be associated with 16 Brivo Device Groups.
   d) See the Brivo Configuration Guide for Allegion Offline Locks for additional details.

2. ASSA Abloy.

a. Aperio™ Technology Wireless Locks.
1) Aperio Hubs: Aperio-enabled locks communicate wirelessly to an Aperio AH30 IP Hub, which connects to a Brivo ACS300 or ACS6000 control panel via the control panel's Admin network port.
2) Each Aperio Hub supports up to 16 Aperio locks per panel.
3) Each Brivo Panel supports up to 30 AH40 Aperio Hubs.
4) Any combination of up to 30 card readers and Aperio locks may be used per control panel. The Brivo control panel model determines maximum number of readers and locks total per panel:

a) ACS6000-E or ACS6008-E control panel: 30.

b) ACS300-E control panel: 2 wired, 28 to 30 wireless.

5) *Hub Event Messages:* The following event messages are sent to the control panel by the Aperio Hub:

a) Lock RF Communication Restored.

b) Lock RF Communication Failure.

c) Door Pulsed by Admin.

d) Door Ajar.

e) Door Ajar Cleared.

f) Door Forced.

g) Opened by Key.

h) Lock Tamper.

i) Lock Tamper Cleared.

j) Lock Low Battery.

k) Lock Battery Critical.

l) Unlock on Schedule

m) Lock on Schedule

3. Salto.

a. *Salto Sallis Wireless Locks:* Sallis wireless locks communicate through Salto wireless nodes within 30 ft. of the lock. The wireless nodes communicate to a Brivo control panel through a Salto router.

b. *Salto Router:* Device that allows a Brivo Access account to utilize Salto Wireless door locks. Once a Salto router is configured on a Brivo Access account, new doors added to the account may select the Salto router as a controller.

1) Salto Node/Router Utilization:

a) Up to 16 locks per node.

b) Up to 7 nodes per router.

c) 1 router per Brivo control panel.

d) Control panel determines maximum number of locks per panel.

2) *Brivo Control Panel Maximum Readers/Locks:* A control panel supports any number of reader and Sallis wireless lock combinations, up to the maximum capacity of the panel:

a) ACS6000-E or ACS6008-E control panel: 30.

b) ACS300-E control panel: 2.

3) *Salto Node Event Messages:* The following event messages are sent to the control panel by the Salto node:

a) Open with card.
b) Open with metallic key.
c) Open with PPD (Portable Programming Device).
d) Open from Host.
e) Door Forced.
f) Door Forced Cleared.
g) Door Ajar.
h) Door Ajar Cleared.
i) Communication has been established.

c. Salto Sallis door locks cannot utilize the Brivo Access antipassback functionality.

## 2.9 BRIVO ACCESS EDITIONS

A. Product feature availability and complimentary subscriptions are provided in four product editions, as shown in Table 3 below.

Table 3. Brivo Access Editions

| Features | Standard | Professional | Enterprise | Multi-Family |
|---|---|---|---|---|
| Administrators available | Up to 10 | Up to 30 | Unlimited | Up to 30 |
| Event Tracking | Yes | Yes | Yes | Yes |
| Device Status | Yes | Yes | Yes | Yes |
| Facility Lockdown | Yes | Yes | Yes | Yes |
| Role-based admin permissions | Yes | Yes | Yes | Yes |
| Remote & Mobile Management | Yes | Yes | Yes | Yes |
| Video Surveillance | Yes | Yes | Yes | Yes |
| Multi-factor Authentication | Yes | Yes | Yes | Yes |
| Custom Event Classification | — | Yes | Yes | — |

| | | | | |
|---|---|---|---|---|
| Event Trend Analysis | — | Yes | Yes | — |
| Identity Connector | Available for Purchase | Yes | Yes | Available for Purchase |
| API Integration | Available for Purchase | Yes | Yes | Available for Purchase |
| Occupancy Tracking | — | Yes | Yes | — |
| Anomaly Detection | — | — | Yes | — |
| Global View | — | — | Yes | — |
| Data Explorer | — | — | Yes | — |
| Shared Access | — | — | Yes | — |
| Single sign-on (SSO) | Available for Purchase | Available for Purchase | Yes | Available for Purchase |
| Single Pane of Glass | — | — | — | Yes |
| Brivo Mobile Pass | Available for Purchase | 500 | 1000 | 500 |
| Data Reporting Retention | 1 Year | 0-2 Years | 0-3 Years | 1 Year |

| | | | | |
|---|---|---|---|---|
| Variable Data Retention | — | Yes | Yes | Yes |
| Additional Data Retention | Available for purchase | Available for purchase | Available for purchase | Available for purchase |
| Brivo Visitor | Available for Purchase | 1 Subscription | 3 Subscriptions | Available for Purchase |
| Brivo Snapshot | Available for Purchase | 1 Subscription | 3 Subscriptions | Available for Purchase |

## 2.10 SOFTWARE SECURITY AND DATA PRIVACY

A. *Security and Privacy Details:* For details relating to Manufacturer's cybersecurity and data privacy practices, and the system's conformance to the confidentiality, integrity, availability and other requirements identified below, see:

1. Brivo Access Information Security White Paper.

2. Brivo Services Terms of Use.

3. Brivo Services Privacy Statement

B. *Cloud Infrastructure Security:* Utilize leading cloud infrastructure service providers who provide in- depth cybersecurity protection for their cloud infrastructure including networking.

C. *Cloud Application Security Controls Documentation:* Provide cloud application security documentation via the Security, Trust, Assurance, and Risk (STAR) public registry of the Cloud Security Alliance. View Brivo STAR listing and download the completed Consensus Assessments Initiative Questionnaire (CAIQ) spreadsheet, which is used to document compliance with the Cloud Security Alliance's Cloud Controls Matrix, a cybersecurity control framework for cloud computing.

D. *Data Security and Privacy Controls:* Provide security and privacy measures including those required to achieve GDPR compliance.

1. *Logical Data Separation:* Provide effective logical data separation for different customer accounts and allow customers to further restrict data access within their organizations by utilizing role-based user access privileges.

2. *Additional Data Separation:* Ensure additional data segregation by providing separate environments for different functions, especially for testing and production.

3. *Data Encryption:* Used standards-based encryption for data at rest and in motion.

4. *Control of Processing:* : Implement procedures to ensure customer data is processed only as instructed by customer, and as described in product documentation, throughout entire chain of system processing activities, including affiliates and subcontractors.

5. *Regular Audits:* Ensure regular compliance audits are performed on technical and organizational data security measures implemented by Manufacturer and Manufacturer's affiliates and sub-processors.

6. *Security Controls:* Provide a variety of security controls including:

   a. Password security and login protection.

   b. Authentication for Customer Care callers prior to divulging account information or performing any actions such as a password reset on an account.

   c. Ensure Manufacturer's personnel cannot set a defined password for users.

d. Provide strong subscriber account access control features including role-based permissions and multi-factor authentication.

7. *Security Policies, Procedures and Controls:* Establish an array of security policies as approved by internal Information Security Team (IST) and designated members of senior management. Ensure policies are annually audited by third-party as part of SOC 2 assessments. Make latest SOC 2 report available from Manufacturer's sales team under mutual NDA. Provide public documentation that describes corporate and data center security policy and practice elements, such as:

a. Security Logs.

b. Incident Management.

c. User Authentication.

d. Data center and office physical security.

e. Performance, reliability and backup:

f. High availability cloud infrastructure across multiple geography and cloud infrastructure availability zones.

g. Low-latency high-performance scaling including the use of serverless computing and containers.

h. Robust and tested backups.

i. Publicly announced status updates for any planned or unplanned downtime on website status page (status.brivo.com).

j. Disaster recovery.

k. Administrator activity audit trail logging and reporting.

## PART 3 - EXECUTION

### 3.1 PREPARATION

A. Software Setup:

1. Determine administrator role assignments.

2. Determine site area operations schedules, including normal business and holiday door/gate and elevator floor lock/unlock schedules.

3. Determine user group settings.

4. Determine user information details to provide, considering standard and custom data fields.

5. Design badge templates.

6. Develop notification scheme.

7. Determine actions/responses from individual input points.

8. Determine if custom reports are needed, and if so, define them.

B. Integrations:

1. *Elevators:* Coordinate with trade.

2. *Fire Alarm:* Coordinate with trade where applicable.

3. *Identity Management/Business Information Systems:* Coordinate with IT department and/or IT service provider.

4. *Intrusion Detection/Perimeter Protection System:* Coordinate with system service provider.

5. *Video Surveillance:* Coordinate with video system service provider.

## 3.2 SITE QUALITY ASSURANCE

A. *Acceptance:* Installer shall provide a test plan including system acceptance inspections and test demonstrations to be jointly performed by Installer and Owner. Owner shall designate personnel to observe and/or perform test steps as agreed with Installer.

1. Include the following verifications in the test plan:

a. *Security System Operator Permissions:* Operator permissions have been established per operator job and task requirements, and that all system operator actions can be performed per assigned duties – for Owner technical and administrative personnel, contracted security officer personnel, and security system services provider technicians – per Owner preferences.

b. *User Building Access Permissions:* Credential-holder permissions have been defined per user groups. Access is granted and denied at each reader location according to defined user groups.

c. *Integrations:* All integrations are working fully as expected.

B. *Inspections:* Verify by inspection and formalize by signed-off inspection documentation that system installation has been performed as specified above.

C. *Acceptance Test:* Execute test plan and formalize by documentation sign-off that system performance has been demonstrated to the satisfaction of Owner. Owner's Representative retains right to suspend and/or terminate testing at any time upon failure of the system to perform as specified.

1. Collaborate with Owner's Representative prior to start of testing, to establish criteria pass/fail criteria and classification of test execution problems, such as:

a. *Pass/fail:* Criteria determining what constitutes a test pass or failure.

b. *Suspension and resumption:* Criteria determining when testing must be suspended and resulted later.

c. *Show Stopper:* Stop test, fix problem and restart test from beginning.

d. *Major Problem:* Fix problem before test can be resumed or concluded.

e. *Minor Problem:* Add problem to “punch list”, complete test.

f. *Special Issue:* Investigate to determine which problem category above category applies.

## 3.3 SYSTEM ACCEPTANCE

A. Owner’s Representative shall, upon successful completion of acceptance test (or subsequent punch list retest), issue a letter of acceptance.

**END OF SECTION**

# Section 28 14 00 - Access Control System Hardware

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes: Detailed specifications for Cloud-Based Physical Access Control System hardware including door control hardware provided as a service, plus compatible door control hardware provided by third parties independently of the System subscription.

B. See additional Summary information is provided in PART 1 of Section 28 13 00.

C. See specification Section 08 70 00 Door Hardware for close coordination with Access Control System.

### 1.2 REFERENCE STANDARDS

A. European Commission, (CE) Compliant.

B. Federal Communications Commission (FCC), Part 15 Class A Compliant.

C. European Union, ROHS Compliant.

D. Underwriters Laboratories, Inc. (UL), UL294 Listed – Underwriters Laboratory Safety Standard 294 for Access Control System Units.

## PART 2 - PRODUCTS

### 2.1 CLOUD-BASED PHYSICAL ACCESS CONTROL SYSTEM HARDWARE

A. Manufacturers:

1. Brivo Systems, LLC
   a. Headquarters: 7700 Old Georgetown Rd, Suite 300, Bethesda, MD 20814.
   b. Telephone: EU - (+44) 2081 329 232. Americas – 1-866-274-8648
   c. *Website:* www.brivo.com.

2. Substitution Limitations: Only Brivo-manufactured or Brivo-branded cellular modules, controllers, I/O expansion boards, and readers shall be used, except for third-party hardware identified herein as system-compatible.

## 2.2 ACCESS CONTROL PANELS

A. Description: IoT-native cloud-managed intelligent control panels (“controllers”, “panels”) for

Cloud-Based Physical Access Control System for management of card reader and I/O and BD board hardware, and communication with Cloud-Based Physical Access Control System data center, and electrical door lock (door relay output , REX and Door Position Inputs)

B. Common Controller Design Requirements:

1. Independent Function: Controller must function independently of connection to cloud system, with no loss in access and I/O control functionality when not connected to cloud system.
2. Cloud Connection: Communication between Controller and cloud system shall be by Controller-initiated outbound connections only. Controller shall reject inbound connection attempts from any source, making it impossible to: initiate a telnet, FTP, HTTP/S or any other type of communication session; burden the device through a denial of service (DoS) attack; infect the controller with malware; or gain access to any controller data.
3. Control Panel and Cloud Data Center Authentication:
   a. Controller shall have knowledge of public key associated with digital certificate on one or more Brivo cloud data center web servers.
   b. Controller shall check validity of digital certificate presented by Brivo cloud data center and only establish connection after cloud data center’s certificate has been validated.
   c. Similarly, Brivo cloud data center shall check validity of digital certificate presented by Controller and only establish a TLS session to download data and upload event information after controller’s certificate has been validated.
4. Secure Cloud Connection: Communication between Controller and cloud system shall use TLS 1.2 or 3.0 with AES256 encryption and SHA256 certificate with 4096-bit key length.
5. Secure Reader Communications: Controller shall support OSDP Secure Channel Protocol for secure communication with readers.
6. Modular Design: Expandable modular system design shall consist of main controller boards, door control boards, I/O control boards and communication module boards.
7. Individual Fusing: Provide individually fused interface boards, locks, and REX devices.
8. Reader Communication Protocols: Support all Wiegand and HID formats up to 128 bits, iCLASS and OSDP protocols over RS485 electrical interface. Wiegand interface is not supported by the ACS100 or SDC controllers.
9. Network Communication Options:
   a. Any communication method (Wired, Wireless or Cellular) may be used individually per controller. SDC and ACS100 do not support the CNM cellular modem.
   b. Two or all three methods may be connected concurrently with different priority setting per method to establish failover capability.

C. Mercury MP1502 Controllers.

1. Technical Specifications: Note that quantities are per Controller board not per system.
   a. Max Credentials: Unlimited credentials per panel when online and connected to Brivo Access. Up to 240,000 credentials per Controller while offline.

b. Max Event History: Unlimited events per panel when online and connected to Brivo Access. 50,000 events in FIFO buffer per Controller while offline.
c. Max Readers: 30 total with 14 door expansion boards. 2 OSDP or Wiegand (on controller board), 28 Wiegand (on door expansion boards).
d. Max Inputs: 520 using MR16IN-S3 expansion modules.
e. Max Outputs: 516 using 14 MR16OUT-S3 expansion modules.
f. Max Expansion Boards: 14 total reader and/or I/O expansion modules.
g. Max Controlled Elevator Floors: 118 via dry contact interface or Destination Dispatch integration (system imposed limitation).
h. Inputs: On-board inputs.
    1) Quantity: 8.
    2) Supervision: Optional 4-state, dual end-of-line supervision.
    3) Tamper and UPS Fault Monitoring: Two unsupervised inputs are dedicated to cabinet tamper and UPS fault monitoring.
i. Outputs: On-board outputs.
    1) Quantity: 4.
    2) Type: Form C Form-C dry contacts.
        a) Normally open (NO) contact: 5 A @ 30 VDC resistive.
        b) Normally closed (NC) contact: 3 A @ 30 VDC resistive.
j. Host Communications:
    1) Ethernet connection (10-BaseT/100Base-TX) using port 443 outbound.
    2) Micro USB port (2.0) with optional adapter: pluggable model USB2-OTGE100.
k. Authentication and Encryption:
    1) EP1502: X.509 Digital Certificates and TLS 1.1 with AES 128-bit encryption.
    2) LP1502: X.509 Digital Certificates and TLS 1.2/1.1 with AES 256-bit encryption.
    3) OSDP supports Secure Communication Protocol (SCP).
l. Serial I/O Device Communications: 2-wire RS-485.
    1) Communications: 2,400 to 115,200 bps, asynchronous, half-duplex.
    2) Parameters: 1 start bit, 8 data bits, No parity bit, and 1 stop bit.
m. Reader Inputs:
    1) Quantity: 2.
    2) Interface Type: Wiegand or RS485 OSDP.
    3) Power: 12 VDC ± 10 % regulated, 300 mA maximum each reader (jumper selectable) (input voltage (VIN) must be greater than 20 VDC) or 12 to 24 VDC ± 10 % (input voltage (VIN) passed through), 300 mA maximum each reader.
    4) Data Inputs: TTL compatible, F/2F or 2-wire RS-485.
    5) RS-485 Mode:
        a) Communications: 2,400 to 115,200 bps, asynchronous, half-duplex.
        b) Parameters: 1 start bit, 8 data bits, No parity bit, and 1 stop bit.
    6) LED Output: TTL levels, high>3 V, low<0.5 V, 5 mA source/sink maximum.
    7) Buzzer Output: Open collector, 12 VDC open circuit maximum, 40 mA sink maximum.
n. Primary Power: 12 to 24 VDC ± 10 %, 500 mA maximum (reader and USB ports not included)
o. Cable Requirements:
    1) Power and Relays: 1 twisted pair, 18 to 16 AWG.
    2) Ethernet: CAT-5, minimum.
    3) 3) RS-485:

a) I/O Device Port: 1 twisted pair, shielded, 120 ohm impedance, 24 AWG, 4,000 ft. (1,219 m) max.
b) Reader Port: 1 twisted pair, shielded, 120 ohm impedance, 24 AWG, 2,000 ft. (610 m) max.

4) *Alarm Input:* 1 twisted pair, 30 ohms maximum.

p. Product Compliance:
1) MP1502:
a) UL294 Recognized
b) FCC Part 15 Class A
c) CE Compliant
d) RoHS (2011/65/EU & 2015/863)
e) EU REACH (1907/2006)
f) California Proposition 65
g) NIST Certified Encryption

q. Card Formats:
1) 4 active card formats per EP1502.
2) 26-bit, 37-bit, Corporate 1000 (35 and 48-bit).

r. Environmental:
1) Temperature:
a) Storage: -55 to +85 °C.
b) Operating: 0 to +70 °C.
2) Humidity:
a) EP1502: 0 to 95 % relative non-condensing humidity.
b) LP1502: 5 to 95 % relative non-condensing humidity.
3) Dimensions:
a) Height: 8 inches.
b) Width: 6 inches.

## 2.3 CELLULAR NETWORK MODULE

A. Description: Brivo Cellular Network Module allows Brivo control panels to communicate without the requirement of an Ethernet or Wi-Fi connection. The Cellular Network Module connects to the ACS6000 or ACS300 access control panel via the USB port.

1. For use with Brivo E Series control panels only.
2. Cellular plan billed separately.

B. Model Territory and Carrier Options:

1. Zone 1:
a. Territory: United States.
b. Carrier: Verizon.
c. SIM: 4G SIM for connecting one ACS300 or ACS300 access control panel.
2. Zone 2:
a. Territory: Canada and the United States.
b. Carriers: US AT&T, T-Mobile, CAN-Bell, Telus, Rogers.
c. SIM: 4G SIM for connecting one ACS300 or ACS300 access control panel.

C. Module Connectivity:

1. Cellular Antenna: Included antenna external to enclosure panel.
2. Cellular Network Type: 4G LTE.
3. Control Panel Connection: USB to ACS6100 or ACS300 control panel, configurable to provide primary or back-up failover connectivity.
4. Power: 5VDC via control panel USB connection.

## 2.4 DOOR CONTROL BOARDS

A. Mercury MR52-S3 Reader Interface Module – Series 3.

1. Primary Power: 12 to 24 VDC ± 10 %, 500 mA maximum (reader and USB ports not included).
2. Intelligent Controller Communication: 2-wire RS-485 supporting 9600, 19200, 38400 or 115200 bps.
3. Outputs:
   a. Quantity: 6.
   b. Type: Form-C with dry contacts.
      1) Normally open (NO) contact: 5 A @ 30 VDC resistive.
      2) Normally closed (NC) contact: 3 A @ 30 VDC resistive.
4. Readers:
   a. Quantity: 2.
      1) Power: 12 VDC ± 10 % regulated, 300 mA maximum each reader (jumper selectable) (input voltage (VIN) must be greater than 20 VDC) or 12 to 24 VDC ± 10 % (input voltage (VIN) passed through), 300 mA maximum each reader.
      2) Data Inputs: TTL compatible, F/2F or 2-wire RS-485.
      3) RS-485 Mode:
         a) Communications: 2,400 to 115,200 bps, asynchronous, half-duplex.
         b) Parameters: 1 start bit, 8 data bits, No parity bit, and 1 stop bit.
      4) LED Output: TTL levels, high>3 V, low<0.5 V, 5 mA source/sink maximum.
      5) Buzzer Output: Open collector, 12 VDC open circuit maximum, 40 mA sink maximum.
5. Cable Requirements:
   a. Power and Relays: 1 twisted pair, 18 to 16 AWG.
   b. Ethernet: CAT-5, minimum.
   c. RS-485:
      1) I/O Device Port: 1 twisted pair, shielded, 120 ohm impedance, 24 AWG, 4,000 ft. (1,219 m) max.
      2) Reader Port: 1 twisted pair, shielded, 120 ohm impedance, 24 AWG, 2,000 ft. (610 m) max.
   d. *Alarm Input:* 1 twisted pair, 30 ohms maximum.
6. Environmental:
   a. Temperature:
      1) Storage: -55 to +85 °C.
      2) Operating: 0 to +70 °C.
   b. Humidity: 5 to 95 % relative humidity non-condensing.
7. Dimensions:
   a. Width: 6 inches.
   b. Length: 1 inch.

c. Height: 8 inches.
8. Weight: 11 ounces.
9. Product Compliance:
   a. UL294 Recognized
   b. FCC Part 15 Class A
   c. CE Compliant
   d. RoHS (2011/65/EU & 2015/863)
   e. EU REACH (1907/2006)
   f. California Proposition 65

## 2.5 I/O EXPANSION BOARDS

A. Mercury MR16IN-S3 Input Expansion Board.

1. Primary Power:
   a. 12-24VDC ±10%, 1100 mA maximum.
   b. 12VDC at 850mA nominal.
   c. 24VDC at 450mA nominal.
2. Communication:
   a. Cable: 2-wire RS-485.
   b. Maximum Distance: 4,000 feet using Belden 9841.
3. Inputs:
   a. Quantity: 18.
      1) Tamper and UPS Fault Monitoring:
         a) Quantity: 2.
         b) Type: Unsupervised inputs dedicated to tamper and power monitoring.
      2) General Purpose:
         a) Quantity: 16.
         b) Type: Programmable circuit.
4. Outputs:
   a. Quantity: 2.
   b. Type: Form-C with dry contacts.
      1) Normally open (NO) contact: 5 A @ 30 VDC resistive.
      2) Normally closed (NC) contact: 3 A @ 30 VDC resistive.
5. Temperature:
   a. Storage: -55 to +85 °C.
   b. Operating: 0 to +70 °C.
6. Humidity: 10 to 95 percent relative humidity non-condensing .
7. Product Compliance:
   a. UL294 Recognized.
   b. FCC Part 15 Class A.
   c. CE Compliant.
   d. RoHS (2011/65/EU & 2015/863).
   e. EU REACH (1907/2006).
   f. California Proposition 65.
8. Offline mode operation:
   a. Input Mode: Programmable for offline conditions.

B. Mercury MR16OUT-S3 Output Expansion Board.

1. Primary Power:
   a. 12-24VDC ±10%, 1100 mA maximum.
   b. 12VDC at 850mA nominal.
   c. 24VDC at 450mA nominal.
2. Communication:
   a. Cable: 2-wire RS-485.
   b. Maximum distance: 4,000 feet using Belden 9841.
3. Inputs:
   a. Quantity: 2.
      1) Type: Unsupervised inputs dedicated to tamper and power monitoring.
4. Outputs:
   a. Quantity: 16.
   b. Type: Form-C with dry contacts, 5 Amp at 28VDC.
5. Temperature:
   a. Storage: -55 to +85 °C.
   b. Operating: 0 to +70 °C.
6. Humidity: 10 to 95 percent relative humidity non-condensing .
7. Product Compliance:
   a. UL294 Recognized.
   b. FCC Part 15 Class A.
   c. CE Compliant.
   d. RoHS (2011/65/EU & 2015/863).
   e. EU REACH (1907/2006).
   f. California Proposition 65.
8. Offline mode operation:
   a. Relay Mode: Programmable for offline conditions.

## 2.6 SMART POWER SYSTEM COMPATIBILITY

A. Smart Power Systems:

1. Altronix Trove.
2. Life Safety Power (LPS).

## 2.7 CARD READERS

A. Supported and Approved Card Readers

1. Must be OSDP data format.
2. Capable of 13.56MHz and accepting. Low frequency prox must be programmed out of the reader.
3. Contactless type smart card readers, red light when door is locked, green light when door is unlocked, with or without keypad as noted on the drawings.
4. PACS manufacturer brand labeled by one of the above.
5. Valid card presentation shall shunt the associated access controlled door alarm and unlock electric lock.

a. Manufacturers:
   1) HID Signo
   2) Pre-approved equal

## 2.8 EXAMINATION

A. Verification of Conditions:

1. Examine pathways intended for cables for cable installation hazards and other conditions that would negatively affect cable installation.
2. Verify mounting space allocations for electronic equipment panels.
3. Verify actual locations of conduits and junction boxes for communications and power cabling.
4. Proceed with installation only after unsatisfactory conditions have been corrected.

## 2.9 PREPARATION

A. Setup Data: Review configurable features of System equipment, user credentials, and access control management. Address the following network, hardware and software items prior to configuring equipment and access management parameters:

1. Networking and Equipment Setup Preparation:
   a. Internet inbound and outbound bandwidth requirements, Internet Service Provider, and service subscription level.
   b. Obtain manufacturer equipment installation manuals and hardening guides.
   c. Establish deployment network security plan, consistent with existing Customer network security practices, equipment networking requirements and device hardening guidance. Include roles and responsibilities for verification and validation of security configurations.
2. Equipment Setup Preparation:
   a. Obtain manufacturer equipment operation manuals and setup guidance.
   b. Develop credential scheme, defining credential formats and encoding.
   c. Document equipment configuration to be set up for each piece of on-premises access control equipment.
   d. Perform pre-installation procedures documented in system and device manufacturer installation manuals or other instructions.

B. Coordination with Trades: As applicable for the deployment installation and setup work, coordinate with trades planners and technicians, and technical service providers, for:

1. Electric Power: Electric power provision requirements
2. Elevator Systems: Elevator control/destination dispatch interface/integration
3. Information Systems: Interface/integration for the one-way or two-way exchange of information related to risk related site activity and conditions.
4. Fire Alarm Systems: Interface to fire alarm system control panels for receipt of fire alarm notifications.

## 2.10 INSTALLATION

A. Contractor shall fulfill the following requirements:

1. Install, configure and connect existing and new on-premises physical access control system equipment and devices to achieve the access control functionality as agreed with the Customer, in accordance Manufacturer's guidance and instructions, and in conformance to applicable building codes.
2. Cable and Wiring:
   a. Install system and device cable in dedicated conduit. System and device cable shall not share conduit, raceways, compartments, outlet boxes, junction boxes or similar fitting with other building wiring.
   b. Wiring conductors connected to terminal strips shall be individually numbered and each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with the name and number of the particular device as identified and shown on project drawings.
   c. Exposed wiring inside and outside the control console, cabinets, boxes and similar enclosures, shall be dressed down neatly and secured with wiring cleats or wire ties.
   d. Cabinets, boxes, and similar enclosures containing security system components and/or cabling, which may easily be accessible to employees or to the public, shall be provided with a lock. Boxes above ceiling level in occupied building areas shall not be considered to be accessible. Cabinets, boxes, and similar enclosures containing security system components shall incorporate a tamper switch that is monitored by the system and whose activation initiates tamper notifications to the Customer and the security systems service contractor, configured according to their preferences.
3. Drawing and Diagram Usage:
   a. Device Locations: System devices identified on building drawings are intended to generally indicate areas where such devices are to be located. Installers shall be responsible for determining final location of these devices in accordance with Owner's requirements.
   b. Cabling Components: Riser diagrams are schematic and do not show every conduit, wire box, fitting, or other accessory required. Provide such materials as necessary for a complete and functioning installation. Install in accordance with referenced codes and these specifications. Use weatherproof equipment or covers where installed in areas exposed to weather.

## 2.11 SITE QUALITY ASSURANCE

A. Inspections: Verify by inspection and formalize by signed-off inspection documentation that system installation has been performed as specified above.

B. Acceptance Test and System Acceptance: See Section 28 13 00 PART 3.

## PART 3 - EXECUTION

### 3.1 MANUFACTURER'S INSTRUCTIONS

A. Compliance

1. Comply with manufacturer's written data, including product technical bulletins, product catalog installation instructions and product carton installation instructions.

### 3.2 EXAMINATION

A. Site Verification of Conditions

1. Verify that substrate conditions, which have either been previously installed under other sections, or that existing site conditions, are acceptable for product installation in accordance with manufacturer's instructions.
2. Verify that building doors, frames, walls, wire runs, related items, and conditions are ready to receive work of this Section.

### 3.3 PROTECTION

A. Other Trades

1. Protect installed work of other trades.

### 3.4 PREPARATION

A. Manufacturer Forms

1. Obtain and complete project planning forms from manufacturer of surveillance system; customize forms to be project specific.

B. Final Setup

1. Review, adjust, and prepare final documents to establish system software setup.

C. Record Setup Data

1. Electrical Preparation:
   a. Coordinate with trade where applicable
2. Elevators:
   a. Coordinate with trade where applicable
3. Information Services:
   a. Coordinate with trade where applicable
4. Fire Alarm:
   a. Coordinate with trade where applicable

## 3.5 INSTALLATION

A. Installation

1. The installer shall show evidence of factory certification from the HACS manufacturer.
2. The installer shall install all system components and appurtenances in accordance with the manufacturer's specifications, referenced practices, guidelines and applicable codes. Furnish all necessary interconnections, services, and adjustments required for a complete and operable system as specified. Control signal, communications, and data transmission line grounding shall be installed as necessary to preclude ground loops, noise and surges from adversely affecting system operation.

B. Wiring

1. All wiring is to be installed in dedicated conduit throughout. Cable shall not be pulled into conduits or placed in raceways, compartments, outlet boxes, junction boxes or similar fittings with other building wiring.
2. All low voltage wiring outside the control console, cabinets, boxes and similar enclosures, shall be plenum rated where required by code.
3. All wiring conductors connected to terminal strips shall be individually numbered and each cable or wiring group being extended from a panel or cabinet to a building mounted device shall be identified with the name and number of the particular device as identified and shown on building drawings.
4. All exposed wiring inside and outside the control console, cabinets, boxes and similar enclosures, shall be dressed down neatly and secured with wiring cleats or wire ties.

C. Containers

1. All exposed metallic flexible conduit and armored cable shall be dressed down neatly and secured with low profile, metal fasteners.
2. All cabinets, boxes, and similar enclosures containing security system components and/or cabling, which may easily be accessible to employees or to the public, shall be provided with a lock. Boxes above ceiling level in occupied areas of the building shall not be considered to be accessible.
3. All junction boxes and small device enclosures below ceiling level, and easily accessible to employees or the public, shall be covered with a suitable cover plate and secured with tamper proof screws.
4. End-of-Line resistors shall be installed at the field device location and not at the controller panel location.

D. Drawings and Diagrams

1. System devices identified on building drawings are intended to generally indicate areas where such devices are to be located. Installers shall be responsible for determining final location of these devices in accordance with Owner's requirements.
2. Riser diagrams are schematic and do not show every conduit, wire box, fitting, or other accessories. Provide such materials as necessary for a complete and functioning installation. Install in accordance with referenced codes and these specifications. Use weatherproof equipment or covers where installed in areas exposed to weather.

## 3.6 POST-INSTALLATION

A. Software updates to the HSMS application are to be delivered automatically without dealer intervention.

B. Firmware updates to SDCs are to be automated and shall not require physical access to the SDCs.

## 3.7 FIELD QUALITY CONTROL

A. Written Reports

1. Contractor must note any variants at the site and notify owner's representative within three business days of anything that might affect the delivery date of the system or any trades associated with the functioning of the system.

B. Manufacturer's Field Services

1. When applicable, contractor is to coordinate a specific number of visits with the manufacturer's engineering support team for the system design, insulation, commissioning, final testing, or training.

## 3.8 TESTING & VERIFICATION

A. Perform tests recommended and required by manufacturer to verify required performance of Brivo Systems LLC products.

B. The Installer is required to place entire system into full and proper operation as designed and specified.

C. Verify that all hardware components are properly installed, connected, communicating and operating correctly.

D. Verify that all system software is installed, configured, and complies with specified functional requirements.

## 3.9 COMPLETION & CLEANUP

A. Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

B. The Installer shall perform final acceptance testing in the presence of Owner's representative, executing a point by point inspection against a documented test plan that demonstrates compliance with system requirements as designed and specified.

1. Submit documented test plan to Owner at least (14) days in advance of acceptance test, inspection and check-off.

2. Conduct final acceptance tests in presence of Owner's representative, verifying that each device point and sequence is operating correctly and properly reporting back to control panel and control center.

C. Acceptance by Owner is contingent on successful completion of check-off; if check-off is not completed due to additional work required, re-schedule and perform complete check-off until complete in one pass, unless portions of system can be verified as not adversely affected by additional work.

D. The system shall not be considered accepted until all acceptance test items have been successfully checked-off. Beneficial use of part or all of the system shall not be considered as acceptance.

1. The Installer shall provide system operations, administration, and maintenance training by factory trained personnel qualified to instruct in the following areas
   a. Owner will designate personnel to be trained.
      1) Provide printed training materials for each trainee including product manuals, course outline, workbook or student guides, and written examinations for certification.
      2) Provide hands-on training with operational equipment.

**END OF SECTION**

# SECTION 28 31 11 - FIRE DETECTION AND ALARM SYSTEM

## PART 1 - GENERAL

### 1.1 SECTION INCLUDES

A. Fire Alarm and Smoke Detection Control Panel.

B. Initiating devices.

C. Auxiliary devices.

D. Notification appliances.

E. Fire alarm wire and cable.

F. Protective devices.

G. Interfaces with Divisions 7, 21 and 23 systems.

H. Testing.

### 1.2 RELATED SECTIONS

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

B. Division 7 – Elevators.

C. Division 21 – Fire Suppression.

D. Division 23 - Mechanical.

E. Section 26 05 33 - Conduit.

F. Section 26 05 19 - Building Wire and Cable.

G. Section 26 05 34 - Boxes.

H. Section 26 05 80 - Equipment Wiring Systems.

I. Section 26 05 53 - Electrical Identification.

## 1.3 REFERENCES

A. NFPA 70 - National Electrical Code.

B. NFPA 72 - National Fire Alarm Code.

C. NFPA 101 - Life Safety Code.

D. North Carolina State Building Code.

E. Testing Laboratory Compliance: Comply with provisions of UL safety standards pertaining to fire alarm systems. Provide products and components which are Listed and Labeled.

F. FM Compliance: Provide fire alarm systems and accessories which are FM approved.

## 1.4 SYSTEM DESCRIPTION

A. This document provides for the furnishing, installation, and connection of a microprocessor controlled, intelligent reporting fire alarm equipment required to form a complete coordinated system ready for operation. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, control panels, auxiliary control devices, annunciators, power supplies, and wiring. The fire alarm system shall comply with applicable provisions of the NC Building Code, NFPA 70 - National Electrical Code (NEC) and NFPA 72 -National Fire Alarm Code. The Contractor shall furnish all parts, materials, and labor customarily required or provided for a complete and operating system, in accordance with all requirements applicable, even if each needed item is not specifically shown or described in the project plans or specifications

B. Fire Alarm System: NFPA 72, addressable, manual and automatic local fire alarm system with connections to central station. The system shall be nominal 24VDC operating voltage, non-coded, and supervised (including control circuits). All equipment supplied shall be listed for the purpose for which it is used, and installed in accordance with any instructions included in its listing. It shall also be new, with a full warranty (parts and labor) of at least one year from the date of final acceptance. The system shall have multiple access levels to permit the disablement of individual alarm inputs or normal system responses (outputs) for alarms without changing the system’s executive programming or affecting operation of the remainder of the system.

## 1.5 SUBMITTALS

A. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Submittals shall demonstrate compliance with technical requirements by reference to each subsection of this specification.

C. Product Data: Provide electrical characteristics and connection requirements, and provide current draw for each device submitted and the listed minimum voltage required to operate. Panel submittal shall list voltage drop allowed for panel and for individual NAC circuits.

D. The fire alarm contractor shall submit complete Shop Drawings to the Architect/Engineer for review, prior to performing any work. They shall clearly demonstrate compliance with the Architect/Engineer's Drawings and specifications, which have a System Response Matrix showing the fire alarm system's actions (outputs) required for each type of alarm, supervisory, and trouble signal. Any non-compliant features shall be fully described.

E. The submitted shop drawings shall show equipment, device identification numbers and locations, and connecting wiring of entire fire alarm system. Include wiring and riser diagrams, including floor plans indicating final outlet locations showing address of each addressable device. Wiring diagrams shall be based on the project floor plans, with devices and proposed conduit routing. The conductor composition for each conduit section shall be provided. The distance and route for each NAC (Notification Appliance Circuit) shall be shown. Riser diagrams shall show consecutive connections for all devices with addresses and candela and candela ratings. Provide detailed battery capacity calculations.

F. Provide floor plans showing aspiration detection pipe layout as well as documentation to show proof that system will balance.

G. Architect/Engineer's approval (with or without comments) of contractor's Shop Drawings, samples, cut sheets, etc., is for general conformance with the contract documents and design concept. It shall not relieve the contractor of responsibility for full compliance with the project plans and specifications, EXCEPT for any specific non-compliant features for which the Architect/Engineer gives written authorization.

H. Installation Instructions: The contractor shall submit to the Architect/Engineer the manufacturer's detailed installation instruction for the Fire Alarm Control Panel and all duct mounted smoke detectors, flow switches, tamper switches, supervisory switches, and similar items which require mechanical installation.

I. Battery Calculations:

1. Include a copy of system battery sizing calculations with the shop drawing submittal to the Architect/Engineer. Use manufacturer's battery discharge curve to determine expected battery voltage after 60 hours of providing standby power. Then use calculated Notification Appliance Circuit current draw in the alarm mode to determine expected voltage drop at End of the Line Resistor (EOL), based on conductor resistance per manufacturer's data sheet or NEC.
2. Fire Alarm Vendor's calculations shall be submitted with the shop drawings, and prior to installation of equipment. In the submittal package identify Notification Appliance Circuits (NAC) current draws and voltage drops for each circuit. In no case shall the calculated voltage at any notification appliance fall below the minimum listed operating voltage for the devices used.

3. The voltage drop at EOL shall not exceed 14% of the expected battery voltage, after the required standby time plus alarm time. Determine "worst case" voltage at far end of each NAC, by subtracting its calculated V-drop from the expected battery voltage. The result shall be no less than the minimum listed operating voltage for the alarm notification appliances used.
4. All of these calculations shall be placed on a dedicated sheet of as-built drawings, for future reference by fire alarm service technicians. NAC voltage drop shall be verified during system tests.
5. Provide copies of battery and voltage drop calculations at SCO Final Inspection.

J. Maintenance Data: The contractor shall submit maintenance data and parts lists for each type of fire alarm equipment installed, including furnished specialties and accessories. This data, product data, and shop drawings shall be included in the maintenance manual.

K. Maintenance Contract: The contractor shall submit a quote for a maintenance contract to provide all maintenance, test, and repair described below and/or in accordance with NFPA-72, "Guide for Testing Protection Signaling Systems". Include also a quote for unscheduled maintenance/repair, including hourly rates for technicians trained on this equipment, and response travel costs. Submittals that do not identify all post contract maintenance costs shall not be accepted. Rates and costs shall be valid for the period of five (5) years after expiration of the guaranty. Maintenance and testing shall be on a semiannual basis or as required whichever is the most restrictive. A preventive maintenance schedule shall be provided by the Contractor that shall describe the protocol for preventive maintenance. The schedule shall include:

1. Semiannual systematic examinations, adjustment and cleaning of all detectors, manual fire alarm stations, control panels, power supplies, relays, water-flow switches and all accessories of the fire alarm system.
2. Semiannual testing of each circuit in the fire alarm system.
3. Semiannual testing of each smoke detector in accordance with the requirements of NFPA 72.

L. Certifications: Submit a certification from the major equipment manufacturer indicating that the proposed supervisor of installation and the proposed performer of contract maintenance is an authorized representative of the major equipment manufacturer. Include names and addresses, and telephone numbers in the certification. The installing contractor’s technicians shall hold current (within previous 24 months) certifications issued by the manufacturer. These certifications shall be submitted to the Architect/Engineer prior to installation showing name, photo identification, date of training and date of certification.

M. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and commissioning of products.

## 1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years documented experience, and with service facilities within 100 miles of Project. Products of firms that do not maintain factory authorized service organization and spare parts are not acceptable.

B. Installer: Company specializing in installing the products specified in this section with minimum five years documented experience installing fire detection and alarm systems similar in size and scope of the project. The fire alarm contractor shall be authorized by his respective factory to ensure proper specification adherence, final connection, test, certification, warranty compliance, and service. Additionally, the fire alarm contractor shall submit a letter of authorization on official letterhead of the company product stating the company is an authorized distributor of that product. The company shall maintain a service organization with adequate spare parts inventory within 75 miles of the installation site.

C. All connections to the FACP and the system's programming shall be done only by the manufacturer, or by an authorized distributor that stocks a full complement of spare parts for the system. The technicians are required to be trained and individually certified by the manufacturer for the FACP model/series being installed. This training and certification shall have occurred within the most recent 24 months, except that a NICET Level III certification shall extend this to 36 months. Copies of the certifications shall be part of the Shop Drawing submittal to the Designers, prior to installation. The submittal cannot be approved without this information.

## 1.7 REGULATORY REQUIREMENTS

A. Equipment and installation shall conform to requirements of NFPA 70, NFPA 72, NFPA 101, North Carolina State Building Code and shall be FM approved.

B. Furnish products listed and classified by testing firm acceptable to authority having jurisdiction as suitable for purpose specified and indicated.

# PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

A. Fire Lite.

B. Potter (non-proprietary).

C. Silent Knight (non-proprietary).

D. Notifier.

E. Edwards.

F. Siemens.

G. Substitutions: As permitted under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

## 2.2 FIRE ALARM CONTROL PANEL (FACP) (Also identified as Fire Alarm Control Unit – FACU)

A. General: The FACP shall meet the following general requirements:

1. The system must be the addressable type, with a 24vdc nominal operating voltage.
2. The system must have multiple access levels so Owner's authorized personnel can disable individual alarm inputs or normal system responses (outputs) for alarms, without changing the system's executive programming or affecting operation of the rest of the system. The process on how to do this must be included in the training required to be given to the Owner's designated personnel, and must also be part of the written documentation provided by the fire alarm equipment supplier.
3. Signal Line Circuits (SLC): Alarm, trouble and supervisory signals from all intelligent reporting devices shall be encoded onto an NFPA Style 6 (Class A) Signaling Line Circuit (SLC) with no “T” taps.
4. Initiation Device Circuits: Initiation Device Circuits (IDC) shall be wired Class A (NFPA 72 Style D).
5. Notification Appliance Circuits (NAC): Notification appliance circuits shall be wired Class B (NFPA 72 Style Y).
6. Digitized electronic signals must employ check digits or multiple polling. In general a single ground or open on any system signaling line circuit, initiating device circuit, or notification appliance circuit must not cause system malfunction, loss of operating power or the ability to report an alarm.
7. Loss of Power: Alarm signals arriving at the main FACP must not be lost following a power failure (or outage) until the alarm signal is processed and recorded.
8. The FACP shall have an Alarm Silence Switch, and be equipped with the Subsequent Alarm (alarm resound) feature. Any remote annunciators or graphic displays located away from the alarm area shall also include an audible signal with alarm resound feature.

B. System Response to an Alarm Condition: When a fire alarm condition is detected and reported by one of the system initiating devices or appliances, the following functions shall immediately occur:

1. The system alarm LED shall flash.
2. A local piezo-electric signal in the control panel shall sound.
3. An 80-character minimum LCD display shall indicate all information associated with the fire alarm condition, including the type of alarm point and its location within the protected premises.
4. On systems equipped with a printer, printing and history storage equipment shall log the information associated with each new fire alarm control panel condition, along with time and date of occurrence.
5. All system output programs assigned via control-by-event equations to be activated by the particular point in alarm shall be executed, and the associated

system outputs (alarm notification appliances and/or relays) shall be activated. Exact programming shall be provided by the Contractor to meet the Owner's requirements.

6. Detect activation of any initiating device and the location of the alarm condition. Operate all notification appliances and auxiliary devices as programmed.
7. Activate all fire alarm Notification Appliances in the building, sounding and flashing in synchronization continuously until the initiating device and control unit have been reset to normal condition.
8. Activate digital alarm communicator.
9. Deactivate door hold control relays such that all smoke doors are allowed to close.
10. Deactivate control relays so that HVAC units shut down. Exception is for hazardous exhaust systems and smoke control.
11. Activate elevator recall sequence if smoke is detected in any elevator lobby, shaft, or in the elevator equipment room.
12. Activate control relay(s) to release all magnetically locked egress doors.
13. See Division 23 for additional actions.

C. System Response to a Trouble Condition:

1. Systems AC power trouble signal shall not be sent unless maintained for 1 to 3 hours (or more) Provide additional relays as required for this purpose.
2. Provide immediate transmission of all other supervising signals.
3. Provide adjustable time delay for all other trouble signals prior to transmission.

D. FACP – Minimum Requirements: The FACP shall contain a microprocessor based Central Processing Unit (CPU). The CPU and its associated equipment shall be protected so it cannot be affected by voltage surges or line transients consistent with UL standard 864. The CPU shall communicate with and control the following types of equipment used to make up the system: intelligent detectors, addressable modules, local and remote operator terminals, printers, annunciators, and other system controlled devices. The main FACP shall perform the following functions:

1. Supervise and monitor all intelligent addressable detectors and monitor modules connected to the system for normal, trouble and alarm conditions.
2. Supervise all initiating, signaling, and notification circuits throughout the facility by way of connection to monitor and control modules.
3. Detect the activation of any initiating device and the location of the alarm condition. Operate all notification appliances and auxiliary devices as programmed.
4. Visually and audibly annunciate any trouble, supervisory or alarm condition on operator's terminals, panel display and annunciators.
5. Printer: Not required.
6. Remote Transmissions: The FACP shall be interfaced to a cellular Digital Alarm Communications Transmitter (DACT).
7. Power Supply: The FACP power supplies shall operate on 120 VAC, 60 Hz and shall have a continuous rating adequate to power all equipment and functions in full alarm continuously. All modules and drivers shall be able to withstand prolonged short circuits in the field wiring, either line-to-line or line-to-ground, without damage. Further, the power supply shall be expandable for additional notification appliance power in 3.0 ampere increments. The power supply shall

provide a battery charger using dual-rate charging techniques for fast battery recharge.

8. Batteries: Shall be completely maintenance free, shall not require liquids, fluid level checks or refilling, and shall not be capable of producing spills and/or leaks. Batteries shall be sealed gel-cell type with expected life of 10 years. Battery voltage shall be as required by the FACP and related equipment. Battery shall have sufficient capacity to power the fire alarm system for not less than 24 hours plus 15 minutes of alarm upon a normal AC power failure. NAC circuits shall not exceed 75% of maximum current load allowed.
9. Enclosures: The FACP shall be housed in a 3rd party listed cabinet suitable for surface or semi-flush mounting. Cabinet and front shall be corrosion protected, given a rust-resistant prime coat, and manufacturer's standard finish. The door shall provide a key lock and shall include a glass or other transparent opening for viewing of all indicators. For convenience, the door may be hinged on either the right or left side (field selectable).

E. System capacity and General Operation: The system must have the following capabilities and general operational modes:

1. The FACP must provide, or be capable of expansion to, 198 intelligent/addressable devices per Signaling Line Circuits (SLC) and 1980 annunciation points, minimum, per system. The number of SLCs provided must be as indicated on the Drawings. Total points must be as indicated on the drawings or otherwise specified with minimum 20% spare capacity.
2. The FACP must include a full featured operator interface control and annunciation panel that must include a backlit, 80 minimum character liquid crystal display, individual, color coded system status LEDs, and an alphanumeric keypad for the field programming and control of the fire alarm system.
3. All programming in the system must be achieved with a personal computer on site and without interrupting the alarm monitoring functions of the fire alarm control panel. A copy of the database must be left in the Document Box per NFPA 72.
4. The FACP must be able to provide the following features:
    a. Upload/Download to PC Computer
    b. Charger Rate Control
    c. Drift Compensation
    d. Automatic Day/Night Sensitivity Adjust
    e. Device Blink Control
    f. Pre-alarm Control Panel Indication
    g. Trouble Reminder
    h. NFPA 72 Smoke Detector Sensitivity Test
    i. System Status Reports
    j. Periodic Detector Test
    k. Alarm Verification, by device, with tally
    l. Non-Alarm Module Reporting
    m. Block Acknowledge
    n. Smoke Detector Maintenance Alert
    o. Control-by-Time
5. The control panel must be capable of printing historical data and device parameters and must include all equipment necessary to produce printouts,

including an external printer and must be listed as meeting the NFPA 72 sensitivity testing and maintenance requirements without the need for manually removing and testing each smoke detector. The control panel must provide a display and a printed list of these sensitivity measurements as a permanent record of the required sensitivity testing. The system must also annunciate a trouble condition when any smoke detector approaches 80% of its alarm threshold due to gradual contamination, with an annunciation of the location of the smoke detector requiring service. If any specialized equipment must be used to program any function of the smoke detector devices, then one must be furnished as part of the system.

6. The system must perform time-based control functions including automatic changes of specified smoke detector sensitivity settings.
7. Central Processing Unit:
    a. The Central Processing Unit (CPU) must communicate with, monitor, and control all other modules within the control panel. Removal, disconnection or failure of any control panel module must be detected and reported to the system display by the CPU.
    b. The CPU must contain and execute all control-by-event (including ANDing, ORing, NOTing, CROSSZONEing) programs for specific action to be taken if an alarm condition is detected by the system. Such control-by-event programs must be held in non-volatile programmable memory, and must not be lost with system primary and secondary power failure. The CPU must also provide a real-time clock for time annotation of all system displays. The Time-of-Day and date must not be lost if system primary and secondary power supplies fail.
    c. The CPU must be capable of being programmed on site without requiring the use of any external programming equipment. Systems that require the use of external programmers or change of EPROMs are not acceptable.
8. Operators Control: Provide an operators interface which allows the following minimum functions. In addition, the operators interface must support any other functions required for system control and/or operation:
    a. Acknowledge (ACK/STEP) Switch
    b. Signal Silence Switch
    c. System Reset Switch
    d. System Test Switch
    e. Lamp Test Switch
    f. Programmable, supervised switches for fire safety function bypasses. i.e. NAC Bypass, Elevator Capture Bypass, HVAC Shutdown Defeat, Smoke Control Bypass, etc. Switch operation must be password protected.
9. Display: The system display must provide all the controls and indicators used by the system operator and may also be used to program all system operational parameters. The display assembly must contain, and display as required, custom alphanumeric labels for all intelligent detectors, addressable modules, and software zones.
    a. The system display must provide an 80minimum character back-lit alphanumeric Liquid Crystal Display (LCD).
    b. The Display must also provide four Light-Emitting-Diodes (LEDs), which must indicate the status of the following system parameters: AC POWER, SYSTEM ALARM, SYSTEM TROUBLE, and SIGNAL SILENCE.

c. The system display must provide a touch key-pad with control capability to command all system functions, entry of any alphabetic or numeric information, and field programming. Two different password levels must be accessible through the display interface assembly to prevent unauthorized system control or programming.

10. Signaling Line Circuit (SLC) Interface Board:
    a. The FACP must contain SLC interface boards as required to communicate with the SLC. Each SLC board must monitor and control a minimum of 198 intelligent addressable devices. This includes 99 analog detectors (Ionization, Photoelectric, or Thermal) and 99 monitor or control modules.
    b. Each SLC interface board must contain its own microprocessor, and must be capable of operating in a local mode (any SLC input activates all or specific SLC outputs) in the event of a failure in the main CPU of the control panel. The SLC interface board must not require any jumper cuts or address switch settings to initialize SLC Loop operations. SLC interface boards must provide power and communicate with all intelligent addressable detectors and modules connected to its SLC Loop on a single pair of wires. This SLC Loop must be capable of operation as NFPA 72 Class A (Style 6) or Class X (Style 7).
    c. Each SLC interface board must receive analog information from all intelligent detectors and must process this information to determine whether normal, alarm, or trouble conditions exist for that particular detector. The SLC interface board software must include software to automatically maintain the detector's desired sensitivity level by adjusting for the effects of environmental factors, including the accumulation of dust in each detector. The analog information may also be used for automatic detector testing and for the automatic determination of detector maintenance requirements.
11. Remote Transmissions: The FACP must be interfaced to a Digital Alarm Communications Transmitter (DACT). See requirements in NFPA 72, 26.6 for acceptable means to transmit fire alarm signals.
12. Power Supply: The FACP power supplies must operate on 120 VAC, 60 Hz and must have a continuous rating adequate to power all equipment and functions in full alarm continuously. All modules and drivers must be able to withstand prolonged short circuits in the field wiring, either line-to-line or line-to-ground, without damage. Further, the power supply must be expandable for additional notification appliance power in 3.0 ampere increments. The power supply must provide a battery charger using dual-rate charging techniques for fast battery recharge.
13. Batteries: Must be completely maintenance free, must not require liquids, fluid level checks or refilling, and must not be capable of producing spills and/or leaks. Batteries must be sealed gel-cell type with expected life of 10 years. Battery voltage must be as required by the FACP and related equipment. Battery must have sufficient capacity to power the fire alarm system for not less than 24 [60] hours plus 5 [15] minutes of alarm upon a normal AC power failure. NAC circuits must not exceed 75% of maximum current load allowed. (For batteries serving emergency voice communications the duration of alarm reserve must be 15 minutes in lieu of 5 minutes)
14. Enclosures: The FACP must be housed in a 3rd party listed cabinet suitable for surface or semi-flush mounting. Cabinet and front must be corrosion protected,

given a rust-resistant prime coat, and manufacturer's standard finish. The door must provide a key lock and must include a glass or other transparent opening for viewing of all indicators. For convenience, the door may be hinged on either the right or left side (field selectable).

## 2.3 NOTIFICATION APPLIANCES

A. Programmable Electronic Sounders: Sounders located outdoors must be listed for use in wet locations. Electric sounders must operate with synchronized audible output and have the following specifications:

1. Voltage: Programmable electronic sounders shall operate on 24 VDC nominal.
2. Programming: Electronic Sounders shall provide the ANSI S3.41 three-pulse temporal pattern audible evacuation signal, described in NFPA 72, with an output sound level of at least 90 dBA measured at 10 feet from the device. Output sound level shall be 120 dB maximum. Electronic Sounders shall be field programmable without the use of special tools.

B. Strobe Lights shall be located as shown on the Drawings. Strobe lights indicated for use exterior to the building shall be mounted at the indicated elevation and listed for use in wet locations. Strobe lights shall operate with synchronized flash output and have the following specifications:

1. Voltage: Strobe lights shall operate on 24 VDC nominal.
2. Maximum pulse duration: 2/10ths of one second.
3. Strobe intensity and flash rate: Shall meet minimum requirements of UL 1971. Provide strobe lights with minimum intensity Candela (Cd) rating of 15/75 Cd, or greater if such is indicated adjacent to the device symbol on the Drawings. Intensity shall be field selectable. The Contractor must verify all candela settings prior to conducting the voltage drop testing required later in this document. Contractor must also verify the design candela settings are adequate for the space being covered. Care must be taken to assure the devices are mounted in the exact locations shown on the approved shop drawing documents. Notify the Architect/Engineer of any deficiencies.

C. Audible Devices:
1. Horns: Where provided, must provide a sound level of 15 dBA above ambient as listed in the NFPA 72.
2. Audible/Visual Combination Devices (Horn/Strobes, Speaker/Strobes and Programmable Electronic Sounders) must comply with all applicable requirements for Horns, Programmable Electronic Sounders and Strobe Lights.

## 2.4 INITIATING DEVICES

A. Addressable Devices - General: All initiating devices must be individually addressable, except aspirating type smoke detectors. Addressable devices must comply with the following requirements:

1. All addressable spot type and duct smoke detectors shall be the analog type and the alarm system shall automatically compensate for detector sensitivity changes due to ambient conditions and dust build-up within detectors. This feature shall be armed and sensitivities set prior to acceptance of the system.
2. Address Setting: Addressable devices shall provide an address-setting means.
3. Connections: Addressable devices shall be connected to a Signaling Line Circuit (SLC) with two (2) wires.
4. Operational Indications: Addressable initiation devices shall provide dual alarm and power LEDs. Both LEDs shall flash under normal conditions, indicating that the device is operational and in regular communication with the control panel. Both LEDs shall be placed into steady illumination by the FACP to indicate that an alarm condition has been detected. The flashing mode operation of the detector LEDs shall be optional through the system field program. An output connection shall also be provided in the device base to connect an external remote alarm LED.
5. Intelligent Initiation Devices: All smoke detectors shall be the "intelligent" in that smoke detector sensitivity shall be set through the FACP and shall be adjustable in the field through the field programming of the system. Sensitivity shall be capable of being automatically adjusted by the FACP on a time-of-day basis. Using software in the FACP, detectors shall be capable of automatically compensating for dust accumulation and other slow environmental changes that may affect performance. The detectors shall be listed by UL as meeting the calibrated sensitivity test requirements of NFPA Standard 72.
6. Spot-type detectors shall be the plug-in type, with a separate base (not a mounting ring), to facilitate their replacement and maintenance. The base shall have integral terminal strips for circuit connections, rather than wire pigtails. Each detector or detector base shall incorporate an LED to indicate alarm.
7. Device mounting Base: Unless otherwise specified all detectors shall be ceiling-mount and shall include a separate twist-lock base with tamper proof feature.
8. Test Means: The detectors shall provide a test means whereby they shall simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a magnetic switch) or initiated remotely on command from the control panel when in the "test" condition.
9. Device Identification: Detectors shall store an internal identifying type code that the control panel shall use to identify the type of device. Device identifications shall be PHOTO or THERMAL.
10. Photoelectric Smoke Detectors: Photoelectric smoke detectors shall use the photoelectric (light-scattering) principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density.
11. Ionization Smoke Detector: Ionization smoke detectors must use the dual-chamber ionization principal to measure products of combustion and must, on command from the control panel, send data to the panel representing the analog level of products of combustion.
12. Thermal Detectors: Thermal Detectors shall be intelligent addressable devices rated at 135°F (58°C) and shall have a rate-of-rise element rated at 15° F. (9.4°C) per minute. It shall connect via two wires to the Fire Alarm Control Panel Signaling Line Circuit. Up to 99 intelligent heat detectors may connect to one SLC loop. Thermal detectors shall use an electronic sensor to measure thermal conditions

caused by a fire and shall, on command from the control panel, send data to the panel representing the analog level of such thermal measurements.

a. Non-Rate of Rise Detectors: Provide thermal detectors with non-rate of rise thermal elements. Non-rate of rise detectors are indicated by NRR adjacent to the thermal detector symbol.
b. Specialized Element Temperature Ratings: Provide thermal detectors with specialized element temperature ratings. Specialized element temperatures are indicated by a temperature rating adjacent to the thermal detector symbol, e.g. 195°F.

13. Multi-sensor Detectors: Detectors employ two or more of the above detection types with integrated operating principals, mounted in a single housing. The outputs of the analog sensors must be transformed into digital signals that are combined and processed by special algorithms. The computations must be designed to discriminate between normal ambient changes in a building and those changes associated with a fire. //Provide photoelectric smoke detection and rate of rise thermal detection. //Provide photoelectric smoke detection, ionization smoke detection and rate of rise thermal detection. //
14. Duct Smoke Detector: In-Duct Smoke Detector Housings shall accommodate a velocity rated photoelectric detector. The device, independent of the type used, shall provide continuous analog monitoring and alarm verification from the panel. When sufficient smoke is sensed, an alarm signal shall be initiated at the FACP. Coordinate with owner for response appropriate for the location.
15. Addressable Pull Stations - General: Addressable pull stations shall, on command from the Control Panel, send data to the panel representing the state of the manual switch. They shall use a key operated test-reset lock, and shall be designed so that after actual emergency operation, they cannot be restored to normal use except by the use of a key. All pull stations shall be dual-action, have a positive, visual indication of operation and utilize a key type reset. Glass-break rods are not allowed. Mount pull station with operating mechanism between 42-inches and 48-inches above finished floor.
16. Linear Beam Smoke Detectors: Must be configured as an integral part of the Fire Alarm system and must meet the following requirements:
    a. Linear beam detectors must have a minimum of three calibrated sensitivity settings capable of maintaining sensitivity between 1.0% and 2.0% per meter obscuration, at any operating distance between 10 and 60 meters.
    b. The manufacturer of linear beam detectors must provide a calibration chart giving the Smoke Sensitivity versus Operating Distance for each sensitivity setting. This chart must show the 3rd party listed sensitivity limits for the entire range of rated operating distances.
    c. Linear beam detectors must be rated for continuous operation up to 122°F (50°C) and a 95% relative humidity.
    d. Compensating circuits must be provided in the detector to maintain normal sensitivity as environment conditions change and as dust builds up on the lenses. When the limits of this compensation are reached, a "trouble" signal must be initiated.
    e. Horizontal and vertical adjustments must be provided, on both the transmitter and the receiver, for alignment of the IR beam. They must permit a minimum angular change of 7.5° from the center axis, in any direction.

f. The IR beam must be modulated, to assure reliable operation in the presence of very high ambient light and/or background IR.
g. Abrupt, maintained blockage of the IR beam must result in a "trouble" signal (not alarm), to be initiated within a time span of 10 seconds minimum to 60 seconds.
h. Do not mount beam detector components on unsupported walls or structures. Vibration can cause nuisance trouble and alarm conditions.

## 2.5 AUXILIARY DEVICES

A. Addressable Dry Contact Monitor Module:

1. Addressable Monitor Modules shall be provided to connect one supervised zone (either Style D or Style B) of non-addressable Alarm Initiating Devices (any Normally Open [N.O.] dry contact device) to one of the Fire Alarm Control Panel Signaling Line Circuit Loops. Monitor modules shall be installed as required by the system configuration. All required monitor modules may not be shown on the Drawings.
   a. Indication of Operation: An LED shall be provided that shall flash under normal conditions, indicating that the Monitor Module is operational and in regular communication with the control panel.
   b. Supervision: Unless specifically noted otherwise on the drawings provide one monitor module for each sprinkler switch.
2. Two Wire Detector Monitor Module: Addressable Monitor Modules shall be provided to connect one supervised IDC zone, Class A (Style D or Style B operation) of non-addressable 2- wire smoke detectors or alarm initiating devices (any N.O. dry contact device) to one of the Fire Alarm Control Panel Signaling Line Circuit Loops.
3. Monitor modules shall be installed as required by the system configuration. All required monitor modules may not be shown on the Drawings. Indication of Operation: Unless otherwise indicated on the Drawings an LED shall be provided that shall flash under normal conditions, indicating that the Monitor Module is operational and in regular communication with the control panel.

B. Addressable Control Module:

1. Addressable Control Modules shall be provided to supervise and control the operation of one conventional Notification Appliance Circuit (NAC) of compatible, 24 VDC powered, polarized Audio/Visual (A/V) Notification Appliances. For fan shutdown and other auxiliary control functions, the control module may be set to operate as a dry contract relay. The control module shall provide address-setting means using DIP switches and shall also store an internal identifying code that the control panel shall use to identify the type of device. An LED shall be provided that shall flash under normal conditions, indicating that the control module is operational and is in regular communication with the control panel.
2. Configuration:
   a. The control module NAC circuit may be wired for Style Z Class A with up to 1 Amp of inductive A/V signal, or 2 Amps of resistive A/V signal operation, or as a dry contact (Form C) relay. The control module shall be suitable for

pilot duty applications and rated for a minimum of 0.6 amps at 30 VDC. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to insure that 100% of all auxiliary relay or NACs may be energized at the same time on the same pair of wires.

b. Power Source: Audio/visual power shall be provided by a separate supervised power loop from the main fire alarm control panel or from a supervised, 3rd party listed remote power supply. A/V power sources and connections are not shown on the Drawings

c. Test Switch: A magnetic test switch shall be provided to test the module without opening or shorting its NAC wiring.

C. Isolator Module:

1. Isolator Modules shall be provided to automatically isolate wire-to-wire short circuits on an SLC loop. The Isolator Module shall limit the number of modules or detectors that may be rendered inoperative by a short circuit fault on the SLC Loop. Modules shall be readily accessible (not above ceiling) and clearly labeled.
2. Operation: Isolator Modules shall operate such that if a wire-to-wire short occurs, the Isolator module shall automatically open-circuit (disconnect) the SLC loop. When the short circuit condition is corrected, the Isolator Module shall automatically reconnect the isolated section. The Isolator Module shall not require any address-setting, and its operations shall be totally automatic. It shall not be necessary to replace or reset an Isolator Module after its normal operation.
3. Isolator Modules shall provide a single LED that shall flash to indicate that the Isolator is operational and shall illuminate steadily to indicate that a short circuit condition has been detected and isolated.

D. Water Flow Switch: Flow switches must be integral, mechanical, non-coded, non-accumulative retard type. Flow switches must have an alarm transmission delay time that is conveniently adjustable from 0 to 60 seconds. Initial settings must be 30-45 seconds. Flow switches must be located a minimum of one (1) foot from a fitting that changes the direction of the flow and a minimum of three (3) feet from a valve as required per NFPA 13. Installation: Water Flow Switches must be connected by the Division 16 (Electrical) Contractor but furnished and installed by the Division 23 (Mechanical) Contractor.

E. Sprinkler and Standpipe Valve Supervisory Switch:

1. Supervisory switch mechanisms must be contained in weatherproof housings that must provide a 3/4 inch tapped conduit entrance and must incorporate the necessary facilities for attachment to the valves. Switch housing must be finished in red baked enamel.
2. Mounting: Mount switch so as not to interfere with the normal operation of the valve and adjust to operate within two revolutions toward the closed position of the valve control, or when the stem has moved no more than one-fifth of the distance from its normal position.

F. Serially Connected Remote Annunciators:

1. Annunciators shall communicate with the fire alarm control panel via an EIA-485 communications loop (four-wire) and shall individually annunciate all zones in the system. System zones shall be as indicated on the Drawings.
2. Annunciator Indicators: The annunciator shall provide a red Alarm LED per zone, and a yellow Trouble LED per zone. The annunciator shall also have an "ON-LINE" LED, local piezo sounder, local acknowledge/lamp test switch, and custom zone/function identification labels. Annunciator switches may be used for System control such as, Global Acknowledge, Global Signal Silence, and Global System Reset. All anunnciator switches and indicators shall be software programmable.
3. LCD Alphanumeric Display Annunciator: The Alphanumeric Display Annunciator shall be a supervised, remotely located back-lit LCD display containing a minimum of eighty (80) characters for alarm annunciation in clear English text. The LCD Annunciator shall display all alarms and trouble conditions in the system.
4. If both LED and LCD functions are not provided in a single remote annunciator, provide both LED and LCD remote annunciators installed adjacent in flush wall-mounted enclosure(s). Provide a common flush face plate of matching brushed aluminum.
5. System Capacity: The system must allow a minimum of four LCD annunciators. In addition to annunciation functions, each LCD annunciator must be capable of the following software programmed system functions: Acknowledge, Signal Silence and Reset.
6. Connections: The annunciator must connect to a two-wire EIA-485 interface. The two-wire connection must be capable operation at distances of 6,000 feet. Provide interface to fiber optic cable systems and/or repeater units where such are indicated on the Drawings.

G. Remote Annunciator Indicator Lights (RAIL): RAILs shall be provided with a key type switch for testing of the annunciated device. RAILs shall operate on 24 VDC nominal. See installation detail on the Drawings.

H. Door Hold-Open Magnets:

1. Door hold open magnets must be suitable for mounting in a single gang electrical device box. Door hold open magnets must be furnished with keepers, door chains, and other accessories as required to properly hold open doors as indicated on the Drawings. Holding force of the magnet must be appropriate for the door to be held open.
2. Door hold open magnets shall operate in a fail safe manner, i.e., the door shall release in event of a failure of voltage to the device.
3. Power Source: Door hold open magnets shall be configured to operate from a nominal 24 VDC system as supplied by the FACP or other power supply listed for the purpose. All hold open magnet supply sources, whether a part of the FACP or whether derived from a separate power supply, shall be supervised. Door hold open magnet circuits which use step-down transformers, 120 VAC, or local relays are not permitted. Door shall close after 60 seconds of the power loss.

I. Battery Power Supply (BPS) &/or Supplementary Notification Appliance Circuit (SNAC): These types of panels must be completely maintenance free, must not require liquids, fluid level checks or refilling, and must not be capable of producing spills and/or leaks. Batteries must be sealed gel-cell type with expected life of 10 years. Battery voltage must

be as required by the FACP and related equipment. Battery must have enough capacity to power the fire alarm system for not less than //24 // 60 // hours plus // 5 // 15 // minutes of alarm upon a normal AC power failure. Battery cabinet must be twice the size of the batteries it will contain. NAC circuits must not exceed 75% of maximum current load allowed.

J. Surge Protection: The following protection against voltage transients and surges shall be provided by the fire alarm equipment supplier, and installed by the electrical contractor:

1. On AC Input: A feed-through (not shunt-type) branch circuit transient suppressor such as Leviton 51020-WM-DN, or Di-Tech DTK-120S20A, or equivalent UL 1449 – 4th Edition Listed device.
2. For each AC power circuit that interfaces with fire alarm equipment install an AC suppressor in a listed enclosure near the electrical panelboard, and trim excess lead lengths. Wind small coil in the branch circuit conductor just downstream of the suppressor connection. Coil to be 5 to 10 turns, about 1" diameter, and securely tie-wrapped. This series impedance shall improve the effectiveness of the suppressor in clipping fast rise time voltage transients.
3. On DC Circuits Extending Outside Building: Adjacent to the FACP, and also near point of entry to outlying building, provide "pi"-type filter on each leg, consisting of a primary arrestor, series impedance, and a fast acting secondary arrestor that clamps at 30v-40v. Some acceptable models: Simplex 2081-9027, Simplex 2081-9028, Transtector TSP8601, Ditek DTK 2MHLP24BWB series, Citel America B280-24V, and Northern Technologies DLP-42. Submit data on others to the Architect/Engineer for approval. UL 497B listing is normally a prerequisite for their consideration. Devices using only MOV active elements are not acceptable.

K. Wiring:

1. Addressable loop (signaling line) circuits shall be wired with type FPL/FPLR/FPLP fire alarm cable, AWG 18 minimum, low capacitance, twisted shielded copper pair. Cable shield drain wires shall be connected at each device on the loop to maintain continuity, taped to insulate from ground, and terminated at the FACP. Acceptable cables include Atlas 228-18-1-1STP, BSCC S1802s19 (same as EEC 7806LC), West Penn D975, D991 (AWG 16), D995 (AWG 14), or equal wire having capacitance of 30pf/ft. maximum between conductors. Belden 5320FJ is acceptable if only FPL rating is needed. The cable jacket color shall be red, with red (+) and black (-) conductor insulation.
2. Unshielded cable, otherwise equal to the above, is permitted to be used if the manufacturer's installation manual requires, or states preference for, unshielded cable.
3. In underground conduit, Type TC or PLTC cable (PE insulated) shall be used to avoid problems from moisture.

**2.6 TERMINAL CABINETS:** Terminal cabinets must be sheet steel, hinged cover type not less than 10” x 16” x 10” deep. Cabinets must conform to Specs Section 26 05 34 and must be labeled in accordance with Specs Section 26 05 53.

## PART 3 - EXECUTION

### 3.1 FIRE ALARM SYSTEM

A. The fire alarm system shall be new and furnished with a warranty (parts & labor) of at least one year from the date of final inspection and/or acceptance by the Owner. Equipment, initiating devices, and alarm appliances shall be arranged and the annunciator zones shall be configured as directed by the Architect/Engineer.

B. All equipment supplied shall be specifically listed for its intended use and shall be installed in accordance with the manufacture’s recommendations. The contractor shall consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation.

C. All system components shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load. Adhesives are not permitted to mount fire alarm system components to building surfaces or structure.

D. When programming the system, activate the automatic drift compensation feature for all spot-type smoke detectors. Systems with alarm verification are not to have this feature activated without written direction from the Owner's representative or the AHJ. Alarm verification must not be used with multi-sensor/multi-criteria detectors under any circumstances, as inadequate system response may result.

E. Set spot-type smoke detector sensitivities to normal/medium, unless directed otherwise by the Architect/Engineer or Owner's rep.

F. Print a complete System Status and Programming Report after the above steps have been done. This shall include the program settings for each alarm initiating device and the current sensitivity of each analog addressable smoke detector.

### 3.2 FIRE ALARM CONTROL EQUIPMENT INSTALLATION

A. The technician who makes final connections and programs the FACP is the "installer" even though most field connections to system devices and appliances are normally made by electrical contractor personnel. The responsibility for assuring a proper installation overall rests with this individual fire alarm system technician. In addition to doing the final hookups and activating the system, this individual must check the field connections to assure all work is properly done. The absence of system "trouble" signals is not an adequate measure of the field wiring, which could have "T" taps, the wrong type of wire, improper terminations, ground (drain wire) issues, etc..

B. Notification Appliance Circuit booster power supplies shall be individually monitored by the FACP and protected by a smoke detector per NFPA 72. They shall not be located above a ceiling, or in non-conditioned space. A 24vdc power circuit serving addressable control relays shall also be monitored for integrity. Note if the contractor elects to provide additional remote power supplies, 120 VAC circuits required by the power supplies shall be provided by the contractor at no additional cost to the Owner. Basic operating instructions shall be framed and permanently mounted at the FACP. In addition, a fully executed NFPA 72 "Record of Completion" form shall be installed in a glass front frame screwed to the wall adjacent to the FACP.

C. Basic operating instructions must be framed and permanently mounted at the FACP. (If the Owner concurs, they may instead be affixed to the inside of the FACP's door.) In addition, the NFPA 72 "Record of Completion" must either be kept at/in the FACP, or its location must be permanently indicated there by an engraved label. All System documentation must be provided and housed in a Documentation Cabinet at the control panel or other approved location. (Per 2013 NFPA 72: 7.7.2)

D. Provide an engraved label inside the FACP identifying its 120vac power source, as follows: Panelboard location, panelboard identification, and branch circuit number.

E. Alarm notification appliances (audible and visible) shall comply with NFPA 72, the North Carolina Building Code, and ANSI 117 criteria for intensity and placement. The audible evacuation signal shall be the ANSI S3.41 three-pulse temporal pattern. All strobe lights installed in a single space shall be synchronized. Mount devices on the ceiling where shown.. Wall mounted devices must be mounted with the entire lens between 80” minimum and 96” maximum off finished floor. See the NFPA 72 for additional alarm notification appliance requirements for special situations.

## 3.3 ADDRESSABLE INTERFACE MODULES (Control and Monitor Modules)

A. Addressable interface modules (used to monitor all contact type initiating devices) shall be located in conditioned space, unless they are tested, listed, and marked for continuous duty across the range of temperatures and humidity expected at their installed location.

B. One module may serve as many as 3 sprinkler system valve supervisory switches in a single space; otherwise provide one module per switch.

C. One module may serve as many as 6 heat detectors in a single space.

D. Sprinkler system supervisory circuits for monitoring valve position, air pressure, water temperature, pump status, etc., must cause distinct audible and visible indications at the FACP. The audible supervisory signal must either be a 4" diameter bell or a pulsing piezo-electric alarm. Provide the following engraved label adjacent to the bell/alarm: "SPRINKLER STATUS ABNORMAL". If only valve position is supervised, provide an engraved label reading: "SPRINKLER VALVE CLOSED"

## 3.4 SURGE PROTECTION

A. For each AC power circuit that interfaces with fire alarm equipment install an AC suppressor in a listed enclosure near the electrical panelboard, and trim excess lead lengths. Wind small coil in the branch circuit conductor just downstream of the suppressor connection. Coil to be 5 to 10 turns, about 1" diameter, and securely tie-wrapped. This series impedance must improve the effectiveness of the suppressor in clipping fast rise time voltage transients.

B. On DC Circuits Extending Outside Building: Install the surge arrestor in a labeled enclosure near the point of entry to or exit from each building.

## 3.5 AC POWER

A. Switching to emergency power during alarm shall not cause signal drop-out. Batteries shall meet the appropriate NFPA capacity requirements, with a 25% safety factor. This requirement is in effect even if generator power is supplied to the Fire Alarm Control Panel.

B. The branch circuit breaker(s) supplying the system shall be physically protected by a panelboard lock and circuit breaker handle lock and each circuit breaker shall be identified with a 1/4" permanent red dot applied to its handle.

C. Provide an engraved label at each fire alarm system control unit, system sub-panel or data gathering panel, supplementary notification appliance (SNAC) panel, digital alarm communicator, etc.

D. The fire alarm system shall monitor 120VAC power to shunt trip breakers used in conjunction with fire suppression systems. Examples include a shunt trip used for cooking appliance power shut-off when the kitchen hood fire suppression system is activated, or primary elevator power shut-down upon sprinkler flow in any elevator equipment space or shaft. Use an addressable monitor module to accomplish this supervisory function.

## 3.6 CONDUIT AND WIRING

A. The exterior of all junction boxes containing fire alarm conductors shall be painted red; box interiors shall not be painted. Box covers for junction boxes containing fire alarm conductors shall be painted red on both sides.

B. The exterior of all junction boxes containing fire alarm conductors must be painted red; box interiors must not be painted. Box covers for junction boxes containing fire alarm conductors must be painted red on both sides.

C. Box covers shall be labeled to indicate the circuit(s) or function of the conductors contained therein. Lettering shall contrast with the box cover paint and shall be neatly applied using machine generated white lettering on a clear background. Handwritten labels or labels made from embossed tape are not acceptable. Lettering must be a minimum of 5/16” high and clearly readable from a minimum of 12 feet distant.

D. Fire alarm system wiring may be free run where concealed above accessible ceilings, otherwise cables shall be in installed metal conduit. Use listed plenum cable in environmental air spaces including plenum ceilings. Surface metal raceway may be used where specifically permitted. All fire alarm system raceway, couplings, and connectors shall meet the performance and installation requirements of Specification Section 26 05 33.

E. If cable size and the requirement to maintain a Class "A" loop on all Signaling Line Circuits cause conduit fill to exceed specified maximums for the 1/2" size; 3/4" raceway shall be used.

F. All conduits that penetrate outside walls from air conditioned space shall have internal sealing (duct-seal), to prevent condensation from infiltrating humid air.

G. All wiring shall be color coded All the circuits in the system shall be wired with AWG 14, minimum, stranded copper, THHN/THWN conductor, installed in metallic conduits. Color Coded wires shall be in accordance with the following scheme, which shall be maintained throughout the system, without color change in any wire run;

| | | |
|---|---|---|
| 1. | Initiating Circuits, general | Red (+)/White (-) |
| 2. | Initiating Circuits, smoke only | Violet (+)/Gray (-) |
| 3. | Signal Line Circuit cable | Red jacket with Red(+)/Black(-) |
| 4. | Alarm Indicating Appliance Circuits | Blue (+)/Black (-) |
| 5. | AHU Shutdown Circuits | Yellow (+)/Brown (-) |
| 6. | Door Control Circuits | Orange |
| 7. | Elevator Capture Circuits | Brown |

H. To minimize wiring fault impact, isolation modules must be provided in all of the locations listed below. If ceiling height is ≤10 feet, isolator base type initiating devices are permitted to be used to satisfy any or all of the following:

1. In or immediately adjacent to the FACP, at each end of the addressable loop. These two isolators must be in the same room and within 15 feet of the FACP.
2. After each 20 initiating devices and control points on the addressable loop, or a lesser number where recommended by the manufacturer.
3. For loops with 20 devices and control points, install an isolator at the approximate middle of the loop, in addition to those at the FACP.
4. Near the point any addressable circuit extends outside the building, except for those attached to the building exterior walls and well sheltered by walkways.
5. For loops covering more than one floor, install isolator at terminal cabinet on each floor, with additional isolator(s) on any floor with over 20 addresses.
6. Each isolation module must be clearly labeled, readily accessible for convenient inspection (not above a lay-in ceiling), and shown on as-built drawings.

I. Provide isolation modules in all of the locations listed below. If ceiling height is ≤10 feet, isolator base type initiating devices are permitted to be used to satisfy any or all of the following:

1. In or immediately adjacent to the FACP, at each end of the addressable loop. These two isolators shall be in the same room and within 15 feet of the FACP.
2. After each 20 initiating devices and control points on the addressable loop, or a lesser number where recommended by the manufacturer.
3. For loops with 20 devices and control points, install an isolator at the approximate middle of the loop, in addition to those at the FACP.
4. Near the point any addressable circuit extends outside the building, except for those attached to the building exterior walls and well sheltered by walkways.
5. For loops covering more than one floor, install isolator at terminal cabinet on each floor, with additional isolator(s) on any floor with over 20 addresses.
6. Each isolation module shall be clearly labeled, readily accessible for convenient inspection (not above a lay-in ceiling), and shown on as-built drawings.

J. Detection or alarm circuits shall not be included in raceways containing AC power or AC control wiring. Within the FACP, any 120VAC control wiring or other circuits with an externally supplied AC/DC voltage above the nominal 24VDC system power shall be properly separated from other circuits and the enclosure shall have an appropriate warning label to alert service personnel to the potential hazard.

K. Class A Circuits Required: Systems with one or more addressable sub-panels that (1) have an integral addressable loop controller, or (2) monitor multiple non-addressable initiation zones, shall comply with the NFPA 72 requirements for Style 6 circuits.

L. There shall be no splices in the system other than at device terminal blocks, or on terminal blocks in cabinets. "Wire nuts" and crimp splices shall not be permitted. Permanent wire markers shall be used to identify all connections at the FACP and other control equipment, at power supplies, and in terminal cabinets. All terminal block screws shall have pressure wire connectors of the self lifting or box-lug type.

M. In multistory buildings, all circuits leaving the riser on each floor must feed through a labeled terminal block in a hinged enclosure accessible from the floor. If building layout requires the terminal cabinet to be above a drop ceiling, its location must be clearly and permanently identified with a placard readable from floor. Terminal block screws must have pressure wire connectors of the self-lifting or box lug type.

N. All wiring shall be checked for grounds, opens, and shorts, prior to termination at panels and installation of detector heads. The minimum resistance to ground or between any two conductors shall be ten (10) megohms, as verified with a megger. Provide advance notice to the Architect/Engineer of these tests.

O. The system shall be electrically supervised for open or (+/-) ground fault conditions in SLC, alarm circuits, and control circuits. Removal of any detection device, alarm appliance, plug-in relay, system module, or standby battery connection shall also result in a trouble signal. Fire alarm signal shall override trouble signals, but any pre-alarm trouble signal shall reappear when the panel is reset.

## 3.7 NOTIFICATION DEVICES

A. Both audible and visible alarm signals shall be provided. Visible signals shall be the strobe (flash discharge) type, with white or clear lens, and shall comply with current ADA requirements for intensity and placement.

B. Alarm notification appliance (NAC) circuits shall be NFPA 72 Style Y (Class B). The load connected to each circuit shall not exceed 80% of rated module output and the coverage of each circuit shall not exceed 3 floors (to limit the effect of faults, and to facilitate trouble-shooting). The NAC voltage drop during alarm shall not exceed 14% of the voltage measured across the batteries at that time. To achieve this, the design shall consider wire size, length of circuit, device load, inherent voltage loss within the FACP's power supply, etc. The contractor shall use power outage testing to verify that the NAC circuit was designed and installed properly.

C. End of Line (EOL) Device: The end of line device shall be installed in accessible terminal cabinets or dedicated accessible boxes, to facilitate testing and maintenance. The location of all end of line devices must be labeled on the device, with NAC panel number and NAC circuit number, and recorded on the "As-built" drawings. EOL must not be located more than 12-feet above finished floor.

## 3.8 DETECTORS

A. Detectors used for elevator: Primary, alternate recall points and the machine room & the shaft shall be indicated on the control Matrix. Elevator capture or control signals shall come from the FACP as relayed by control modules.

B. When installed in a room, detectors shall be oriented so their alarm light is visible from the nearest door to the corridor, unless Remote Alarm Indicator Light (RAIL) equipped.

C. Spot-type smoke detectors must secure the head to the base thru the built-in locking device. For detector mounted within 12 feet of the floor, activate this lock after the system has been inspected and given final acceptance.

D. Unless suitably protected against dust, paint, etc., spot type smoke detectors shall not be installed until the final construction clean-up has been completed. In the event of contamination during construction, the detectors shall be replaced by the contractor at no additional cost to the Owner. Covers supplied with smoke detector heads do not provide protection against heavy construction dust, spray painting, etc., and shall not be used for that purpose. They are suitable only during final, minor cleanup or touchup operations.

E. The FACP and all other control equipment locations, including any transponders, sub-panels, and booster power supplies, must be protected by a spot type smoke detector located within 15 feet of the equipment (measured horizontally). All sub-panels and booster power supplies may not be shown on the Drawings. It is the contractor's responsibility to add additional devices to comply.

F. A detector installed where accidental damage or deliberate abuse is expected shall be provided with a guard that is listed for use with it and is acceptable to the AHJ.

G. Identification of individual detectors is required. Assign each a unique number as follows, in sequence starting at the FACP: (Addressable Loop # -- Device #) Show on the as-built plans, and also permanently mount on each detector's base so that it's readable standing on the floor below without having to remove the smoke detector. Exception: For detectors with housings (i.e., air duct, projected beam, air sampling, flame), apply the identification to a suitable location on exterior of their housing. Device labels may not be affixed to the device. Identification labels for white detector bases, control/monitor modules and other light colored devices shall be printed labels with black lettering on a clear background. Identification labels for red notification appliance housings and other dark color devices shall be printed labels with white lettering on a clear background. Handwritten labels or labels made from embossed tape are not acceptable.

H. Duct Mounted Smoke Detectors:

1. Refer to Division 23 Drawings for locations and quantities of duct mounted smoke detectors.
2. All air duct/plenum detectors shall have a Remote Alarm Indicator Lamp (RAIL) installed in the nearest corridor or public area and identified by an engraved label affixed to the wall or ceiling. Where detectors are in close proximity, RAIL devices shall be grouped as shown on the Drawings. Duct smoke detectors are permitted to be installed only inside an air duct. Do not install in front of a return air opening. Duct detectors shall also be installed in a manner that provides suitable, convenient access for required periodic cleaning and calibration. The numbers of detectors per duct shall be per NFPA 72 requirements based on the size of the air duct, air duct configuration, air speed, and duct manufacture’s installation requirements.
3. Each duct detector installation shall have a hinged or latched duct access panel, 12x12 inches minimum, for sampling tube inspection and cleaning. Indicate airflow direction on the duct, adjacent to the detector, using stencil or permanent decal.
4. Duct detector sampling tubes shall extend the full width of the duct. Those over 36 inches long shall be provided with far end support for stability. The preferred method for providing support is to extend the intake tube through the far side of the duct, seal around the tube where it penetrates the duct wall, and plug the end with a rubber stopper. This facilitates visual inspection, intake tube cleaning, and injection of smoke or equivalent aerosol for testing the detector.
5. Duct smoke detector mounting position and air sampling tube orientation are critical for proper operation. The Manufacturer's detailed installation instructions shall be followed. The contractor shall mark the direction of air flow on the duct at each duct detector location.
6. Unless the AHJ requires otherwise, all duct smoke detectors shall be programmed for fire alarm (not for supervisory annunciation).
7. A fire alarm panel output for a duct detector signal must be as required by NC Building Codes and NFPA 72.

## 3.9 PRINTER

Provide a 120vac tractor feed event printer that uses ordinary (non-thermal) paper. Install in location selected by the Owner.

## 3.10 AIR HANDLER UNIT (AHU) SHUTDOWN

A. A supervised "AHU Shutdown Defeat" switch shall be provided in/adjacent to the FACP or as a key-operated function in the Remote Annunciator. If the FAA option is utilized, provide an informative engraved label at the FACP about this function. The switch shall cause a system "trouble" indication when it's placed in the off-normal ("Shutdown Defeated") position. This is to provide the Owner with a convenient means to temporarily resume HVAC operation in the event an unwanted alarm shall not clear, prior to arrival of the fire alarm service technician.

B. If the building has smoke control system fans (pressurization or exhaust), or smoke purge fans, provide Hand-Auto-Off switches at an approved location. They must be clearly labeled, and FACP -monitored or provided with status indicator lights. This is often provided by the controls contractor, rather than the fire alarm contractor, and does not need to be part of the fire alarm system. Responsibility should be clearly indicated in the project specification. For three-position toggle switches we recommend this intuitive arrangement: Hand (Manual Run) to be "up" and have an amber LED; Auto to be center position with a green LED; Off to be down and have a red LED.

C. All shutdown relays must be directly controlled and monitored by the fire alarm system. The Building Automation System (BAS) must not be used for life safety functions unless the BAS is supervised by the Fire Alarm System for off normal conditions. Relays should be wired fail safe. (BAS systems typically are not battery backed and typically do not supervise themselves or their wiring, for faults or communication loss between processors or CPU’s.)

D. Buildings with smoke control or smoke removal systems must have the Fire Fighter’s Smoke Control Panel monitored by the Fire Alarm System, for all trouble conditions.

E. If the system includes AHU shutdown or smoke removal startup, silencing the alarm (without resetting) shall not reverse the shutdown.

## 3.11 ANNUNCIATOR

A. Each addressable fire alarm system must include an LED-type "zone" annunciator at (or in) the FACP, and in another location if shown. As a minimum, this annunciator must indicate the specific type of alarm or supervisory signal (smoke detector, water-flow, sprinkler valve closed, etc.), for groups of addressable devices. The area ("zone") that is represented by each LED must not exceed 1 floor or 22,500 square feet, and must not cross building fire walls or smoke compartments.

1. Systems in 1 or 2-story buildings, which have 30 or fewer initiating devices, are permitted to omit the LED-type "zone" annunciator.

2. Systems with a Graphic Annunciator (GA) are permitted to omit the LED-type "zone" annunciator.
3. The LED annunciator is permitted to be omitted if the FACP has a multi-line display that automatically defaults to displaying the first alarm, plus the first 3 (minimum) water-flow alarms and the last alarm. This is permitted to be done using 2 automatically alternating screens. If there is no sprinkler system, program the FACP to show the first 4 alarms plus the last alarm received.

B. Where indicated on the Drawings, a Graphic Annunciator (GA) with separate Light Emitting Diodes (LED) indication for each alarm and supervisory signal initiating device must be included. Multiple initiating devices of the same type within a single room may be permitted to share a common LED. The GA must show all major building features such as corridors, elevators, stairs, exits, and "YOU ARE HERE". GA layout must be submitted for approval. Graphic Chart must be mounted behind Plexiglas and secured to surface. Mounting must be such that charts cannot be removed without the proper tools.

## 3.12 ALARM VERIFICATION FOR SMOKE DETECTORS

A. The fire alarm system shall be equipped with Alarm Verification where required for the application.

B. System shall provide as a feature an alternate signal processing algorithm to verify the presence of smoke. The algorithm shall be selectable during system programming. The total effective delay created by the verification algorithm shall not exceed 60 seconds. Do not activate alarm verification unless directed to do so by AHJ, Architect/Engineer or the Owner.

## 3.13 REMOTE ALARM TRANSMISSION REQUIREMENTS

A. Each system with automatic fire detection, or which monitors a sprinkler system, shall be equipped with a 4-channel (minimum) Digital Alarm Communicator Transmitter (DACT) for transmission of fire alarm, supervisory, and trouble signals to a Central Station, Remote Supervising Station, or Proprietary Supervising Station. DACT shall be dual line type in accordance with NFPA 72.

B. As applicable the following signals shall be reported:

1. Fire Alarm
2. Sprinkler Water-flow Alarm
3. Fire Pump Running Alarm (if pump provided)
4. Fire Pump Abnormal Status Supervisory Signal
5. Sprinkler Valve Tamper (Closed) Supervisory Signal
6. Sprinkler Low Temperature / Air Pressure Supervisory Signal
7. Burglary / Intrusion / Duress / Other Security or Emergency Alarm
8. Fire Alarm System AC Power Trouble (only if 120vac interrupted for 1 to 8 hours)

C. In lieu of a DACT, the use of an addressable network is acceptable. Other appropriate means of transmitting fire alarm system signals off-premises may be permitted to be used, at the discretion of the AHJ who approves the plans.

D. For buildings with full-time on-site staffing assuring response (prison camps hospitals, etc.), notification at a constantly attended location would be acceptable. An outside bell and high-power strobe light could be an effective means of signaling alarm. Where specifically permitted by the AHJ, the following could be provided: Fire Alarm Bell, 10" diameter, weatherproof Strobe Light, 100 cd minimum, double flash, clear lens, weatherproof.

E. Sprinkler and fire pump supervisory signals are permitted to be combined by the DACT, for transmission. Contact the AHJ for more information.

F. The precedence of DACT / signals transmitted to the Supervising Station must be as follows:

1. Fire Alarm
2. Water flow
3. Supervisory Signal
4. Trouble Signal*
5. Security Alarm

G. The Contractor must provide a type of DACT that is compatible with the Owner's alarm receiving equipment, or the Supervising Station selected by the Owner, as applicable. He must also program the PROM, connect each DACT to the telephone line(s) provided to him, and verify proper signal receipt by the Supervising Station. The transmission means must comply with NFPA 72.

## 3.14 AUTOMATIC SMOKE DOOR AND AUTOMATIC LOCK REQUIREMENTS

A. Door holders shall be controlled by the building's smoke detection system FACP. Individual smoke detector auxiliary contacts shall not be used to release door holders.

B. Automatic door locks controlled by the system shall be either fail safe magnetic locks or fail-safe electro-mechanical with reverse bevel dead bolts.

C. All locked protected doors shall immediately unlock upon fire alarm, loss of AC power, disablement of the fire alarm system (defined as loss of 24 VDC power) or upon manual operation of an unlock switch at a constantly attended location.

## 3.15 SPRINKLER SYSTEM MONITORING

A. The following sprinkler system alarm and supervisory functions must be provided as a part of the fire alarm system:

1. Water-flow alarm, by sprinkler zone (not to exceed one floor).
2. Supervision of each control valve.

3. Supervision of air pressure, if used (both high and low).
4. Supervision of fire pump.
5. Hot Box low temperature.
6. Elevator shunt trip power off. Provide breaker clip on circuit breaker used for elevator shunt trip power.

## 3.16 FIRE ALARM SYSTEM INSTALLATION AND CONFIGURATION

A. Supervision required: The connection between individual addressable modules and their contact type initiating device(s) shall be supervised.

B. Floor Plans with Device Numbers: A copy of the floor plans shall be provided at the control panel in a separate enclosure. Plans shall be reduced in size from engineering plans in order to fit on 11” x 17” sheets. All device addresses shall be clearly labeled on plans. Indicate locations of all cabinets, modules and end of line device. Plans shall be bound in book form. Sheets shall be laminated. Provide legend for symbols. Provide holder for plan book in panel or in a locked box adjacent to panel keyed to match panel. Provide label for box and book.

## 3.17 FIRE AND LIFE SAFETY CRITERIA FOR DOORS CONTROLLED BY FIRE ALARM SYSTEM

A. Exit or exit access doors that are locked to delay egress, in accordance with the NC Building Code:

1. These doors shall immediately unlock upon any fire alarm signal, loss of building AC power, disablement of the fire alarm system (defined as loss of its 24vdc power), or upon manual operation of an unlock switch at a constantly attended location.
2. Where installed on smoke or fire doors, power failure shall cause these mechanisms to default to the egress mode with normal mechanical latching; this is to assure the smoke or fire doors continue to perform their vital function in a power failure situation, instead of swinging open and allowing the passage of smoke and fire between compartments.
3. Smoke doors are permitted to be held open by 24vdc wall/floor-mounted magnets powered by the FACP, and released upon alarm. The resulting current drain shall be included in the standby battery calculations or the system shall be programmed to drop the door hold-open magnet load 60 seconds after the loss of 120vac power

B. Rolling steel fire doors shall be released by their thermal link or closed by FACP command. These fire doors shall either:

1. Automatically reset when raised to their normal position, or have a motor down - motor up mechanism controlled by the FACP.

## 3.18 SYSTEM DOCUMENTATION, TRAINING AND MAINTENANCE

A. Maintenance: The manufacturer, or authorized distributor, shall maintain software version records on the system installed. The system software shall be upgraded free of any charge if a new VER is released during the warranty period. For new VER to correct operating problems, free upgrade shall apply during the entire life of the system.

B. System Report in addition to the Shop Drawing submittal described elsewhere, the fire alarm system contractor shall provide the Architect/Engineer two bound copies of the following technical information, for transmittal to the owner:

1. As-Built wiring diagram showing all loop numbers and device addresses, plus terminal numbers where they connect to control equipment.
2. As-built wiring and conduit layout diagrams, including wire color code and/or label numbers, and showing all interconnections in the system.
3. Electronic circuit diagrams of all control panels, modules, annunciators, communications panels, etc.
4. Manufacturer's detailed maintenance requirement.
5. Technical literature on all control equipment, isolation modules, power supplies, batteries, detectors, manual stations, alarm/supervisory signal initiating devices, alarm notification appliances, relays, remote alarm transmission means, etc.
6. The as-built "calculations" sheet.

C. Electronic archive: Complete configuration data (site-specific programming) for the system shall be stored on electronic media and archived by the fire alarm system manufacturer or authorized distributor. A diskette or CD copy of this data shall be submitted to the Architect/Engineer for transmission to the Owner on the day the system is commissioned. The contractor shall provide the Owner with one copy of the following:

1. All software required, both for the installed fire alarm system and personal computer (PC) necessary to access the fire alarm system for trouble shooting, programming, modifications, monitoring, de-bugging, or similar functions, (if Owner does not have the needed PC to check the system).
2. Complete documentation for all software for both the installed fire alarm system and for any interface PC software necessary for system functions as described above.
3. Framed floor plans, mounted at the FACP. Plans shall show all system devices with the unique device identification numbers indicated adjacent to each device. The identification numbers shall match those represented in the as-built drawings and those reported at the FACP and the LCD annunciator.
4. Interconnection cable where such is required to connect the fire alarm system to a PC; (if Owner does not have the needed PC to check the system).

D. Training; the manufacturer's authorized representative must instruct the Owner's designated employees in operation of the system, and in all required periodic maintenance. A minimum of 8 hours on-site time must be allocated for this purpose and, for those facilities operating on a 24-hour basis (prisons, hospitals, etc.) one additional hour of instruction must be individually provided for the 2nd and 3rd shift. Two copies of a written, bound summary must be provided, for future reference.

1. Scheduling of training shall be arranged to meet the Owner's schedule. Additional training shall be available at a cost to be mutually agreed upon by the Owner and the Contractor.
2. Training must be in the Owner's provided classroom.
3. The training may not be waived, deleted or reduced in the number of hours required.
4. Training must cover as minimum the following topics:
   a. Preventive maintenance service techniques and schedules, including historical data trending of alarm and trouble records.
   b. Overall system concepts, capabilities, and functions. Training must be in depth, so that the owner must be able to take any device out of service and return any device to service without need of Manufacture's approval or assistance.
   c. Explanation of all control functions, including training to program and operate the system software.
   d. Methods and means of troubleshooting and replacement of all field wiring devices.
   e. Methods and procedures for troubleshooting the main fire alarm control panel, including field peripheral devices as to programming, bussing systems, internal panel and unit wiring, circuitry and interconnections.
   f. Manuals, drawings, and technical documentation. Actual system software used for training must be provided in digital form and must be left with the Owner at the completion of training for the Owner's use in the future.
   g. The Owner must be trained to perform all NFPA 72 required maintenance. The training must include both demonstration and supervision of a "hands-on" replacement of heads. Panel modifications required to take detector heads out of service and return them to service must be "hands-on" training session. The training must be in a minimum of two 4-hour sessions provided on separate days. The schedule must be coordinated with the Owner. A written competency test must be submitted to the Architect/Engineer and to the Owner as a sample prior to using the written competency test at the site. A written description of a hands-on test must be provided to the Architect/Engineer and Owner for review prior to using the test at the site. As a minimum the following tests must occur during certification of the Owner's employee:
      1) Three smoke heads must be taken offline at the panel and removed physically.
      2) Three smoke heads must be reinstalled and returned to service at the fire alarm panel.
      3) The vendor must provide three dirty smoke detector heads to be installed at various positions in the building. The Owner must print a sensitivity report and the employees must find the "dirty" smoke detector heads by reviewing the sensitivity report.
      4) A ground fault and an isolation problem must be introduced by the vendor into the system. The employees must then find the ground fault and the isolation problem.
      5) An NFPA 72 "Record of Completion" form must be provided and the employees must fill out the forms which must be checked by the vendor for proper use of the form.

6) The written testing for how to perform services on a panel must be given during the last 4 hour session with the employees.
7) The vendors must witness the Owner's "trained" employees, train other employees and correct any mistakes made during the training session. This is expected to occur during the 2nd four hour session.

## 3.19 SPARE PARTS

A. The following spare parts must be provided with the system. For multi-building projects, calculate quantities separately for each building that contains a dedicated fire alarm control panel. If FACP also serves auxiliary buildings (e.g., storage, boiler/chiller), calculate as if one building. Increase decimal quantities to the next higher whole number:

1. Fuses (if used) ..... 2 of each size in system
2. Manual Fire Alarm Boxes..... 2% of installed quantity
3. Addressable Control Relays..... 4% of installed quantity
4. Indoor Horns/Speakers with Strobes Lights..... 4% of installed quantity
5. Indoor Strobe-only Notification Appliances..... 4% of installed quantity
6. Monitor Modules (Addressable Interface) ..... 4% of installed quantity
7. Isolation Modules / Isolation Bases.....4% of installed quantity
8. Addressable, Electronic Heat Detectors..... 4% of installed quantity
9. Spot-Type Smoke Detectors / Sounder Bases……. 6% of installed quantity
10. No spares are required for projected beam, air sampling, or duct smoke detectors, except provide spare filters for aspiration detectors, 2 percent of each type installed, but no less than ten (10).

## 3.20 SYSTEM TESTING AND CERTIFICATION

A. Upon completion of the installation the Contractor and the Manufacturer's authorized installer together shall conduct a 100% performance test of each and every alarm initiating device for proper response. The system shall operate for 48 hours prior to start of test. The Contractor shall be present for the full 100% test.

B. The A/E and Owner must be given 7 days advance notice of the tests. All Audio Visual Device Testing must be scheduled with the owner.

C. 100% Test: The manufacturer or authorized distributor (by definition, "installer") shall 100% test all site-specific software functions for the system and then provide a detailed report or check list showing the system's operational matrix. This documentation shall be part of the "System Status and Programming Report".

1. Upon completion of the installation and its programming, the installer's technician shall test every alarm initiating device for proper response and indication, and all alarm notification appliances for effectiveness. Also, in coordination with the other building system contractors, all other system functions shall be verified, including (where applicable) elevator capture and the control of HVAC systems, door locks, pressurization fans, fire or smoke doors/dampers/shutters, etc. The

Architect/Engineer shall be notified in advance of these 100% tests, to permit witnessing them if desired.

2. If AHU shutdown occurs for any alarm, then the matrix shall indicate the specific control relay(s) for that function being commanded to operate for alarm from any initiating device. If a rolling steel fire door is to drop only upon water-flow alarm from its sprinkler zone, or upon any two spot smoke detectors in adjacent spaces being simultaneously in alarm, the matrix shall show the door's control relay activating upon alarm from the applicable water-flow switch(es), or from any two smoke detectors in the selected spaces (AND gate)
3. The Digital communicator shall be on-line tested for proper communication to the receiving station.
4. All supervised circuits shall also be tested to verify proper supervision. Control circuits and remote annunciation lines are among those required to be supervised.
5. All testing described above shall be repeated in the event that subsequent software or wiring modifications are determined necessary to meet the requirements of the contract documents. Such re-testing shall be included as part of the base bid and provided at no additional cost to the Owner.
6. Test Documentation: The installer shall fill out and submit the following documentation to the Owner, through the Architect/Engineer, prior to the AHJ's system acceptance inspection:
    a. Written verification that this 100% system test was done with copy of print out generated during test.
    b. The NFPA 72, "Record of Completion" Form. Use this form (no substitutes) to detail the system installation and also to certify that: (a.) It was done per Code, and (b.) The Code-required 100% test was performed. The fire alarm installer (manufacturer or authorized distributor's technician) shall sign this form. If a representative of the AHJ, Owner, or Architect/Engineer witnesses the tests, in whole or in part, they shall also sign the form to signify that fact only (annotating the form as needed to clarify their limited role).
    c. For buildings with a smoke control or smoke purge system, an HVAC balance report, in the smoke control / smoke purge mode.
    d. The System Status and Programming Report described in NFPA 72. This shall be generated on the day of the system acceptance inspection and shall include the measured sensitivity of each smoke detector.
7. After completion of the 100% system test and submission of documentation as described above, the installer shall request the Architect/Engineer set up an inspection. The system shall operate for at least two days prior to this inspection. The responding Fire Department shall be notified of this, for pre-fire planning purposes.

## 3.21 PRE-FINAL AND FINAL INSPECTION

A. Pre-Final Inspection: At the Owner’s request and after passing the Architect/Engineer’s pre-final inspection, the Contractor and Manufacturer’s authorized installer must conduct a system test in the presence of the Owner and the Architect/Engineer.

B. Final Inspection: The fire alarm system must be inspected, with portions of it functionally tested. This must normally include the use of appropriate means to simulate smoke for testing detectors, as well as functionally testing the system interface with building

controls, fire extinguishing systems and any off-premises supervising station. Operation of any smoke removal system must be checked as instructed by the AHJ. This statistical (sampling) inspection is intended to assure that the contractor has properly installed the system and performed the 100% operational test as required by NFPA 72. The electrical contractor must provide two-way radios, ladders, and any other materials needed for testing the system, including a suitable smoke source.

C. The person that programmed the system must be present for the Architect/Engineer's final inspection.

D. Smoke control and smoke management systems must be tested by measuring air flow rates and pressure differentials, plus observing any effect the system has on the operation of exit, elevator, and stairway doors. Testing with smoke is not acceptable.

E. The test must be conducted entirely by the Contractor. A copy of the final database software must be presented to the Owner before this test. The software must be loaded from these disks into the system in the presence of the Owner. The review must then be conducted using this software. Any deficiencies must be recorded and corrected. After the items have been corrected, the system must be tested again.

1. In the event of malfunctions or excessive nuisance alarms, the Contractor must take prompt corrective action. The Owner may require a repeat of the Contractor's 100% system test, or other inspections.
2. Test Report: Upon successful completion of the Inspection and after the correction of all efficiencies, the manufacturer's authorized representative must issue a test report to the Architect/Engineer and Owner, detailing and certifying the test.
3. System Acceptance: After successful completion of the Final Inspection and recommendation of the Architect/Engineer, the system must be accepted by the Owner. At this time the warranty period begins.

**END OF SECTION**

# Technical Specification 001

# DEFINITIONS AND TERMS

## 1.0 General

a) The intent of this specification is to explain and define certain terms and phrases that appear in the Brunswick County *Engineering Design Manual, Technical Specifications, and Standard Details for Water and Sewer Systems* (hereinafter "Design Manual").

b) For a Brunswick County Capital Improvement Program (CIP) project, Article 1 of the *Brunswick County General Conditions of the Contract* (hereinafter "General Conditions") shall be the official definition of terms. This technical specification is intended to be a guide to language in the Design Manual and therefore complimentary to Article 1 of the General Conditions, and in the case of any conflict between this specification and Article 1 of the General Conditions, this specification shall be subordinate to Article 1 of the General Conditions.

## 2.0 Interpretation of Certain Terms and Words

a) Except as specifically defined herein all words used in these Technical Specifications have their customary dictionary definitions. For the purposes of these Technical Specifications certain words or terms used herein are hereby defined as follows:

b) Words used in the present tense include the future tense. Words used in the singular include the plural and words used in the plural include the singular. Words used in the masculine include the feminine also.

c) The word "shall" is always mandatory

d) The word "may" is permissive

e) The word "lot" includes the word "plat" or "parcel"

f) The word "person" includes a firm, association, organization, partnership, trust company, limited liability company, or corporation as well as an individual.

## 3.0 Definitions

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| AASHTO: | American Association of State Highway and Transportation Officials. |
| AHJ: | Authority Having Jurisdiction. |
| ANSI: | The latest edition of Standards published by the |

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| | American National Standards Institute. |
| ASTM: | The latest edition of Standards published by the |
| | American Society of Testing and Materials. |
| AWWA: | American Water Works Association. |
| Cleanout: | An access point for a gravity sewer service lateral to be used for inspection and maintenance purposes by County staff or licensed plumbers. |
| Clearing & Grubbing: | The removal and disposal of all trees, root mat, roots, logs, shrubs, grass, weeds, fallen timber and any other litter or surface debris such as, but not limited to, fences, steps, walls, chimneys, column footings, other footings, foundation slabs, basements, other foundation components, sign, junked vehicles, and other rubble and debris, which occur within areas designated as Easements, Limits of Disturbance, or clearing limits, as shows on the Contract Drawings. The more expansive limits shown on the drawings shall define the area to be cleared and grubbed unless otherwise note as an undisturbed area. All areas cleared and grubbed shall be left in a condition to meet the requirements of Brunswick County Technical Specification TS 025: Landscaping. The word clearing shall be interchangeable with clearing and grubbing. |
| Contractor: | A person or business entity legally licensed by the State of North Carolina Licensing Board for General Contractors; to perform installation, repairs, and connections to County water and sewer systems. The license holder must also have the Underground Utilities designation in addition to a General Contractor license. |
| County: | Brunswick County. |
| Customer: | Any person, firm, association, business, or governmental agency that receives water and / or sewer service from Brunswick County Public Utilities. |
| Density: | The number of habitable structures per acre, or number of bedrooms per development, used to calculate water and waste water flow rates. |
| Design Manual: | This ***Brunswick County Engineering Design*** |

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| | *Manual, Technical Specifications, and Standard Details for Water and Sewer Systems*. |
| Developer: | Any person, firm, corporation, or other legal entity improving property for commercial, industrial, or residential purposes. |
| Drawings: | All plans, profiles, maps, or other drawings that show the location, character, dimensions, and details of the work produced by an Engineer. |
| Design Work: | Work produced by a Professional Engineer for a developer or the County related to the installation of water, sewer, or stormwater infrastructure. |
| DWQ: | Division of Water Quality (a division of NCDEQ). |
| Easement: | Legal rights conveyed by a Grantor to a Grantee to any person, firm, corporation or public entity for the use of a strip or parcel of land for a specified purpose; fee simple land ownership rights do not convey with an easement. |
| EJCDC: | Engineers Joint Contract Documents Committee. |
| Engineer: | A person registered as a Professional Engineer by the North Carolina Board of Registration for Engineers and Land Surveyors (the Board) in one of the approved fields of licensure by the Board and qualified to design and permit water transmission and distribution, sewer collection, pump stations, water treatment, wastewater treatment, stormwater, streets, curb and guttering, or other required design elements and procedures. |
| FDC: | Fire Department Connection; a device on the size of a building, or possibly some distance remote from the building, that is connected to the sprinkler system for the purposes of allowing the Fire Department to boost the sprinkler system pressure via external means – usually by use of a fire department pumper truck. |
| Feet of Head: | A unit of pressure measurement; a column of water 2.31 feet tall = 1.0 PSIG. |
| Governing Authority: | The Board of Commissioners of Brunswick County, North Carolina. |

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| Lot**:** | A piece, parcel, tract, or plat of land intended as a unit for the transfer of ownership for development. |
| NCDEQ: | North Carolina Department of Environmental Quality. |
| NCDOT: | North Carolina Department of Transportation. |
| NEC**:** | National Electrical Code – NFPA 70. |
| NEMA: | National Electrical Manufacturers Association. |
| NFPA 110: | National Fire Protection Association; Standard for Emergency and Standby Power Systems. |
| NSF: | National Sanitation Foundation. |
| Owner: | Brunswick County, or County. |
| Planning Commission: | The Brunswick County Planning Board. |
| Plat: | A map or drawing upon which a plan of subdivision or development is presented for review and approval. |
| PSIG: | Pounds per Square Inch, Gage – a unit of pressure measurement. |
| Public Right-of- Way (or ROW): | Public rights-of-way are considered to mean public street rights-of-way or any other public right-of-way. |
| Public Utility Easement, or (PUE): | Permanent easements and associated rights in the name of the County as the Guarantee and that are a matter of public record by virtue of being recorded at the County Register of Deeds office; usually obtained for the installation and maintenance of water mains, sewer mains, water and/or sewer pump stations, water storage tanks, etc. |
| Pump Station: | A structure or pumping facility used to facilitate the transmission of water or wastewater through the use of pumps and a transmission and/or distribution system. |
| Private Easement: | Easement rights negotiated between two private parties; the County is not a party to a Private Easement. |

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| PWSS**:** | Public Water Supply Systems (a division of NCDEQ). |
| SCADA: | Supervisory Control and Data Acquisition; a means of remotely monitoring water, sewer, and pump station infrastructure. |
| Service Box: | A water meter box or a low pressure sewer box on a customer's property. |
| Service Lateral: | The connection between a County water and/or sewer main and the service box on the customer's property. |
| Sewer Main: | Any pipe or conduit that is part of the County's sewer transmission and/or distribution system and is used to transport sewer flow from more than one user connection to a waste water treatment facility. |
| Shop Submittals: | Technical information submitted to the Engineer and / or the County for review and approval of materials to be used in the construction of water and sewer systems. |
| Standard Details: | The water, sewer, and pump station detail drawings prepared by the County Engineering and Public Utilities departments and are posted on the County website for use by the design community. |
| Subdivision: | The division of a tract of land into two or more lots for the purpose, whether immediate or future, of sale or development. This includes all division of land involving a new street or a change in the arrangement of streets and includes any re-subdivision of land. Subdivision shall also refer to uses of land not ordinarily considered a subdivision such as mobile home parks, multifamily parcels, townhouses, and planned unit developments. |
| Surveyor: | A person registered as a Land Surveyor by the North Carolina Board of Registration for Engineers and Land Surveyors and qualified to practice land surveying. |
| Temporary Construction Easement: | Temporary Construction Easements that are |

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| | obtained from a private or public landowner for temporary impacts due to utility infrastructure construction; TCEs are not recorded at the County Register of Deeds and the TCE dissolves at the end of the construction project. |
| User Connection: | The point of connection of a customer's plumbing to the County's service box. |
| Water Main: | Any pipe or conduit that is part of the County's water transmission and/or distribution system and is used to transport water flow to more than one user connection from a water treatment facility. |

# Technical Specification 002

# EXISTING UNDERGROUND UTILITY LINES AND STRUCTURES

## 1.0 General

a) Every landowner, developer, or contractor who contracts to perform excavation, demolition, or installation activities within a site or on a project located in Brunswick County is responsible to ascertain the location and type of all underground utility lines or structures that may be located within the limits of the project work area.

b) Some of these underground utilities or structures may have been designated on the plans, however, the exact location may vary and others may not be designated. The contractor is fully responsible for verification of the exact location of all underground utility lines or structures within the work limits, whether shown on the plans or not, and for providing necessary protection and/or repair if damaged.

c) For a Brunswick County Capital Improvement Program (CIP) project Article 21 of the *Brunswick County General Conditions of the Contract* is also a part of this specification and is fully incorporated herein. Where a conflict may exist between this technical specification and Article 21 of the General Conditions, this specification shall be subordinate to Article 21 of the General Condition of the Contract.

## 2.0 Underground Damage Prevention Act

a) The contractor is directed to comply fully with the applicable provisions of Senate Bill 168 "Underground Damage Prevention Act" as passed by the General Assembly of the State of North Carolina.

b) Listing of Utility Companies: The following utility companies may have facilities within the work limits and it is required that the contractor establish coordination and utilities location with each prior to initiating work. There may be others not mentioned here and it is the contractor's responsibility to ensure that the proper notification has been made to all utilities owners with infrastructure within the proposed project work area:

1) Brunswick County Public Utilities
250 Grey Water Road NE
Field Operations Center
Supply, North Carolina 28462
910.253.2860

2) ATMC
640 Whiteville Road NW
Post Office Box 3198
Shallotte, North Carolina 28459
910.755.1706

3) Brunswick EMC
Post Office Box 826
Shallotte, North Carolina 28459
910.754.4391
800.842.5871

4) Progress Energy Carolinas, Inc.
8645 Trade Street
Leland, North Carolina 28451
910.383.4042

5) Piedmont Natural Gas
Corporate Office
4720 Piedmont Row Drive
Charlotte, North Carolina 28210
704.364.3120
Natural Gas Emergencies: 800.752.7504 or 911

6) The contractor shall call the North Carolina One Call Center at:

811 or 1-800-632-4949
**www.nc811.org**

for locates on underground utilities.

## 3.0 Existing Underground Utility line or Structure Location and Marking by Owners

a) The contractor shall make a documented request to the North Carolina One Call Center, and/or individual utility owners, in order to locate their facilities within the project work limits at least 48 hours in advance of the day excavation or demolition work is scheduled to begin. Location assistance requested from the owner should include the actual horizontal location, type number, size and depth of all lines. Some, but not all, cooperative actions the contractor should take either on or off the job site are as follows:

b) The contractor shall ascertain if the utility owner desires to have his representative present during the work.

c) The contractor shall comply with all standard regulations and take all precautions required by the owner of the facility.

d) All costs associated with locating and marking existing utilities or the utilities representatives shall be the responsibility of the contractor.

e) The contractor shall inform all equipment operators, either those employed by him or those employed by his subcontractors, of information obtained from the utility owners prior to initiation of work.

f) The contractor shall immediately notify utility owner of any leaks or breaks, dents, gouges, grooves or other damages to such line coating or cathodic protection created or discovered by him in the course of the work.

g) The contractor must immediately alert the occupants of the adjacent premises of any emergencies that he may create or discover at the work site.

## 4.0 Location and Protection of Utility Lines

a) The location of all utilities shall be made with locating equipment well in advance of actual work. The located facility shall be plainly marked by coded paint designations on the paved areas or by coded stakes or flags along the unpaved areas. All marked locations are to be made at least 500 feet in advance of all trench excavation and the location and utility protection provided by the contractor must be to the satisfaction of the engineer and the County. Furthermore, the contractor shall uncover any utility and obtain the utility elevation as required by the engineer. All damages to existing utility facilities in the work area during trenching and installation of facilities for this contract are the responsibility of the contractor and he shall repair or replace damaged lines to the satisfaction of the utility owner.

## 5.0 Protection of Existing Utilities and Facilities

a) In the conduct of his operations, the contractor shall take special precautions to protect equipment, structures, utility lines, roadways, subsurfaces, submerged, and overhead facilities against damage. In the event the facilities are disturbed, damaged, or injured as a result of the contractor's operation then the contractor shall immediately notify the utility owner and the County, and in conjunction with the owner determine the proper method of replacing, repairing, or restoring the affected facilities to the conditions which existed prior to the contractor's operations.

b) The contractor shall, at his own expense, replace, repair or restore the affected facilities or areas to their original condition or shall reimburse the owner of said facilities for such expenses as the said owner may accrue in performing the work.

## 6.0 Connections to Existing Facilities

a) Connections to existing facilities which are in service shall be thoroughly planned in advance, and all required equipment, materials and labor required for a successful connection shall be on hand at the time of undertaking the connections. Work shall proceed continuously (around the clock) if necessary to complete connections in the minimum time. Operation of valves or other appurtenances on existing utilities, when required, shall be by or under the direct supervision of the owning utility.

b) Brunswick County Engineering and Utilities Departments do not allow tapping operations to existing mains on Fridays or on the day before a scheduled County holiday.

c) A County Engineering and /or Public Utilities department inspector must be present during all wet tap operations on existing mains, and the contractor shall retrieve the coupon removed from the main and deliver same to County staff for verification of successful coupon removal.

d) The contractor shall comply with all NCDOT requirements for work within public rights- of-way during normal working hours and also in advance of weekends and holidays.

# Technical Specification 003

# FIELD ENGINEERING

## 1.0 General

a) The intent of this specification is to briefly describe the responsibilities of the Engineer and the utility contractor with regards to field engineering for a water and / or sewer project permitted in the County's name as public infrastructure.

b) For a Brunswick County Capital Improvement Program (CIP) project Article 11 of the *Brunswick County General Conditions of the Contract* is also a part of this specification and is fully incorporated herein. Where a conflict may exist between this technical specification and Article 11 of the General Conditions, this specification shall be subordinate to Article 11 of the General Condition of the Contract.

## 2.0 Construction Layout

a) It shall be the Engineer's responsibility to:

1) Perform all required field surveying and engineering in order to produce accurate plans for the project.

2) For projects that involve public sewer, the engineer shall field locate all wells within the construction project limits and within the radius of any wellhead protection zone required by the North Carolina Department of Environmental Quality / Public Water Supply Section, and to show the location of these wells and wellhead protection radii on the engineered drawings submitted to Brunswick County Engineering for plan review and approval. They shall also be shown on the asbuilt drawings.

3) Establish all required horizontal and vertical control required for the project work area for the contractor by utilizing permanent and temporary benchmarks and showing these benchmarks on the engineered plans.

b) It shall be the utility contractor's responsibility to:

1) Utilize the provided bench marks for vertical and horizontal control as indicated on the plans. It shall be the responsibility of the utility contractor to perform all of the field horizontal and vertical control of the facilities, and to maintain or replace these points and to provide such supplemental and additional finished lines, offsets, grades, and other measurements as may be required to ensure control and completion of the work, including staking the work limits of any utility easement and/or rights-of-way.

2) All permanent and temporary benchmarks used during construction layout shall be noted on the record drawings and asbuilt drawings.

## 3.0 Asbuilt Drawings

a) It shall be the utility contractor's responsibility to:

1) Maintain a marked up set of the construction drawings that accurately reflects all changes made to the work as approved by the Engineer and/or Brunswick County staff.

2) Provide the record drawings to the Engineer at the end of the project so that accurate asbuilt drawings can be produced by the Engineer.

b) It shall be the Engineer's responsibility to:

1) Provide asbuilt drawings to Brunswick County at the end of the project in accordance with:

a) The Brunswick County Construction Checklist, and

b) Brunswick County Technical Specification TS 010: *As-Built Drawings*.

# Technical Specification 007

# PROJECT SUBMITTALS

## 1.0 General

a) The intent of this specification is to provide guidance to the utility contractor on the project submittal process.

b) For Brunswick County Capital Improvement Program (CIP) projects, Article 10 of the Brunswick County *General Conditions of the Contract* provides guidance on the project submittal process, and the utility contractor shall comply with the General Conditions for the submittal process. Article 10 of the *General Conditions of the Contract* is fully incorporated herein by reference.

## 2.0 Submittals

a) Submittals are defined as shop drawings, diagrams, illustrations, schedules, performance charts, technical specification sheets, sewer pump curves, brochures, and other data prepared and submitted for review and approval by the utility contractor for the project.

## 3.0 Submittal Procedures

a) All submittals shall be delivered to the Engineer by the utility contractor. The Engineer will review the submittals and certify they meet or exceed County requirements. The number of required copies to be submitted will be determined by the Engineer with a minimum of three (3) – one set will be retained by the Engineer and the remaining two sets will be given back to the utility contractor and the County after review and approval by the Engineer.

## 4.0 Shop Drawings

a) Shop drawings shall show the principal dimensions, weight, structural and operating features, performance characteristics, wiring diagrams, space required, clearances, type and/or brand of finish or shop coat, grease fittings, etc., depending on the subject of the drawing. When it is customary to do so, or when the material dimensions are of particular importance or when so specified, the drawings shall be certified by the manufacturer or fabricator as correct.

b) When so specified or if considered by the Engineer to be acceptable, manufacturer's specifications, catalog data, descriptive matter, illustrations, etc., may be submitted for review in place of shop and working drawings. In such case, the requirements shall be as specified for shop and working drawings, insofar as possible.

c) The utility contractor shall be responsible for the prompt submission of all shop and working drawings in accordance with the project schedule to prevent delay to the commencement of work due to the absence of such drawings.

d) No material shall be purchased or fabricated until the required shop drawings and associated submittals have been submitted, reviewed, and approved by the Engineer.

## 5.0 Developer Installed Infrastructure

a) The developer's Engineer shall be responsible for ensuring the contractor utilizes materials that meet the County's technical specifications and standard details for water and sewer infrastructure that is permitted in the County's name.

b) County staff reserves the right to reject any material deemed unfit or not meeting County standards.

## 5.0 Certifications and Tests

a) Two copies of certifications and reports of tests, when required under the various sections of the Contract Documents, shall be submitted to the Engineer.

b) The utility contractor shall provide the originals of all bacteriological testing results for water mains to the County.

# Technical Specification 010

# AS-BUILT (RECORD) DRAWINGS

## 1.0 General

a) It is the intent of this specification to provide information to the design engineer and utility contractor concerning requirements for acceptable record drawings for all projects with infrastructure permitted in the county's name.

b) Accurate as built drawings are an important closeout component of a project and are required for:

- Signing water, sewer, and pump station state permit certifications
- Issuance of Substantial Completion and Final Acceptance
- Updating the county water and sewer GIS utility map

**Water and / or sewer certifications submitted by the design engineer of record will not be processed without approved as built record drawings that conform to this specification regardless of who prepares the record drawings.**

## 2.0 Record Drawings

a) The utility contractor is responsible for employing the design engineer and/or a surveyor licensed in the State of North Carolina to provide accurate record drawings upon completion of construction. The record drawings must be sealed, signed, and dated by the engineer or land surveyor.

b) The record drawings shall be provided to the county as: One set of paper drawings and a CD or USB drive containing both **georeferenced** AutoCAD (Version 2007 or later) and Adobe PDF format files. The PDF files must be of **each individual plan sheet of the record drawings**.

c) Record drawings shall conform to this as built technical specification and will also accurately identify the location of all properties, rights-of-way, and easements utilized for the installation of all installed facilities. Record drawings will utilize offsets and benchmarks as necessary to identify the location of all facilities correctly and accurately within the properties, rights-of-way, or easements, and will also indicate any and all encroachments which exist. All aboveground structures such as manholes, fire hydrants, valve boxes, meter boxes, electrical services, pump stations, air release valves, etc., will also be clearly identified.

d) Horizontal control shall be per the State Plane Coordinate System (NAD 83).

e) Vertical control shall be per NAVD 88.

**AS-BUILT (RECORD) DRAWING CHECK LIST**

Plan sheet size: 24" x 36" (Arch D) with engineer's seal and / or surveyor's seal as applicable

Each sheet of the record drawings, including the required Brunswick County Cover Sheet, shall have the NCDEQ PWSS water permit number and / or the NCDEQ DWQ sewer permit number for the project on the sheet.

Drawings shall be prepared at a scale of 1" = 50' (horizontal) and 1" = 5' (vertical)

Indexed Brunswick County Cover Sheet with: Location of plan-profile sheets by sheet number, name of project and/or subdivision, owner's name, address, phone number, engineer's name, address, phone number, surveyor's name, address, phone number, date, north arrow, scale, site map of project site shown as an inset (minimum size 3" x 3")

Total linear feet of mains shown on cover sheet as:

Water Mains _____ Force mains_____ Gravity sewer mains_____

Gravity sewer shall be shown in both plan and profile view with all manhole inverts accurately field located and labeled in profile view and a manhole name and/or number assigned to each manhole. Manhole rim and invert elevations shall be accurately located and shown. If applicable clearly indicate and label all five (5) foot diameter manholes. All sewer mains and manholes shall have stationing numbers for ease of reference.

Plans shall show individual services for gravity sewer cleanouts, water meter boxes, and low-pressure sewer services and shall be accurately located and shown on the plans as follows:

Gravity sewer cleanout – open circle
Water meter service – open box
Low pressure sewer – open oval

Clearly indicate all gravity sewer service laterals and indicate their size (4 inch or 6 inch)

Gravity sewer cleanouts shall be located by measuring from the nearest downstream manhole along the sewer main upstream to a point which lies on a line that is perpendicular to the sewer main and connects said point and the cleanout – for example, 150 / 15R (150' from downstream manhole and 15' over to the right side of main)

Water taps and meters larger than the standard one (1) inch lateral with (¾) inch meter shall be clearly identified with the size of the service lateral and water meter

Drawings shall indicate water and sewer phases and their relationship to other subdivision phases (if applicable)

Use complete and accurate material descriptions, for example, pipe material (PVC, DIP, HDPE, Fusible PVC, etc.), pipe diameter, DR # of pipe, pressure class of any DIP, length, slope (for gravity sewer), AWWA and / or NSF

Show station or distance to beginning and end of all changes in pipe material and pipe deflections

Show all existing and required vertical and horizontal separations between sewer mains and water mains and between water mains / sewer mains and stormwater pipes

Show existing grade elevations and proposed finish grade elevations

Show all water supply wells within a one hundred (100) foot radius of any gravity sewer main or pressure force main

If any vented manholes were used [eg, rims less than (2) feet above 100-year flood elevation] then show the vented manhole and vent and indicate a watertight ring and cover

Show location and size of all air release valves, gate valves, plug valves, butterfly valves, fire hydrants, post flushing hydrants, temporary blow offs, tees, crosses, cleanouts, etc., along all water mains and sewer force mains

Show lot numbers, lot lines, easement lines, rights-of-way lines, and street names

For horizontal directional drills and jack-and-bores the drilling logs are to be incorporated with the record drawings

# Technical Specification 011

# DEWATERING

## 1.0 General Dewatering Requirements for Utility Work

a) All ground water which may be found in the trenches and any water which may get into them from any cause whatsoever shall be pumped or bailed out so that the trench shall be dry during all pipe laying periods.

b) All water pumped from the trenches shall be disposed of in compliance with the applicable local regulations of the appropriate governing body, and in accordance with all issued permits for the project.

c) If dewatering operations cause a turbidity problem due to suspended sands or silts in the water it shall be the utility contractor's responsibility to utilize adequate methods to prevent unacceptable turbidity discharges, such as the use of a filtration sock or other methods.

d) Any damage to property, or notices of violation from NCDEQ, shall be the utility contractor's responsibility to correct to the satisfaction of the Engineer at no cost to Brunswick County. All fines imposed by NCDEQ shall be paid by the utility contractor.

e) The contractor shall be required to well point, pump, or provide other measures necessary to keep the trench dry during pipe laying operations.

f) The use of large amounts of crushed stone is not an approved dewatering method.

g) Dewatering operations shall be maintained until all backfilling and compaction is completed or as directed by the Engineer or County staff.

h) No water shall be permitted to reach any poured concrete until it has sufficiently hydrated to a minimum strength such that water will not affect the cured concrete strength.

i) The contractor shall provide and place all necessary flumes or other channels of adequate size to carry temporarily all streams, brooks, stormwater or other water which may flow along or across the lines of the pipe line. All flumes or channels thus utilized shall be tight so as to prevent leakage into the trenches.

# Technical Specification 012

# TRENCH BOXES, SHEETING, AND SHORING

## 1.0 Sheeting and Shoring

a) Trench boxes, sheeting, shoring, and bracing shall be utilized as needed by the utility contractor during the installation of utility infrastructure in order to protect human life, prevent accidents, maintain trench integrity during pipeline laying operations, prevent damage to buildings or other structures along the line of construction, and to ensure a quality installation.

b) The contractor is responsible for all aspects of using trench boxes, sheeting, and shoring during the project. Care must be taken not to damage in any way water mains, water service pipes, drain pipes, sanitary or stormwater sewers, sewer service pipes, gas mains, oil mains, electric conduits or other structures encountered on the line of the work during trench excavation.

c) Special conditions of an NCDOT Encroachment Permit may require the use of sheeting and shoring while working in the DOT rights-of-way. The Engineer is responsible for the design and approval of any sheeting and shoring required by NCDOT.

d) Only shoring authorized by the Engineer and approved by the Engineer shall be left in place. For shoring left in the public right-of-way the utility contractor must also obtain NCDOT approval.

e) Whenever timber or other sheeting is driven to a depth below the elevation of the top of the pipe, that portion of the sheeting below the elevation of the top of the pipe shall not be disturbed or removed. Whenever timber or other sheeting is driven for the protection of trench walls in water-bearing soil, no portion of such sheeting below a level of 4 feet over the top of the pipe shall be removed.

# Technical Specification 013

# EXCAVATING, GRADING, TRENCHING, & BACKFILLING

## 1.0 General

a) The utility contractor shall furnish all labor, equipment, and materials for all excavation, grading, trenching, and backfilling associated with the installation of water, sewer, pump stations, drainage structures, curb and gutter, streets, sidewalks, driveways, slopes, storm drainage, and other associated infrastructure within the limits of the project work area. All work done shall be in accordance with the approved plans and specifications.

## 2.0 Existing Conditions and Utility Locations

a) It is the utility contractor's responsibility to perform all site inspections to familiarize himself with the scope of work involved and the existing conditions at the project site.

b) The contractor is responsible for locating all existing underground utilities in the area of work. If utilities are to remain in place then the contractor shall provide adequate means of protection during earthwork, excavating, trenching, and backfilling operations.

c) Should unlocated, or incorrectly located, piping or other utilities be encountered during excavation the utility owner shall be notified immediately. The utility contractor shall cooperate with the County and other respective utility companies to protect and keep respective services and facilities in operation. The contractor shall also repair any damaged utilities to the satisfaction of the utility owner.

d) Barricade all open excavations occurring as part of this work and post with warning signs and /or lights. Continuously operate all warning lights as recommended by the Authority Having Jurisdiction (AHJ). The utility contractor shall also protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

## 3.0 Technical Standards

a) ASTM C33 ---- Standard specification for concrete aggregates
b) ASTM D2487 - Classification of soils for engineering purposes.

## 4.0 Soil Classifications

a) Use soils free of debris, roots, wood, scrap material, vegetation, refuse, soft unsound particles, organic matter, refuse, frozen materials, rocks and lumps greater than 4 inches in diameter and other deleterious matter.

b) For the purpose of this specification, soils to be used as fill material are grouped into five classes according to soil properties and characteristics:

Class I: Angular, 1/4 to 1-1/2 inch, graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, and crushed stone, crushed gravel, and crushed shells

Class II: Coarse sands and gravels with maximum practical size of 1-1/2 inch, including variously graded sands and gravels containing small percentages of fines, generally granular and non-cohesive, either wet or dry. Soil Types GW, GP, SW, and SP are included in this class.

Class III: Fine sand and clayey gravels, including fine sands, sand-clay mixtures, and gravel-clay mixtures. Soil Types GM, GC, SM, and SC are included in this class.

Class IV: Silt, silty clays, and clays, including inorganic clays and silts of medium to high plasticity and liquid limits. Soil Types MH, ML, CH, and CL are included in this class. **These materials are not recommended for bedding**, **haunching, or initial backfill.**

Class V: This class includes the organic soil, OL, OH, PT as well as soils containing frozen earth, debris, rocks, larger than 40 mm (1-1/2 in.) in diameter, and other foreign materials. **These materials are not recommended for bedding, haunching, or initial backfill.**

## 5.0 Trench Excavation, Pipe Bedding, Backfilling, and Compaction for Utility Systems

a) Trenching of utilities as a method of installation is not allowed in Brunswick County

b) Trench Excavation

1) Excavation shall be accomplished in accordance with the grades and lines as established by the Engineer or Surveyor and as required by the work to be performed. Excavation shall include the removal and replacement of all asphalt, concrete, curb, rock, earth, fences, trees (as applicable), shrubs, and other materials. The contractor will exercise care to prevent undercutting lower than the required subgrade. All materials from excavation, considered as suitable by this specification, shall be used as fill wherever required, and the contractor shall arrange his work so that this usage of excavated materials will be possible. Unsuitable and surplus materials from the excavation, if any, shall be disposed of by the contractor at his expense. All areas of the site shall be graded and maintained at all times to prevent surface runoff from draining into the excavations and to prevent ponding of water therein.

2) Excavated materials not required for topsoil, fill or backfill shall be removed from the site of the work by the contractor, but none shall be

deposited on private property without written consent of the property owner. For County capital improvement projects any agreements between the contractor and private property owners must be provided to the County also.

3) All excavations shall be in compliance with all current OSHA requirements and it is the utility contractor's responsibility to ensure that the project work is in compliance with all OSHA requirements.

4) All piping shall be installed at a minimum depth of 36 inches unless otherwise approved by Brunswick County. Installations shallower than 36 inches, if approved, will require the use of ductile iron pipe.

5) Trenches for piping shall be excavated true to line and grade as shown on the approved plans.

6) Trench widths at and below the top of the pipe shall be the minimum necessary for proper installation. Trench banks above the top of the pipe shall be as vertical as practicable. Overdepth excavation shall be backfilled with Class I material and compacted.

7) The utility contractor shall provide, at his expense and as directed by the Engineer, especially bedding material or concrete encasement as may be necessary due to over-width excavation.

8) Trench depth to the lines and grades shown on the drawings. Where elevations are not shown, trench to a depth sufficient to provide at least 36 inches of cover above the top of pipe, unless otherwise specified. Grade all trenches to provide a constant slope free of sags and high spots. Recesses shall be excavated where required to accommodate bells and joints.

9) Keep trenches free of water. Include cost of dewatering in unit price bid for pipe. No separate payment for dewatering will be made by the County.

10) Properly brace sheet and support trench walls as soil conditions require and in strict conformance with the approved plans, all pertinent laws, and OSHA regulations. Provide adequate bracing and shoring to protect adjacent improvements. Contractor shall provide certification for all premanufactured trench bracing devices prior to any excavation activities.

c) Pipe Bedding

1) Gravity Sewer Mains – Refer to Brunswick County gravity sewer pipe bedding Standard Detail:

<u>Class A bedding</u>: For gravity mains less than twenty (20) feet deep undercut trench bottom six (6) inches minimum below pipe and fill with size #57 stone up to and including the springline of the pipe.

Class B bedding: For gravity mains greater than twenty (20) feet deep undercut trench bottom six (6) inches minimum below pipe and fill with size #57 stone to six (6) inches above the pipe.

2) Pressure Mains, Water or Sewer- it is not necessary to bed pressure mains unless unusually wet or mucky field conditions are encountered. Pressure mains shall be installed in properly excavated trenches on the native soil of the trench. If wet or mucky field conditions are encountered then size #57 stone shall be used to provide a firm bedding but only at the direction of the Engineer or County staff.

3) Service Pipe – bedding is not required on water and sewer service laterals unless unusual conditions are encountered in the field. In these cases the Contractor shall bed the service pipe per direction from the Engineer or County staff.

d) Initial and Final backfilling

1) After properly installing the pipe and bedding, if required, trench backfill shall progress as rapidly as pipe laying will permit.

2) Backfill materials shall be of suitable material and be capable of being compacted to a minimum of ninety-eight (98) percent ASTM D698 (Standard Proctor) maximum density at optimum moisture content.

3) Initial and Final backfill shall be of the Type 1 or Type II material as follows:

a) Type 1 Material: Excavated material from the trench or materials from other sources which are free from large clods, roots or stones larger than 1 inch may be used as initial backfill in trenches (see Pipe Trench Detail).

b) Type 2 Material: Excavated material from the trench or materials from other sources which are free from large clods, roots or stones larger than 8 inches may be used as final backfill in trenches but shall not be used in the final twelve (12) inches of fill (see Pipe Trench Detail).

4) Backfill around the pipe by placing in layers no more than six (6) inches in depth. Backfill shall be compacted with light tamps for the full width of the trench to provide adequate support for the bottom and sides of the pipe. Backfill shall be carried up evenly on both sides of the trench excavation. Particular care is required in backfilling gravity sewer pipe to prevent excessive pipe deflection.

e) Compaction

1) When existing plans and grades require the use of fill to reach the required elevation, the contractor shall deposit suitable material from previously

excavated areas or use borrow material. Such material shall be free from debris, roots, trash, stones, or other harmful substances, and shall be spread in successive layers of loose material not more than six (6) inches in depth.

2) Each layer shall be spread uniformly by motor grader or other approved device and rolled with an approved tamping or three-wheeled power roller until thoroughly compacted to a minimum of ninety-eight (98) percent ASTM D698 (Standard Proctor) maximum density at optimum moisture content. Rolling with rubber tired vehicles or track type equipment will not be allowed.

## 6.0 Crushed Stone

a) Crushed stone shall be size # 57 washed stone only

## 7.0 Concrete

a) Concrete placed for cradles, thrust blocks, or encasement shall be 3,000 psi minimum strength at twenty-eight (28) days hydration.

## 8.0 Foundation

a) Foundation shall be required in wet, yielding and mucky locations. Foundation shall be constructed by removal of wet, yielding or mucky material and its replacement with sufficient Class I material to correct the instability. Foundation shall only be installed with the approval of the Engineer or Brunswick County staff. Undercutting and filling with stone will not be allowed or paid for in order to control water in the excavation trench.

## 9.0 Undercutting

a) Undercutting, unless authorized by the Engineer, shall be replaced and compacted at the contractor's expense. If the material, after excavation to subgrade, is found to be soft, spongy or unfit for use as subgrade, such unsuitable material shall be removed to a depth as directed by the Engineer and the subgrade shall be brought to proper elevation by filling with suitable material from the excavation or from an approved borrow site.

## 10.0 Borrow Material

a) The Contractor will supply all borrow material necessary and will provide all labor and equipment necessary to dig and haul such borrow material. Any and all borrow material utilized shall be of suitable quality and meet the requirements of this technical specification.

## 11.0 Excess Water Control

a) Grade and maintain all areas of the site to preclude surface runoff into excavations and prevent any water accumulation in the excavation.

b) Excavations should be kept free of surface water and/or groundwater. Provide and maintain at all times the necessary means and devices to prevent water from entering the excavations and for removing all water entering the excavations during pipe laying operations. Dewatering shall continue until structure is backfilled and compacted.

c) Include cost of dewatering in the unit cost for pipe. Separate payment will not be made for dewatering operations by Brunswick County.

## 12.0 Contaminated Soils – Excavation, Removal, and Remediation

a) In the event that contaminated soils are suspected or encountered the contractor shall stop digging in the suspect area and immediately notify both the Engineer and Brunswick County staff.

b) It shall be the utility contractor's responsibility to hire a soils testing firm to examine the suspect area for type and density of contamination. Should testing confirm the presence of contaminated soils, the following steps shall be taken:

1) Excavate contaminated material in a manner consistent with all jurisdictional regulations.

2) Immediately remove contaminated material from the site. Contaminated materials may not be stockpiled for any amount of time.

3) Material is to be disposed of at a permitted facility. Tickets must be produced to the Engineer and County staff accounting for every cubic yard of material removed.

4) Per direction of the Engineer and / or Brunswick County, the pipe material shall be changed to pressure class 350 DIP with Nitrile gaskets.

5) The trench is to be bedded and backfilled with select fill per Brunswick County specifications herein.

## 13.0 Field Quality Control

a) Field inspection, sampling and testing will be performed as required at either the direction of the Engineer or Brunswick County

b) If required, an independent soils engineering and testing laboratory shall perform sufficient tests and inspection procedures, to the satisfaction of the Engineer and the County, both in the field and lab to ensure that the provisions of this specification are met. The testing shall be paid by the utility contractor. The testing lab shall be approved by the Engineer and / or Brunswick County.

# Technical Specification 015

# DIRECTIONAL DRILLING

## 1.0 General

a) The intent of this specification is to provide general technical guidance to the utility contractor for the installation of pipelines using horizontal directional drilling (HDD) techniques.

b) The utility contractor shall furnish all labor, materials, equipment, and incidentals required to successfully perform the installation of water, wastewater, and reclaimed water mains at locations shown on the plans by using horizontal directional drilling (HDD) methods.

c) The pipeline shall be complete with all accessories and shall have passed all required testing per the contract documents and other county requirements.

d) The utility contractor shall have made all inspections of the area(s) within the vicinity of the project and the immediate area of the work and become thoroughly familiar with the natural and manmade features encompassed about the project.

## 2.0 Quality Assurance

a) Requirements

1) At the discretion of Brunswick County, it may be required that the utility contractor be prequalified and approved through a prequalification process. The utility contractor must furnish references able to attest to his capabilities in accordance with the prequalification process.

2) The utility contractor shall comply with North Carolina OSHA Standards, Underwriter Laboratories standards, and other requirements of the Authority Having Jurisdiction (AHJ).

b) Reference Standards

1) Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified:

a) ASTM D-1248 and D-3350
b) AWWA C901 or C906
c) NSF 61
d) ASTM D2683 or D3261

## 3.0 Required Submittals

The utility contractor shall submit the following items to the Engineer for review and approval:

a) Pipe material shop drawings

b) Manufacturer's Installation Manual

c) Certificates: Submit certificates of compliance with referenced standards where requested by the engineer

d) Field installation drawings indicating layout and depth of directionally drilled pipe.

e) Record Drawings: During progress of the work, keep an up to date set of drawings showing field and shop drawing modifications including the drilling logs. The drawings shall show all piping on plans and in sections, with all reference dimensions and elevations required for complete record drawings of the directionally drilled pipe including the drilling logs to be included on the record drawings.

f) Erosion control plan for the drilling mud pit work area

g) Frack out containment plan for the drilling area

h) Written verification of required pressure testing per county specifications

i) Work Plan: Prior to beginning work, the Contractor shall submit to the Engineer a work plan detailing the procedure and schedule to be used to execute the project. The work plan should include a description of all equipment to be used, down-hole tools, a list of personnel and their qualifications and experience (including back-up personnel in the event that an individual is unavailable), list of subcontractors, a schedule of work activity, a safety plan (including MSDS of any potentially hazardous substances to be used), traffic control plan (if applicable), an environmental protection plan and contingency plans for possible problems. Work plan should be comprehensive, realistic, and based on actual working conditions for this particular project. Plan should document the thoughtful planning required to successfully complete the project.

j) Equipment: the utility contractor shall submit specifications on directional drilling equipment to be used to ensure that the equipment will be adequate to complete the project. Equipment shall include but not be limited to: drilling rig, mud system, mud motors (if applicable), down-hole tools, guidance system, and rig safety systems. Calibration records for guidance equipment shall be included. Specifications for any drilling fluid additives that the utility contractor intends to use or might use will be submitted. Specifications on material to be used shall be submitted to engineer. Material shall include the pipe, fittings, and any other item which is to be an installed component of the project.

k) Guidance System: A Magnetic Guidance System (MGS) probe or proven gyroscopic probe and interface shall be used to provide a continuous and accurate determination of the location of the drill head during the drilling operation. The guidance shall be capable of tracking at all depths up to fifty (50) feet and in any soil condition, including hard rock. It shall enable the driller to guide the drill head by providing immediate information on the tool face, azimuth (horizontal direction) and inclination (vertical direction). The guidance system shall be accurate up to +/- 2% of the vertical depth and accurate to within two and one-half (2 ½) feet horizontally from the horizontal alignment shown on the drawings.

## 4.0 Materials

a) HDPE: Material shall be high-density polyethylene, extra high molecular-weight, PE3408 pressure rated 200 psi, minimum DR- 9, as manufactured by Plexco or equal.

b) Fusible PVC: Material shall be fusible C-900 or C-905 polyvinyl chloride (PVC), minimum DR-18, rated 150 psi (C900) or 235 psi (C905), as manufactured by Underground Solutions, Inc., or approved equal.

c) Pipe shall be heat fusion welded per the manufacturer's instructions.

d) Mechanical fittings shall be authorized by the manufacturer for use on HDPE and Fusible PVC and approved by the engineer.

## 5.0 Testing and Payment

a) Pipe shall be pressure tested after installation per Brunswick County Technical Specifications and Standard Details for either water distribution or sewer force main piping systems. If a pipe relaxation period is required, the minimum relaxation period shall be forty-eight (48) hours or the manufacturer's recommended relaxation period. After the pipe relaxation period the pipe may have its initial pressure test. If the initial pressure test is successful, the pipe shall also be connected to the water or sewer system to be tested again as part of the overall system pressure test. All connections shall be per county standard detail.

b) County staff, in addition to the engineer, shall be available during the testing for observation and documentation of the pressure test.

c) All unsuccessful pressure testing will be cause for correction by the utility contractor at no additional cost to Brunswick County.

d) All trenchless installations shall pass the initial hydrostatic pressure test per specifications and standard details prior to any payment to any contractor.

## 6.0 Storage and Handling

a) Handle all pipe and accessories carefully with approved handling devices. Do not

drop or roll pipe off trucks. Do not otherwise drop, roll or skid pipe. Materials cracked, gouged, chipped, dented or otherwise damaged will not be approved or accepted for use on county systems.

b) Pipe and appurtenances shall be unloaded opposite to or as close to the place where they are to be laid as is practical to avoid unnecessary handling. Interiors shall be kept completely free from dirt and foreign matter.

c) The utility contractor shall be responsible for the proper support of the piping to ensure that the pipe is not over stressed or damaged in any manner.

## 7.0 Installation

a) General

1) The work shall be performed by the Horizontal Directional Drill (HDD) Technique. Specific details of installation techniques are the responsibility of the utility contractor and must fully comply with the pipe manufacturer's installation recommendations. The county will not direct "means and methods" to the contractor to be used in installation of the directional drill pipe other than that pipe must be installed in accordance with the manufacturer specifications. In general, the work will proceed as follows:

a) Drill a pilot hole from one side of the crossing to the other. The pilot hole follows the design centerline of the pipe with the path recorded and controlled using a specially designed instrument package situated behind the drill bit.

b) A washover pipe is rotated over the pilot drill string behind the pilot drill bit and exits with the drill bit on the other side of the crossing.

c) The drill bit and drill string is withdrawn back through the washover pipe, leaving the washover pipe in place.

d) A series of tools are connected between the end of the washover pipe and the wastewater main and/or water main. The drilled hole is widened to its final diameter with the appropriate tool, head or cutter. Smooth the wall of the bore and direct bentonite to aid in the boring operation. A swivel is installed between the tool, head or cutter and the wastewater main and/or water main to ensure that no torque is transmitted to the pipe main.

e) After the tools are connected between the washover pipe and wastewater force main and/or water main, the drill rig will rotate and pull the washover pipe along the drilled path, with the pipe following slowly behind.

f) After the pipe is in place, and after the pipe relaxation period, if required, it shall be pressure tested per county specifications with a county representative present.

g) A twelve (12) gauge, steel reinforced, insulated copper locator wire shall run continuously with and shall be securely fastened to the water main or forcemain. Refer to county technical specifications for water mains and force mains, and county standard details for more information on the required locator wire.

b) Drill Path Geometry

1) The utility contractor is responsible for horizontal and vertical alignment of the pilot drill and final installed pipe. The pilot drill should conform to the pipeline alignment as shown on the contract drawings. The utility contractor shall submit all proposed changes to the vertical alignment shown on the drawings to the Engineer for approval prior to commencing work. Under no circumstances shall installed pipe be at a higher elevation than that shown on the drawings or vary by more than (2 ½) feet from the horizontal alignment shown on the drawings.

2) The accuracy of the drill exit point shall be within a (2 ½) foot horizontal radius of the design exit point.

3) Entry and exit points shall be located as shown on the contract drawings.

4) The utility contractor shall map to scale the location of each pilot drill string joint to a minimum horizontal and vertical scale of 1 inch equals 20 feet. The map shall be furnished to the Engineer.

5) Should the utility contractor exceed the limits described above, a new pilot drill shall be performed at the expense of the utility contractor and at no cost to the county. The utility contractor may elect to alter the horizontal geometry of the drilling subject to right-of-way restraints. However, payment limits are based upon stations given in the bid form, and payment for directional drilling will be limited to the prices bid therein.

6) If requested by the Engineer and / or County, the utility contractor shall provide a full explanation of details regarding any technical means, methods or equipment necessary to accomplish the work described herein.

c) Job Conditions

1) Existing Utilities: The contractor shall be responsible to field locate existing underground utilities in the areas of work.

a) Should uncharted or incorrectly charted piping or utilities be encountered during the work, consult piping or utility owner and engineer immediately for instructions. Cooperate with owner and

utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.

b) Do not interrupt existing utilities serving facilities occupied and used by owner or others, except when permitted in writing by the engineer and then only after acceptable temporary utility services have been provided.

c) Coordinate with utility companies for shut-off of services, if required.

2) Do not bring explosives onto site or use in the work. Use of explosive materials is specifically prohibited.

3) The utility contractor shall conduct all of his operations and maintain the area of his activities, including sweeping and sprinkling of roadways, so as to minimize the creation and dispersion of dust.

d) Installation Specialist

1) The utility contractor shall provide the full-time services of a competent installation specialist during the directional drilling to assist in technical matters relating to the work. He shall advise the utility contractor on matters to include, but are not limited to, drilling, pipe support, mapping of the pipe location, quality assurance of the work, safety or other items as necessary. Installation specialist may be the contractor's superintendent.

e) Completion of Work

1) Interior of all pipe and fittings shall be inspected and all dirt, gravel, sand, debris, or other foreign material shall be completely removed from pipe interior. A bulkhead shall be attached to the end of the pipe prior to attaching the swivel and barrel reamer to ensure inside of pipe remains clear during pullback operation.

2) Install all pipes accurately to line and grade shown unless otherwise approved by the Engineer.

3) Any time that pipe work is not actively in progress the open ends of pipe shall be closed by a watertight cap.

4) Field cutting pipe, where required, shall be made with a machine specially designed for cutting piping. Cuts shall be carefully done, without damage to pipe, so as to leave a smooth end at right angles to the axis of pipe. Cut ends shall be tapered and sharp edges filed off smooth.

5) At completion of pipe installation, the utility contractor shall install transition fittings as required to the piping and then cap with watertight caps or plugs.

6) At completion of pipe installation, the utility contractor shall furnish accurate drill logs indicating placement of pipe as installed. The entire drill path shall be accurately surveyed with entry and exit stakes placed in the appropriate locations within areas indicated on drawings. If the utility contractor is using a magnetic guidance system, the drill path will be surveyed for any surface geomagnetic variations or anomalies.

## 8.0 Environmental Controls

a) Disposal of drilling mud:

1) The drilling mud cannot be disposed of on the project site.

2) Off-site disposal of the drilling mud is the utility contractor's responsibility.

3) The utility contractor shall comply with all applicable laws and regulations regarding the transport and off-site disposal of the drilling mud and all excess excavated materials.

4) All costs for proper transport and disposal of drilling mud and all excess excavated materials shall be included in the price bid for the work.

b) All operations involving drilling mud shall be controlled and monitored by the utility contractor to ensure containment:

1) The utility contractor shall establish bermed or sandbagged pits of sufficient sizes to accommodate the volume of drilling mud anticipated plus a two-foot freeboard. The bermed areas shall be maintained and designed by the utility contractor to ensure containment and prevent loss of drilling mud.

2) Transportation of the disposal materials off-site by public roads shall meet all North Carolina Department of Transportation requirements.

3) Transportation of materials by barge or scow shall be in accordance with the Corps of Engineers and U.S. Coast Guard requirements.

## 9.0 Asbuilt / Record Drawings

a) The utility contractor shall deliver the drilling logs to the engineer for inclusion in the final as-built drawings for the project. The design profile for the directional drill installation shall be updated with the drilling log data. The drilling logs shall be incorporated in the final as-built drawings provided by the engineer.

SECTION 31 10 00 - 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.

1.2 SUMMARY

A. Section Includes:

1. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Removing above- and below-grade site improvements.
6. Disconnecting, capping or sealing, and removing site utilities.
7. Temporary erosion- and sedimentation-control measures.

1.3 DEFINITIONS

A. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

B. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is the zone where plant roots grow. Its appearance is generally 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.

D. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and indicated on Drawings.

E. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and as indicated on Drawings.

F. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 MATERIAL OWNERSHIP

A. Except for stripped topsoil and other materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.5 SUBMITTALS

A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.

1. Use sufficiently detailed photographs or videotape.
2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

B. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.6 QUALITY ASSURANCE

A. Preinstallation Conference: Conduct conference at the project site.

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.

1. Do not proceed with work on adjoining property until directed by Architect.

C. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises.

D. Utility Locator Service: Notify utility locator service, NC One Call Center for area where Project is located before site clearing.

E. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant-protection measures are in place.

F. The following practices are prohibited within protection zones:

1. Storage of construction materials, debris, or excavated material.
2. Parking vehicles or equipment.
3. Foot traffic.
4. Erection of sheds or structures.
5. Impoundment of water.
6. Excavation or other digging unless otherwise indicated.
7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

G. Do not direct vehicle or equipment exhaust towards protection zones.

H. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

I. Soil Stripping, Handling, and Stockpiling: Perform only when the topsoil is dry or slightly moist.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 312000 “Earthwork”.

1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

## PART 3 - EXECUTION

### 3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction. Provide tree protection.

B. Locate and clearly identify trees, shrubs, and other vegetation to remain or to be relocated. Flag per Brunswick County Tree Protection Detail.

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 erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.

B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.

D. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

## 3.3 TREE AND PLANT PROTECTION

A. General: Protect trees and plants remaining on-site.

B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Landscape Architect.

## 3.4 EXISTING 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 utilities indicated to be removed per Section 331413 “Water Distribution Piping, Valves, Hydrants & Appurtenances” and Section 333111 “Sanitary Sewer Gravity Mains”.

1. Arrange with utility companies to shut off indicated utilities.
2. Owner will arrange to shut off indicated utilities when requested by Contractor.

C. Locate, identify, and disconnect utilities indicated to be abandoned in place.

D. Interrupting Existing Utilities: Refer to Section 011000 “Summary”.

E. Excavate for and remove underground utilities indicated to be removed.

F. Removal of underground utilities is included in earthwork sections and with applicable fire suppression, plumbing, HVAC, electrical, communications, electronic safety and security and utilities sections.

## 3.5 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, 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. Grind down stumps and remove roots, obstructions, and debris.
3. Use only hand methods for grubbing within protection zones.
4. Chip removed tree branches and dispose of off-site.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Place fill material placement in horizontal layers shall be in accordance with Section 312000 “Earth Moving”.

## 3.6 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil in a manner to prevent intermingling with underlying subsoil or other waste materials.

1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects more than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.

C. Stockpile topsoil away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.

1. Limit height of topsoil stockpiles to 72 inches.
2. Do not stockpile topsoil within protection zones.
3. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or reused.
4. Stockpile surplus topsoil to allow for respreading deeper topsoil.

## 3.7 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and 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 along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

## 3.8 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

B. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION 31 10 00

SECTION 31 20 00 – EARTHWORK

PART 1 - GENERAL

1.1 GENERAL

A. The contractor shall furnish all labor, equipment, supplies and materials, and perform all operation in connection with the excavations, grading and backfilling, including borrow for drainage structures, curb and gutter, sidewalks, driveways, pavements, slopes, storm drains, water and sanitary sewer lines, including all hauling, wetting, rolling and other operations pertaining thereto within the clearing limits, complete, in strict accordance with this section of the specifications and the applicable drawings, and subject to the terms and conditions of the contract.

**1**.2 EXISTING CONDITIONS

A. Every reasonable effort has been made to provide accurate information on existing site conditions. The Contractor should become familiar with the site and satisfy himself as to the scope of the work involved and the materials to be encountered. Any significant change in conditions should be immediately brought to the attention of the Owner's representative.

1.3 REFERENCES

A. ASTM C33 - Standard specification for concrete aggregates

B. ANSI/ASTM C136 - Sieve analysis of fine and coarse aggregates.

C. ANSI/ASTM D698 - Tests for moisture-density relations of soils and soil-aggregate mixture using 5.5 lb (2.49 kg) rammer and 12 inch (305 mm) drop.

D. ANSI/ASTM D1556 - Density of soil in place by sand-cone method.

E. ASTM D2487 - Classification of soils for engineering purposes.

PART 2 - PRODUCTS

2.1 SOILS

A. General: Use soils free of organic matter, refuse, rocks and lumps greater than 4 inches in diameter and other deleterious matter. All backfill material located in grass areas and in areas of landscape shall have a PH between 5.5 and 7.0 (refer to landscape specification).

1. Backfilling Materials: Suitable material, when used as backfill in paved areas, shall be capable of being compacted as specified in paragraph "Compaction and Testing" of this section of these specifications.

a. Type 1 Material: Excavated material from the trench or materials

from other sources which are free from large clods, roots or stones larger than 1 inch may be used as initial backfill in trenches (see Trench Details)

b. Type 2 Material: Excavated material from the trench or materials from other sources which are free from large clods, roots or stones larger than 8 inches may be used as final backfill in trenches (see Trench Details)

B. Classification: For the purpose of this specification, soils to be used as fill material are grouped into seven classes according to soil properties and characteristics.

Class I - Angular, 6 to 40-mm (1/4 to 1-1/2 in.), graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone, crushed gravel, and crushed shells (Reference Geotechnical Report and Recommendation).

Class II - Coarse sands and gravels with maximum practical size of 44 mm (1-1/2 in.), including variously graded sands and gravels containing small percentages of fines, such as clayey sands and silty sands. Soil Types GW, GP, SW, SP, SP-SM, SP-SC or SM are included in this class as recommended by the Geotechnical Engineer.

Class III - Fine sand and clayey gravels, including fine sands, sand-clay mixtures, and gravel-clay mixtures. Soil Types GM, GC, SM, and SC are included in this class.

Class IV - Silt, silty clays, and clays, including inorganic clays and silts of medium to high plasticity and liquid limits. Soil Types MH, ML, CH, and CL are included in this class. These materials are not recommended for bedding, haunching, or initial backfill.

Class V - This class includes the organic soil, OL, OH, PT as well as soils containing frozen earth, debris, rocks, larger than 40 mm (1-1/2 in.) in diameter, and other foreign materials. These materials are not recommended for bedding haunching or initial backfill.

C. Topsoil: Natural, friable soil free of subsoil, stumps, rocks larger than 2 inches in diameter, weeds and other material detrimental to plant growth.

D. Granular Fill: Granular fill under floor slabs shall be Class I material.

E. Structural Fill: Fill material placed inside the line of the building foundation or slab shall be Class I, II or III per recommendations of the Geotechnical Engineer.

F. Fill Beneath Pavement: Fill material used beneath pavement and for road shoulders shall be Class II or III.

G. General Fill: General fill material not otherwise specified shall be Class II or III.

H. Trench Backfill: Material used for bedding, haunching and initial backfill shall be as specified hereinafter.

2.2 CRUSHED STONE

A. Crushed stone shall be size no. 57, with fines present to stabilize it in the trench. If fines are insufficient, stone screenings shall be added to extent required to stabilize it in the trench.

2.3 CONCRETE

A. Concrete placed for cradles, thrust blocks, or encasement shall be Class B concrete as specified in Section Concrete.

PART 3 - EXECUTION

3.1 GENERAL

A. Familiarization: Prior to commencement of the earthwork, become thoroughly familiar with the site, the site conditions, and all portions of the work specified in this Section.

B. Approvals: Backfilling and grading operations near foundations, walls, pipes and other portions of the work to be covered shall not commence until the Owner's Representative has completed all required inspections, tests and approvals. Work covered prior to inspection shall be uncovered for inspection purposes and backfilled.

3.2 SURFACE PREPARATION

A. Clearing: Areas designated for clearing and required for construction operations shall be cleared of trees, brush, structures and other materials. Trees which are to remain shall be protected during clearing operations and subsequent work.

B. Grubbing: Roots, stumps and other materials shall be grubbed from the cleared areas to a depth of at least 18 inches. Tree stumps shall be grubbed in their entirety, including tap roots where applicable.

C. Topsoil: Strip existing topsoil from areas to be excavated or graded. Stockpile the topsoil in a suitable area for use during final grading operations. Protect the topsoil from excessive erosion.

D. Unsuitable Material: Remove sod, muck or other unsuitable material to firm subsoil in areas designated for filling or grading operations.

E. Disposal: Trees, stumps, roots, rubbish, unsuitable soil or other material resulting from surface preparation shall be removed from the site by the

Contractor and disposed of.

3.3 EXCESS WATER CONTROL

A. General: Grade and maintain all areas of the site to preclude surface runoff into excavations and prevent ponding of water.

B. Dewatering: Excavations should be kept free of surface water and/or groundwater.
Dewatering is the responsibility of the contractor and shall be included in the bid.

Provide and maintain at all times the necessary means and devices to prevent water from entering the excavations and for removing all water entering the excavations.

C. Softened Subgrade: Remove all soil softened or eroded by the presence of water and replace with suitable backfill material.

3.4 EXCAVATION

Excavation shall be accomplished in accordance with the grades and lines as established by the Engineer and as required by the work to be performed. Excavation shall include the removal and replacement of all asphalt, concrete, curb, rock, earth, fences, trees (as directed by the Engineer), shrubs, and other materials as applicable. The contractor will exercise care to prevent undercutting lower than the required subgrades. All materials from excavation, considered as suitable by the Engineer, shall be used as fill wherever required, and the Contractor shall arrange his work so that this usage of excavated materials will be possible. Unsuitable and surplus materials from excavation, if any, shall be disposed of by the Contractor at this expense. All areas of the site shall be graded and maintained at all times to prevent surface runoff from draining into the excavations, and to prevent ponding of water therein.

Excavated materials not required for topsoil, fill or backfill shall be removed from the site of the work by the Contractor, but none shall be deposited on private property without written consent of the property owner.

A. Unsuitable Materials: Unsuitable materials encountered in an excavation shall be removed as directed by the Owner's representative, backfilled with suitable material and compacted. Unsuitable materials include organic soils, muck, soft and compressible silts and clays and running sands.

B. Undercutting: Undercutting, unless authorized by the Engineer, shall be replaced and compacted, as specified in paragraph 3.6, at the Contractor's expense. If the material, after excavation to subgrade, is found to be soft, spongy or unfit for use as subgrade, such unsuitable material shall be removed to a depth as directed by the Engineer and the subgrade shall be brought to proper elevation by filling with suitable material from excavation or from an approved borrow site.

C. Borrow: The Contractor will supply all borrow necessary and will provide all labor

and equipment necessary to dig and haul such borrow. The placing of borrow shall be as provided for in the paragraph 3.06.

3.5 PREPARATION OF SUBGRADE

A. General: Upon completion of site preparation and excavation, scarify to a depth of 12 inches and compact as specified. For areas to receive fill, the compacted subgrade shall be scarified to a depth of four inches prior to placing the fill.

3.6 FILL AND COMPACTION

A. When and where existing plans and grades require the use of fill to reach the required elevation, the Contractor shall deposit suitable material. Such material shall be free from debris, roots, trash, stones, or other harmful substances, and shall be spread in successive layers of loose material not more than 8 inches in depth. Each layer shall be spread uniformly and rolled with an approved tamping or three-wheeled power roller until thoroughly compacted to a minimum of 98 percent of the standard Proctor maximum dry density (ASTM D-698). The moisture content of the fill should be within +/- 3 percent of the material's standard Proctor optimum moisture content for SP-SM, SP-SC, or SM, and within +/- 5 percent for SW or SP soils. To confirm that the specified degree of compaction is being obtained, field density testing should be performed in each fill by the geotechnical engineer's representative. We recommend that density tests be performed at a minimum frequency of one test per 2,500 square feet per lift in building and pavement areas, and one test per 100 linear feet per lift of utility trench backfill in structural areas. When any portion of the fill is constructed on an old road bed, the existing surfaces shall be scarified and manipulated as directed by the Engineer in order that, when compacted, it shall have a uniform density, as specified above. Fills shall be shaped and maintained at all times during their construction to prevent an accumulation of standing water in the event of rain.

B. Moisture Conditioning: Moisten or aerate the subgrade and fill material as required to obtain proper compaction.

C. Structural Fill: Compact the subgrade and fill to a minimum of 98 percent ASTM D698 (Standard Proctor) maximum density at optimum moisture content.

D. Granular Fill (ABC Stone): Place granular fill on compacted, unscarified fill or subgrade and compact to a minimum 100 percent modified ASTM D1557, maximum density at optimum moisture content.

E. Pavement Areas: Compact the soil subgrade and fill material beneath paved areas and shoulders to a minimum 98 percent ASTM D698 maximum density at optimum moisture content.

F. Landscaped Areas: Compact the subgrade and fill to a minimum 95 percent ASTM D698 maximum density at optimum moisture content. Compact topsoil to 85 percent ASTM D698 maximum density at optimum moisture content.

3.7 FINISH GRADING

A. General: Perform finish grading to the lines and grades shown on the drawings. Finished grades should be smooth and uniform and provide positive drainage.

B. Tolerances:

1. Rough Grade Plus or minus 0.1 foot

2. Finish Grade Plus or minus 0.1 foot

C. Topsoil: The top 4 inches of soil in landscaped areas shall be topsoil.

D. Protection: Protect areas which have been graded from equipment traffic.

3.8 TRENCHING, BACKFILLING AND COMPACTION FOR UTILITY & STORMWATER PIPE SYSTEMS

A. General: Refer to specific utility sections in these specifications for installation requirements. Trench, backfill and compact as specified except as modified herein.

B. Trenching: Trench widths at and below the top of the pipe shall be the minimum necessary for proper installation. Trench banks above the top of the pipe shall be as vertical as practicable. Overdepth excavation shall be backfilled with Class I material and compacted. The Contractor shall provide, at his expense and as directed by the Owner's representative, special bedding material or concrete encasement as may be necessary due to over-width excavation.

C. Depth: Trench to the lines and grades shown on the drawings. Where elevations are not shown, trench to a depth sufficient to provide at least 36 inches of cover above the top of pipe, unless otherwise specified. Grade trenches to provide a constant slope free of sags and high spots.

D. Dewatering: Keep trenches free of water. Include cost of dewatering in bid for pipe. No additional payment for this item is permitted.

E. Trench Bracing: Properly brace, sheet and support trench walls as soil conditions indicate and in strict conformance with all pertinent laws and OSHA regulations. Provide adequate bracing and shoring to protect adjacent improvements. Contractor shall provide certification for all premanufactured trench bracing devices prior to any excavation activities.

F. Bedding, Haunching and Initial Backfill: Tamp to provide firm, even bedding. Excavate bedding material to match the shape of the bottom of the pipe and bell, as detailed in the drawings. Place haunching material so as to provide full bearing around the bottom of the pipe. Place bedding haunching and initial backfill shall be Class I or Class II material in accordance with NC DOT and pipe manufacturers recommendations.

G. Backfill: Backfill the remainder of the trench in accordance with paragraphs 2.01 and 3.06 of this section. Backfill from embedment zone to surface grade may be by hand of mechanical placement. Trench backfill shall be compacted in 8-inch lifts as in spec section 3.6.

H. Foundation: Pipe foundation shall be required in wet, yielding and mucky locations. Foundation shall be constructed by removal of wet, yielding or mucky material and its replacement with sufficient Class I material to correct the instability. In areas where foundation is required bedding shall be class I only.

I. Backfilling in Traffic Areas (Highways, paved streets, paved parking lots, alleys, driveways, highway and street shoulders)

1. Initial Backfilling of Pipe

   a. After preparing the trench for ordinary bedding as described under paragraph 3.08G of this section, this portion of the pipe trench shall be backfilled with suitable materials under and around the pipe, carefully deposited in uniform layers on both sides of pipe and compacted by hand or pneumatic tampers until backfill reaches one (1) foot above top of pipe. The depth of backfill layers shall be six (6) inches maximum. Each layer of material shall be compacted to a dry density 95 percent of the maximum determined by the Standard Proctor Compaction Test.

   b. When crushed stone or concrete encasement is used, the initial backfill of suitable materials will not be required.

   c. The tampers shall be of proper sized to operate between trench wall and pipe without damaging the pipe.

2. Initial Backfilling of Pipe (Crusted Stone Encasement for PVC pipe, DIP in unstable or wet conditions, or crushed stone encasement)

   a. This portion of the pipe trench shall be backfilled with crushed stone to provide crusted stone encasement.

   b. When concrete cradle is used, the initial backfill will start at the top of the concrete and then continue as specified above.

   c. When concrete encasement is used, the initial backfill of crushed stone will not be required.

3. Backfilling Trench to Subgrade After Initial Backfilling (Suitable Materials)

   a. After initial backfilling has been compacted as specified above, backfill the remainder of the trench in compacted layers not to exceed twelve (12) inches using a mechanical tamper up to the

bottom elevation of the pavement structure with suitable materials to be a dry density 95 percent of the maximum determined by the Modified Proctor Compaction Test.

3.9 FIELD QUALITY CONTROL

A. Field inspection, sampling and testing will be performed per owner's instructions.

B. Payment: No separate payment will be made for Excavating, Grading, Trenching and Backfilling. All costs incurred by the contractor for this work should be included in the unit price or lump sum price for the item of work to which it pertains.

END OF SECTION 31 20 00

# SECTION 31 31 16

# TERMITE CONTROL

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Soil treatment.

### 1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components, and profiles for termite control products.
   2. Include the EPA-Registered Label for termiticide products.

### 1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Product Certificates: For each type of termite control product.

C. Soil Treatment Application Report: After application of termiticide is completed, submit report for Owner's records and include the following:
   1. Date and time of application.
   2. Moisture content of soil before application.
   3. Termiticide brand name and manufacturer.
   4. Quantity of undiluted termiticide used.
   5. Dilutions, methods, volumes used, and rates of application.
   6. Areas of application.
   7. Water source for application.

D. Sample Warranties: For special warranties.

## 1.5 QUALITY ASSURANCE

A. Installer Qualifications: A specialist who is licensed according to regulations of authorities having jurisdiction to apply termite control treatment and products in jurisdiction where Project is located and who employs workers trained and approved by manufacturer to install manufacturer's products and who is accredited by manufacturer.

## 1.6 FIELD CONDITIONS

A. Soil Treatment:
   1. Environmental Limitations: To ensure penetration, do not treat soil that is water saturated or frozen. Do not treat soil while precipitation is occurring. Comply with requirements of the EPA-Registered Label and requirements of authorities having jurisdiction.
   2. Related Work: Coordinate soil treatment application with excavating, filling, grading, and concreting operations. Treat soil under footings, grade beams, and ground-supported slabs before construction.

## 1.7 WARRANTY

A. Soil Treatment Special Warranty: Manufacturer's standard form, signed by Applicator and Contractor, certifying that termite control work consisting of applied soil termiticide treatment will prevent infestation of subterranean termites, including Formosan termites (Coptotermes formosanus). If subterranean termite activity or damage is discovered during warranty period, re-treat soil and repair or replace damage caused by termite infestation.
   1. Warranty Period: Five years from date of Substantial Completion.

# PART 2 PRODUCTS

## 2.1 MANUFACTURERS

A. Source Limitations: Obtain termite control products from single source from single manufacturer.

## 2.2 SOIL TREATMENT

A. Termiticide: EPA-Registered termiticide acceptable to authorities having jurisdiction, in an aqueous solution formulated to prevent termite infestation.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Bayer Environmental Science.
      b. Ensystex, Inc.
      c. Syngenta Crop Protection, LLC.

2. Service Life of Treatment: Soil treatment termiticide that is effective for not less than five years against infestation of subterranean termites.

## PART 3 EXECUTION

### 3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for moisture content of soil per termiticide label, interfaces with earthwork, slab and foundation work, landscaping, utility installation, and other conditions affecting performance of termite control.

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

### 3.2 PREPARATION

A. General: Prepare work areas according to the requirements of authorities having jurisdiction and according to manufacturer's written instructions before beginning application and installation of termite control treatment(s). Remove extraneous sources of wood cellulose and other edible materials, such as wood debris, tree stumps and roots, stakes, formwork, and construction waste wood from soil within and around foundations.

B. Soil Treatment Preparation: Remove foreign matter and impermeable soil materials that could decrease treatment effectiveness on areas to be treated. Loosen, rake, and level soil to be treated, except previously compacted areas under slabs and footings. Termiticides may be applied before placing compacted fill under slabs if recommended in writing by termiticide manufacturer.
   1. Fit filling hose connected to water source at the site with a backflow preventer, according to requirements of authorities having jurisdiction.

### 3.3 APPLYING SOIL TREATMENT

A. Application: Mix soil treatment termiticide solution to a uniform consistency. Distribute treatment uniformly. Apply treatment at the product's EPA-Registered Label volume and rate for maximum specified concentration of termiticide to the following so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction.
   1. Slabs-on-Grade and Basement Slabs: Under ground-supported slab construction, including footings, building slabs, and attached slabs as an overall treatment. Treat soil materials before concrete footings and slabs are placed.
   2. Foundations: Soil adjacent to and along the entire inside perimeter of foundation walls; along both sides of interior partition walls; around plumbing pipes and electric conduit penetrating the slab; around interior column footers, piers, and chimney bases; and along the entire outside perimeter, from grade to bottom of footing.

B. Post warning signs in areas of application.

C. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.

## 3.4 PROTECTION

A. Avoid disturbance of treated soil after application. Keep off treated areas until completely dry.

B. Protect termiticide solution dispersed in treated soils and fills from being diluted by exposure to water spillage or weather until ground-supported slabs are installed. Use waterproof barrier according to EPA-Registered Label instructions.

**END OF SECTION**

# SECTION 31 60 00 – AGGREGATE PIERS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 00 and Division 01 Specification Sections, apply to this Section.

### 1.2 DESCRIPTION

A. Work shall consist of designing, furnishing and installing materials, and constructing a ground improvement system at the locations noted on the drawings and as specified herein. Ground improvement system shall be either vibro stone columns or rammed piers. “Aggregate piers” referenced in these specifications refer to both vibro stone columns and rammed piers.

### 1.3 WORK INCLUDED:

A. Provision of all equipment, material, labor, and supervision to design and install aggregate pier elements. Design shall rely on subsurface information presented in the project geotechnical report. Removal of spoils from the site (which result from aggregate pier construction), removal of spoils off the working pad, footing excavation, and subgrade preparation following aggregate pier installation is not included.

B. Drawings and General Provisions of the Contract, including General and Supplemental Conditions, and Division 1 Specifications, apply to the work in this specification.

### 1.4 APPROVED INSTALLERS:

A. Installers of aggregate pier foundation systems shall have a minimum of 5 years of experience with the installation of aggregate piers and shall have completed at least 50 projects of similar size and nature.

### 1.5 RELATED WORK:

A. Section 033000 – Cast in Place Concrete.

B. Section 312000 – Building Earthwork.

C. Geotechnical Report and Recommendations.

### 1.6 REFERENCE STANDARDS:

A. Design: The ground improvement installer shall be responsible for design of a vibro



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stone column or rammed pier ground improvement system that meets the global stability, allowable bearing capacity, and settlement requirements stated on the contract drawings (6,000 psf). Industry recognized standards or design methods specific to the installer's equipment and construction methods shall be used.

B. Modulus and Uplift Testing:

1. ASTM D-1143 – Pile Load Test Procedures.
2. ASTM D-1194 – Spread Footing Load Test.
3. ASTM-D-3689 – Uplift Load Test.

C. Materials and Inspection:

1. ASTM D-1241 – Aggregate Quality.
2. ASTM STP 399 – Dynamic Penetrometer Testing.
3. ASTM D-422 – Gradation Soils.

## 1.7 CONFLICTS IN SPECIFICATIONS/REFERENCES

A. Where specifications and reference documents conflict, the Architect/Engineer shall make the final determination of the applicable document.

## 1.8 CERTIFICATIONS AND SUBMITTALS:

A. The installer shall submit detailed design calculations and construction drawings to the Architect and to the Geotechnical Engineer of Record for approval at least three (3) weeks prior to the start of construction. All plans shall be sealed by a North Carolina Registered Professional Engineer (referred in this specification as "the Designer"). Detailed calculations shall be prepared by the Designer shall be signed and sealed and shall include anticipated loads, design assumptions, and relevant subsurface information.

B. The Stone Column or Aggregate Pier engineer shall have Errors and Omissions design insurance for the work. The insurance policy should provide a minimum coverage of $2 million per occurrence.

C. Modulus and uplift test data - The Installer shall furnish the Construction Manager a description of the installation equipment, installation records, complete test data, analysis of the test data and recommended design parameter values based on the modulus test results. The report shall be prepared under supervision of a registered professional engineer.

D. Daily Progress Reports – The Installer shall furnish a complete and accurate record of aggregate pier installation to the Construction Manager. The record shall indicate the pier location, length, average lift thickness and final elevations of the base and top of piers. The record shall also indicate the type and size of the densification equipment used. The Installer shall immediately report any unusual conditions encountered



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during installation to the Construction Manager, to the Designer and to the Testing Agency.

### 1.9 BASIS OF PAYMENT:

A. This work will be paid for at the contract lump sum price for AGGREGATE PIERS.

## PART 2 - PRODUCTS

### 2.1 MATERIALS:

A. Aggregate used for piers constructed above the water table shall be Type I Grade B in accordance with ASTM D-1241-68, or shall be other graded aggregate selected by the Installer and successfully used in the modulus test. It shall be compacted to a densification and strength, which provides resistance to the dynamic penetration test (ASTM STP 399) of a minimum average of 15 blows per 1.75-inch vertical movement.

B. For aggregate used for piers constructed below the water table, the gradation shall be the same as Type I Gradation B, except that particles passing the No. 40 sieve shall be eliminated. Alternatively, No.57 stone or other stone selected by the Stone Columns or Aggregate Pier Installer may be used. Dynamic penetration resistance testing is inappropriate for this material.

C. Potable water or other suitable source shall be used to increase aggregate moisture content where required. Access to water on site shall be provided to the Installer.

D. Installer to coordinate adequate and suitable marshalling areas on the project site for the use of the Installer for the storage of aggregate and equipment.

## PART 3 - DESIGN REQUIREMENTS

### 3.1 **STONE COLUMN AND AGGREGATE PIER DESIGN**:

A. The Aggregate Pier design stiffness modulus value shall be verified by the results of the modulus test, described in this specification.

B. Stone Columns or Aggregate piers shall be designed in accordance with generally-accepted engineering practice and the methods described in Section 1 of these Specifications. The design shall meet the following criteria.

1. Minimum Allowable Bearing Pressure for Aggregate Pier Reinforced Soils: 6,000 psf.
2. Minimum Aggregate Pier Area Coverage (for square Spread Footings): 30%.
3. Estimated Total Long-Term Settlement for Footings: ≤1-inch.
4. Estimated Long-Term Differential Settlement of Adjacent Footings: ≤ ½-inch.
5. Life of Structure: 50 years.



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C. The design submitted by the Installer shall consider the bearing capacity and settlement of all footings supported by aggregate piers, and shall be in accordance with acceptable engineering practice and these specifications. Total and differential settlement shall be considered. The design life of the structure shall be 50 years.

D. The Stone Column or Aggregate Pier system shall be designed to preclude plastic bulging deformations at the top-of–pier design stress and to preclude significant tip stresses as determined from the shape of the telltale test curve from telltales installed in modulus test piers. The results of the modulus test shall be used to verify the design assumptions.

## 3.2 DESIGN SUBMITTAL

A. The following shall be included in the design submittal.

1. Signed and sealed detailed design calculations
2. Construction drawings
3. Shop drawings
4. A detailed explanation of the design parameters for settlement calculations
5. The quality control test program for stone columns or aggregate piers meeting the design requirements.

# PART 4 - CONSTRUCTION

## 4.1 STONE COLUMNS:

A. Install stone columns with a down-hole vibrator capable of densifying the aggregate by forcing it radially into the surrounding soil. The vibrator shall be of sufficient size and capacity to construct stone columns to the diameters and lengths shown on the installer’s approved construction drawings.

B. The probe and follower tubes shall be of sufficient length to reach the elevations shown on the installer’s approved construction drawings. The probe, used in combination with the available pressure to the tip jet, shall be capable of penetration to the required tip elevation. Preboring shall be permitted if it is specified in the installer’s approved construction procedure submittal.

C. The probe and follower shall have visible markings at regular increments to enable measurement of penetration and repenetration depths.

D. Provide methods for supplying to the tip of the probe a sufficient quality of air or water to widen the probe hole to allow adequate space for stone backfill placement around the probe.

E. The probe shall penetrate into the foundation soil layer to the minimum depths required in the installer’s construction plans.



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F. Lift thickness shall not exceed 4 feet. After penetration to the treatment depth, slowly retrieve the vibrator in 12-inch to 18-inch increments to allow backfill placement.

G. Compact the backfill in each lift by repenetrating it at least twice with the vibrating probe to densify and force the stone into the surrounding soil.

H. Install stone columns so that each completed column is continuous throughout its length.

## 4.2 RAMMED PIERS:

A. All Aggregate Pier elements shall be pre-augered using mechanical drilling or excavation equipment. Installation of piers without pre-augering shall not be allowed because this technique results in significant disturbance and remolding of the matrix soils surrounding the piers.

B. If cave-ins occur during excavation such that the sidewalls of the hole are deemed to be unstable, steel casing or a drilling slurry shall be used to stabilize the excavation.

C. If cave-ins occur on top of a lift of aggregate such that the volume of the caved soils is greater than 10 percent of the volume of the aggregate in the lift, then the aggregate shall be considered contaminated and shall be removed and replaced with uncontaminated aggregate.

D. Special high-energy impact densification apparatus shall be employed to densify the Aggregate Pier elements during installation. The apparatus shall apply direct downward impact energy to each lift of aggregate.

E. A minimum tamper energy level of 250,000 foot-pounds of force per minute shall be applied by the energy source.

F. The bottom of the excavation shall be densified prior to the placement of the aggregate. If wet, soft or sensitive soils are present, open-graded aggregate, such as ASTM No.57 stone or other, shall be placed at the bottom of the excavation and compacted to stabilize the element bottom and may serve as the initial lift.

G. Densification shall be performed using a beveled tamper. The beveled tamper foot is required to adequately increase the lateral earth pressure in the matrix soil during installation.

H. Downward pressure shall be applied to the tamper shaft during tamping.

I. Each lift of aggregate shall be tamped for a minimum of 15 seconds.

## 4.3 PLAN LOCATION AND ELEVATION OF AGGREGATE PIER ELEMENTS



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A. The center of each pier shall be within six inches of the plan locations indicated. The final measurement of the top of piers shall be the lowest point on the aggregate in the last compacted lift. Piers installed outside of the above tolerances and deemed not acceptable shall be rebuilt at no additional expense to the Owner.

### 4.4 REJECTED AGGREGATE PIER ELEMENTS

A. Aggregate pier elements improperly located or installed beyond the maximum allowable tolerances shall be abandoned and replaced with new piers, unless the Designer approves other remedial measures. All material and labor required to replace rejected piers shall be provided at no additional cost to the Owner.

## PART 5 - QUALITY CONTROL

### 5.1 QUALITY CONTROL REPRESENTATIVE:

A. The Installer shall have a full-time Quality Control (QC) representative to verify and report all QC installation procedures. The Installer shall immediately report any unusual conditions encountered during installation to the Design Engineer, the Construction Manager, and to the Testing Agency. The QC procedures shall include the preparation of Aggregate Pier Progress Reports completed during each day of installation and containing the following information:

1. Footing and Aggregate Pier location.
2. Aggregate Pier length and drilled diameter.
3. Planned and actual Aggregate Pier elevations at the top and bottom of the element.
4. Average lift thickness for each Aggregate Pier.
5. Soil types encountered at the bottom of the Aggregate Pier and along the length of the element.
6. Depth to groundwater, if encountered.
7. Documentation of any unusual conditions encountered.
8. Type and size of densification equipment used.

### 5.2 QUALITY CONTROL VERIFICATION PROGRAM:

A. The installer shall be responsible for design of a verification program to assure the quality of the construction. The program shall verify that the installed ground improvement system satisfies the performance requirements noted on the contract plans and the design requirements determined by the ground improvement system designer. As a minimum, the verification program shall include the following:

1. Program to monitor performance of the ground improvement system during and after construction of the proposed structure or embankment to be supported. This program may include installation of settlement plates, monitoring points, inclinometers, piezometers, or other instrumentation.
2. Stone column installation shall be monitored by an on board computer monitoring



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system. Monitoring system shall log stone column number, time of installation, depth, hydraulic pressure applied during the boring process and during the compacting process. Recorded data for each stone column shall be plotted depth/pressure versus time. Installation records for each shall be made available upon request in electronic format within 24 hours of installation.

3. Proposed means and methods for verification that the installed aggregate piers meet the strength and/or stiffness criteria required by the design. This may include, but shall not be limited to, modulus or load tests on individual elements and/or groups, soil borings, and other methods as approved by the Engineer.
4. Quality control program to verify that the ground improvement system is installed in accordance with the designer's specifications and the requirements in this special provision. The quality control program shall include testing and observations by qualified personnel employed by the ground improvement installer or an independent testing laboratory.

## PART 6 - QUALITY ASSURANCE

### 6.1 INDEPENDENT ENGINEERING TESTING AGENCY

A. The Owner will retain an Independent Engineering Testing firm/Agency to provide Quality Assurance services.

### 6.2 RESPONSIBILITIES OF GEOTECHNICAL ENGINEER & INDEPENDENT ENGINEERING TESTING AGENCY

A. The Geotechnical Engineer of Record shall review and approve the Installer's Design Submittal.

B. The Testing Agency shall monitor the installation of aggregate pier elements to verify that all work is performed in accordance with the approved Design Submittal.

C. The Testing Agency & Geotechnical Engineer of Record shall observe footing excavations and densification of aggregate piers and provide written reports per section 7.3.D.

D. The Testing Agency shall report any discrepancies to the Installer and Construction Manager immediately.

## PART 7 - RESPONSIBILITIES OF CONSTRUCTION MANAGER

### 7.1 PREPARATION:

A. The Installer shall locate and protect underground and aboveground utilities and other structures from damage during installation of the Aggregate Pier elements.



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B. The Construction Manager will provide the site to the Installer, after earthwork in the area has been completed.

C. Site subgrade shall be established by the Site Contractor and verified by the Construction Manager within 6 inches of final design subgrade.

## 7.2 UTILITY EXCAVATIONS:

A. The Site Contractor and Construction Manager shall coordinate all excavations made subsequent to Aggregate Pier installations so that at least five feet of horizontal distance remains between the edge of any installed Aggregate Pier and the excavation. In the event that utility excavations are required at horizontal distances of less than five feet from installed Aggregate Piers, the Construction Manager shall notify the Aggregate Pier Designer to develop construction solutions to minimize impacts on the installed Aggregate Piers.

B. Recommended procedures may include:

1. Using cement-treated base to construct portions of the Aggregate Piers subject to future excavations.

2. Replacing excavated soil with compacted crushed stone in the portions of excavations where the Aggregate Piers have been disturbed. The placement and compaction of the crushed stone shall meet the following requirements.

   The crushed stone shall meet the gradation specified by the Designer.
   The crushed stone shall be placed in a controlled manner using motorized impact compaction equipment.
   The aggregate should be compacted to 95% of the maximum dry density as determined by the modified Proctor method (ASTM D-1557).
   The Testing Agency shall be on site to observe placement, compaction, and provide density testing. The test results shall be submitted to the Designer and the Construction Manager. The subcontractor shall provide notification to the Testing Agency and the Designer when excavation, placement, and compaction will occur and arrange for construction observation and testing.

## 7.3 FOOTING BOTTOMS:

A. Excavation and surface compaction of all footings shall be the responsibility of the Site Contractor.

B. Foundation excavations to expose the tops of Aggregate Pier elements shall be made in a workmanlike manner, and shall be protected until concrete placement, with procedures and equipment best suited to (1) prevent softening of the matrix soil between and around the Aggregate Pier elements before pouring structural concrete, and (2) achieving direct and firm contact between the dense, undisturbed Aggregate Pier elements and the concrete footing.



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C. Recommended procedures for achieving these goals are to:

1. Limit over-excavation below the bottom of the footing to 3-inches (including disturbance from the teeth of the excavation equipment,
2. Compaction of surface soil and top of Aggregate Pier elements shall be prepared using a motorized impact compactor ("Wacker Packer," "Jumping Jack," or similar). Sled-type tamping devices shall not be used. Compaction shall be performed over the entire footing bottom to compact any loose surface soil and loose surface pier aggregate.
3. Place footing concrete immediately after footing excavation is made and approved, preferably the same day as the excavation. Footing concrete must be placed on the same day if the footing is bearing on expansive or sensitive soils.
4. If same day placement of footing concrete is not possible, place a minimum 3-inch thick lean concrete seal ('mud mat") immediately after the footing is excavated and approved.

D. The following criteria shall apply, and a written inspection report sealed by the project Geotechnical Engineer shall be furnished to the Installer to confirm:

1. That water (which may soften the unconfined matrix soil between and around the Aggregate Pier elements, and may have detrimental effects on the supporting capability of the Aggregate Pier reinforced subgrade) has not been allowed to pond in the footing excavation at any time.
2. That all Aggregate Pier elements designed for each footing have been exposed in the footing excavation.
3. That immediately before footing construction, the tops of all the Aggregate Pier elements exposed in each footing excavation have been inspected and recompacted as necessary with mechanical compaction equipment, and that the tops of any Aggregate Pier elements which may have been disturbed by footing excavation and related activity have been recompacted to a dry density equivalent to at least 95% of the maximum dry density obtainable by the modified Proctor method (ASTM D-1557).
4. That no excavations or drilled shafts have been made after installation of Aggregate Pier elements within horizontal distance of five feet from the edge of any pier, without the written approval of the Installer or Designer.

**END OF SECTION**



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SECTION 32 12 16 - ASPHALT PAVEMENT AND MARKINGS

1. GENERAL

1.1 DESCRIPTION: The Work consists of provision and installation of aggregate base course and asphalt surface course, repair of cut or damaged asphalt pavement, pavement marking, installation of monument castings, and related work.

1.2 STANDARD SPECIFICATION: All materials provided and construction performed as a part of the Work described in this Section shall conform to the requirements of the North Carolina Department of Transportation "Standard Specifications For Roads And Structures" (NCDOT), latest edition; except as required herein or on the Drawings. References to methods of measurement and payment are not applicable. Pavement markings and traffic control devices shall be in accordance with the AASHTO "Manual of Uniform Traffic Control Devices," (MUTCD).

2. PRODUCTS

2.1 AGGREGATE BASE COURSE: NCDOT Section 520, Type A.

2.2 ASPHALT CONCRETE BASE COURSE: NCDOT Section 630, Superpave asphalt B25.0.

2.3 ASPHALT CONCRETE BINDER COURSE: NCDOT Section 640, Superpave asphalt B19.0.

2.4 ASPHALT CONCRETE COURSE: NCDOT Section 645, Superpave asphalt SF9.5A / B / C.

2.5 TACK COAT: NCDOT Section 605, all grades.

2.6 MONUMENT CASTINGS: Gray cast iron, ASTM A48, Class 30 round with 15 inch I.D. and 7 1/2 inches high.

2.7 PAVEMENT MARKINGS: Ready mixed type paint, NCDOT Section 1087-2(A) & Fed. Spec. TT-P-115F, white or yellow as required. Thermoplastic markings (NCDOT1087-2B) shall be used for all public streets and markings on driveways within a public right-of-way.

3. EXECUTION

3.1 GENERAL: Contractor is responsible for notifying review agencies of the construction progress and the need for periodic inspections. Contractor shall notify Owner or Owner's surveyor for installation of monuments within the right-of-way.

3.2 SUBGRADE: Compact subgrade as required in Section 02200 Earthwork and NCDOT Section 500. Areas which are unstable or pump shall be excavated, backfilled, and recompacted.

3.3 AGGREGATE BASE COURSE: Construct in accordance with NCDOT Section 520. Base course to extend full depth beneath and 6 inches outside all curbing and pavement edges.

3.4 BITUMINOUS SURFACE COURSE: Construct in accordance with NCDOT Sections 610 and 645. No prime coat shall be required prior to placing surface course over aggregate base course. A tack coat in accordance with NCDOT Section 605 shall be provided where surface course is placed on existing bituminous pavement or abuts to existing bituminous or concrete materials.

3.5 MONUMENT CASTINGS: Install castings upon completion and installation of base course and prior to placing surface course. Castings shall have a 4-inch thick by 12-inch wide concrete footing beneath entire outside perimeter, and shall be adjusted to grade with brick or block, grouted in place. Castings shall be centered on the monuments.

3.6 ADJUSTMENT OF FRAMES, GRATES, AND CASTINGS: Adjust frames, grates, and castings to meet finish grade in accordance with NCDOT Section 858.

3.7 SHOULDER GRADING: Construct in accordance with NCDOT Section 560. Fill material shall be topsoil free of roots and rocks greater than 0.5 inches in diameter.

3.8 PAVEMENT MARKINGS: Provide pavement markings in accordance with the MUTCD, NCDOT Section 1205, and as shown on the Drawings. Markings are not required on public or private streets unless noted otherwise on the Drawings. Parking lot markings will be white or yellow as shown on the plans.

END OF SECTION 32 12 16

SECTION 32 13 13 - PORTLAND CEMENT CONCRETE PAVEMENT

PART 1. GENERAL

1.1 DESCRIPTION OF WORK: Work described in this section is portland cement concrete paving, including curbs, gutters and walkways.

1.2 STANDARD SPECIFICATION: Provisions of the American Concrete Institute (ACI) and American Concrete Pavement Association "Municipal Concrete Pavement Manual" (ACPA) are included by reference.

PART 2. PRODUCTS

2.1 FORMS: Steel, wood, or other suitable material of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal. Use straight forms, free of distortion and defects. Use flexible spring steel forms or laminated boards to form radius bends as required. Coat forms with a non-staining form release agent that will not discolor or deface surface of concrete.

2.2 CONCRETE MATERIALS: ACI 318, unless otherwise specified, minimum compressive strength of 3000 psi at 28 days, with maximum slump of 5 inches. Air content 5%$^{\pm}$ - 1.5%.

2.3 EXPANSION JOINT MATERIALS: Preformed expansion joint fillers ASTM D1751 and sealers, ASTM C920.

2.4 LIQUID-MEMBRANE FORMING CURING COMPOUND: Complying with ASTM C309, Type I, Class A.

2.5 BONDING COMPOUND: Polyvinyl acetate or acrylic base, rewettable type.

2.6 EPOXY ADHESIVE: ASTM C881, two component material suitable for use on dry or damp surfaces. Provide material "Type", "Grade", and "Class" to suit project requirements.

2.7 REINFORCING STEEL

2.7.1 Deformed Steel Bars: ASTM A615, Grade 60 for reinforcement, Grade 40 for tie bars.

2.7.2 Wire Fabric: ASTM A185.

2.7.3 Dowels: ASTM A663, Grade 65, smooth and round.

PART 3. EXECUTION

3.1 SURFACE PREPARATION: Remove loose material from compacted subbase surface immediately before placing concrete. Do not begin paving work until subbase is ready to receive paving. Stringlines will be required to assure proper depth of concrete on all slabs. Absolutely no tolerance will be allowed on minimum slab thickness.

3.2 FORM CONSTRUCTION: Set forms to required grades and lines, rigidly braced and secured. Install sufficient quantity of forms to allow continuous progress of work and so that forms can remain in place at least 24 hours after concrete placement. Check completed formwork for grade and alignment to following tolerances:

Top of forms not more than 1/8" in 10'.

Vertical face on longitudinal axis, not more than 1/4" in 10'.

Clean forms after each use, and coat with form release agent as often as required to ensure separation from concrete without damage.

3.3 CONCRETE PLACEMENT:

3.3.1 General: Comply with requirements of ACI 318 for mixing and placing concrete, and as herein specified. Do not place concrete until subbase and forms have been checked for line and grade. Moisten subbase if required to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment. Use bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces. Deposit and spread concrete in a continuous operation between transverse joints, as far as possible. If interrupted for more than 1/2 hour, place a construction joint. Vibrate all concrete in place to assure proper consolidation.

3.3.2 Curbs and Gutters: Automatic machine may be used for curb and gutter placement at Contractor's option. If machine placement is to be used, submit revised mix design and laboratory test results that meet or exceed minimums specified. Machine placement must produce curbs and gutters to required cross-section, lines, grades, finish, and jointing as specified for formed concrete. If results are not acceptable, remove and replace with formed concrete as specified.

3.4 JOINTS

3.4.1 General: Construct expansion, weakened-plane (contraction), and construction joints true-to-line with face perpendicular to surface of concrete. Construct transverse joints at right angles to the centerline, unless otherwise indicated. When jointing existing structures, place transverse joints to align with previously placed joints, unless otherwise indicated. Joints in sidewalks shall be spaced 5 feet on center. Joints in cubs or pavements shall be a minimum 15 feet on center.

3.4.2 Weakened-Plane (Contraction) Joints: Provide weakened-plane (contraction) joints to a depth equal of at least 1/4 concrete thickness, as follows:

Tooled Joints: Form weakened-plane joints in fresh concrete by grooving top portion with a cutting tool and finishing edges with a jointer.

Sawed Joints: Form weakened-plane joints using powered saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut joints into hardened concrete as soon as surface will not be torn, abraded, or otherwise damaged by cutting action.

Inserts: Use embedded strips of metal or sealed wood to form weakened-plane joints. Set strips into plastic concrete and carefully remove strips after concrete has hardened.

3.4.3 Construction Joints: Place construction joints at end of placements and at locations where placement operations are stopped for a period of more than 1/2 hour, except where such placements terminate at expansion joints.

3.4.4 Expansion Joints: Provide premolded joint filler for expansion joints abutting concrete curbs, catch basins, manholes, inlets, structures, walks and other fixed objects, unless otherwise indicated. Locate expansion joints at 50' o.c. unless otherwise indicated. Extend joint fillers full-width and depth of joint, and not less than 1/2" or more than 1" below finished surface where joint sealer is indicated. If no joint sealer, place top of joint filler flush with finished concrete surface. Furnish joint fillers in one-piece lengths for full width being placed.

3.4.5 Fillers and Sealants: Prior to filling or sealing, remove all foreign material from joints and pavement. Apply fillers and sealers in accordance with the manufacturer's recommendations.

3.5 CONCRETE FINISHING: After striking-off and consolidating concrete, smooth surface by screeding and floating. Use hand methods only where mechanical floating is not possible. Adjust floating to compact surface and produce uniform texture. Distribute concrete as required to remove surface irregularities, and refloat repaired areas to provide a continuous smooth finish. Work edges of slabs, gutters, back top edge of curb, and formed joints with an edging tool, and round to 1/2" radius, unless otherwise indicated. Eliminate tool marks on concrete surface. After completion of floating and troweling when excess moisture or surface sheen has disappeared, complete surface finishing, as follows:

Broom finish, by drawing a fine-hair broom across concrete surface, perpendicular to line of traffic. Repeat operation if required to provide a fine line texture.

Burlap finish, by dragging a seamless strip of damp burlap across concrete, perpendicular to line of traffic. Repeat operation to provide a gritty texture.

Do not remove forms for 24 hours after concrete has been placed. After form removal, clean ends of joints and point-up any minor honeycombed areas. Remove and replace areas or sections with major defects, as directed by Engineer.

3.6 CURING: Protect and cure finished concrete paving, complying with applicable requirements of ACI 318. Use membrane-forming curing and sealing compound or approved moist-curing methods.

3.7 REPAIRS AND PROTECTIONS

3.7.1 Repair and replace broken or defective concrete. Protect concrete from damage until acceptance of work. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur. Sweep concrete pavement and wash free of stains, discolorations, dirt and other foreign material just prior to final inspection.

3.7.2 Drill test cores where directed by Engineer, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with portland cement concrete bonded to pavement with epoxy adhesive.

END OF SECTION 32 13 13

# SECTION 32 91 13

# SOIL PREPARATION

## PART 1 - GENERAL

### 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.

### 2. SUMMARY

a. Section includes planting soils specified by composition of the mixes.

b. Related Requirements:
   1) Section 32 92 00 "Lawns and Grasses" for turf (lawn) planting, hydroseeding, and erosion-control measures.
   2) Section 32 93 00 "Plants" for trees, shrubs, ground covers, and other plants as well as border edgings and mow strips.
   3) Section 33 46 00 "Bioretention Systems" for bioretention soil mixture and placement.

### 3. DEFINITIONS

a. Backfill: The earth used to replace or the act of replacing earth in an excavation. This can be amended or unamended soil as indicated.

b. CEC: Cation exchange capacity.

c. Compost: The product resulting from the controlled biological decomposition of organic material that has been sanitized through the generation of heat and stabilized to the point that it is beneficial to plant growth.

d. NAPT: North American Proficiency Testing Program. An SSSA program to assist soil-, plant-, and water-testing laboratories through interlaboratory sample exchanges and statistical evaluation of analytical data.

e. Organic Matter: The total of organic materials in soil exclusive of undecayed plant and animal tissues, their partial decomposition products, and the soil biomass; also called "humus" or "soil organic matter."

f. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified as specified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

g. SSSA: Soil Science Society of America.

h. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

i. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.

j. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil"; but in disturbed areas such as urban environments, the surface soil can be subsoil.

k. USCC: U.S. Composting Council.

## 4. PREINSTALLATION MEETINGS

a. Preinstallation Conference: Conduct conference at Project site.

## 5. QUALITY ASSURANCE

a. Testing Agency Qualifications: An independent, state-operated, or university-operated laboratory; experienced in soil science, soil testing, and plant nutrition; with the experience and capability to conduct the testing indicated; and that specializes in types of tests to be performed.

1) Laboratories: Subject to compliance with requirements, provide testing by one of the following:
   a) Virginia Tech Soil Testing Laboratory: 145 Smyth Hall (MC 0465), 185 Ag Quad Lane, Blacksburg, VA 24061, www.soiltest.vt.edu.
   b) Waypoint Analytical: 7621 Whitepine Road. Richmond, VA 23237. 1-804-743-9401, www.waypointanalytical.com.

2) Multiple Laboratories: At Contractor's option, work may be divided among qualified testing laboratories specializing in physical testing, chemical testing, and fertility testing.

## 6. PRECONSTRUCTION TESTING

a. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction soil analyses on existing, on-site soil.

1) Notify Architect three days in advance of the dates and times when laboratory samples will be taken.

b. Preconstruction Soil Analyses: For each unamended soil type, perform testing on soil samples and furnish soil analysis and a written report containing soil-amendment and fertilizer recommendations by a qualified testing agency performing the testing according to "Soil-Sampling Requirements" and "Testing Requirements" articles.

1) Have testing agency identify and label samples and test reports according to sample collection and labeling requirements.

## 7. SOIL-SAMPLING REQUIREMENTS

a. General: Extract soil samples according to requirements in this article.

b. Sample Collection and Labeling: Have samples taken and labeled by Contractor.

1) Number and Location of Samples: Minimum of three representative soil samples from topsoil stockpile.
2) Procedures and Depth of Samples: According to USDA-NRCS's "Field Book for Describing and Sampling Soils."
3) Labeling: Label each sample with the date, location keyed to a site plan or other location system, visible soil condition, and sampling depth.

## 8. TESTING REQUIREMENTS

a. General: Perform tests on soil samples according to requirements in this article.

b. Physical Testing:

1) Soil Texture: Soil-particle, size-distribution analysis by the following methods according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods":
a) Hydrometer Method: Report percentages of sand, silt, and clay.

c. Chemical Testing:

1) CEC: Analysis by sodium saturation at pH 7 according to SSSA's "Methods of Soil Analysis - Part 3- Chemical Methods."

d. Fertility Testing: Soil-fertility analysis including the following:

1) Percentage of organic matter.
2) Buffered acidity or alkalinity.
3) Phosphorous ppm.
4) Potassium ppm.

5) Presence and quantities of problem materials including salts and metals cited in the Standard protocol. If such problem materials are present, provide additional recommendations for corrective action.
6) Other deleterious materials, including their characteristics and content of each.

e. Organic-Matter Content: Analysis using loss-by-ignition method according to SSSA's "Methods of Soil Analysis - Part 3- Chemical Methods."

f. Recommendations: Based on the test results, state recommendations for soil treatments and soil amendments to be incorporated to produce satisfactory planting soil suitable for healthy, viable plants indicated. Include, at a minimum, recommendations for nitrogen, phosphorous, and potassium fertilization, and for micronutrients.

1) Fertilizers and Soil Amendment Rates: State recommendations in weight per 1000 sq. ft. for 6-inch depth of soil.
2) Soil Reaction: State the recommended liming rates for raising pH or sulfur for lowering pH according to the buffered acidity or buffered alkalinity in weight per 1000 sq. ft. for 6-inch depth of soil.

## 9. DELIVERY, STORAGE, AND HANDLING

a. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and compliance with state and Federal laws if applicable.

b. Bulk Materials:

1) Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2) Do not move or handle materials when they are wet or frozen.
3) Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates.

# PART 2 PRODUCTS

## 1. PLANTING SOILS SPECIFIED BY COMPOSITION

a. General: Soil amendments, fertilizers, and rates of application specified in this article are guidelines that may need revision based on testing laboratory's recommendations after preconstruction soil analyses are performed.

b. Topsoil: ASTM D5268. Soil must be fertile, friable topsoil of loamy character without admixture of subsoil material. Have topsoil tested by a certified soil testing laboratory to determine the type and quantity of soil amendments necessary.

1) Sources: Reuse surface soil stockpiled on-site.

a) Verify suitability of stockpiled surface soil to produce viable topsoil. Clean surface soil of roots, plants, sod, stones larger than 1 inch, clay lumps, and other extraneous materials harmful to plant growth.
b) Supplement with imported or manufactured topsoil from off-site sources when quantities are insufficient. Obtain topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 4 inches deep, and not from agricultural land, bogs or marshes; that do not contain undesirable organisms; disease-causing plant pathogens; or obnoxious weeds and invasive plants including, but not limited to quackgrass, Johnsongrass, poison ivy, nutsedge, nimblewill, Canada thistle, bindweed, bentgrass, wild garlic, ground ivy, perennial sorrel, and bromegrass.

2) Additional Properties of Soil before Amending: Soil reaction of pH 5.5 to 7 and minimum of 4 percent organic-matter content, friable, and with sufficient structure to give good tilth and aeration.
3) Unacceptable Properties: Clean soil of the following:

a) Unacceptable Materials: Concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
b) Unsuitable Materials: Stones, roots, plants, sod, clay lumps, and pockets of coarse sand that exceed a combined maximum of 8 percent by dry weight of the imported soil.
c) Large Materials: Stones, clods, roots, clay lumps, and pockets of coarse sand exceeding 1 inch in any dimension.

## 2. INORGANIC SOIL AMENDMENTS

a. If topsoil analysis indicates the need for inorganic soil amendments, apply the following standards.

b. Lime: ASTM C602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:

1) Class: O, with a minimum of 95 percent passing through a No. 8 sieve and a minimum of 55 percent passing through a No. 60 sieve.
2) Form: Provide lime in form of ground dolomitic limestone.

c. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent elemental sulfur, with a minimum of 99 percent passing through a No. 6 sieve and a maximum of 10 percent passing through a No. 40 sieve.

## 3. ORGANIC SOIL AMENDMENTS

a. If topsoil analysis indicates the need for organic soil amendments, apply the following standards.

b. Compost: Well-composted, stable, and weed-free organic matter produced by composting feedstock, and bearing USCC's "Seal of Testing Assurance," and as follows:

1) Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.
2) Reaction: pH of 5.5 to 8.
3) Soluble-Salt Concentration: 5 to 10 dS/m.
4) Moisture Content: 35 to 55 percent by weight.
5) Organic-Matter Content: 50 percent of dry weight.
6) Particle Size: Minimum of 98 percent passing through a 3/4-inch sieve.

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, debris, and material harmful to plant growth.

## 4. FERTILIZERS

a. If topsoil analysis indicates the need for inorganic soil amendments, apply the following standards.

b. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1) Composition: 1 lb/1000 sq. ft. of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
2) Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.

# PART 3 EXECUTION

## 1. GENERAL

a. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in planting soil.

## 2. PLACING AND MIXING PLANTING SOIL OVER EXPOSED SUBGRADE

a. General: Apply and mix unamended topsoil with amendments on-site to produce required planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.

b. Subgrade Preparation: Till subgrade to a minimum depth of 4 inches. Remove stones larger than 1-1/2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

1) Apply, add soil amendments, and mix approximately half the thickness of unamended soil over prepared, loosened subgrade according to "Mixing" Paragraph below. Mix thoroughly into top 2 inches of subgrade. Spread remainder of planting soil.

c. Mixing: Spread unamended soil to total depth of 6 inches, but not less than required to meet finish grades after mixing with amendments and natural settlement. Do not spread if soil or subgrade is frozen, muddy, or excessively wet.

1) Amendments: Apply soil amendments, except compost, and fertilizer, if required, evenly on surface, and thoroughly blend them with unamended soil to produce planting soil.

a) Mix lime and sulfur with dry soil before mixing fertilizer.
b) Mix fertilizer with planting soil no more than seven days before planting.

d. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

e. Restore planting beds if eroded or otherwise disturbed after finish grading and prior to planting.

## 3. BLENDING PLANTING SOIL IN PLACE

a. General: Mix amendments with in-place, unamended soil to produce required planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.

b. Preparation: Till unamended, existing soil in planting areas to a minimum depth of 6 inches. Remove stones larger than 1-1/2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

c. Mixing: Apply soil amendments and fertilizer, if required, evenly on surface, and thoroughly blend them into full depth of unamended, in-place soil to produce planting soil.

1) Mix lime and sulfur with dry soil before mixing fertilizer.
2) Mix fertilizer with planting soil no more than seven days before planting.

d. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

## 4. APPLYING COMPOST TO SURFACE OF PLANTING SOIL

a. Application: Apply 1 inch to surface of in-place planting soil, excluding all areas planted with meadow grasses and wildflowers. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.

b. Finish Grading: Grade surface to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

## 5. PROTECTION

a. Protect areas of in-place soil from additional compaction, disturbance, and contamination. Prohibit the following practices within these areas except as required to perform planting operations:

1) Storage of construction materials, debris, or excavated material.
2) Parking vehicles or equipment.
3) Vehicle traffic.
4) Excavation or other digging unless otherwise indicated.

b. If planting soil or subgrade is overcompacted, disturbed, or contaminated by foreign or deleterious materials or liquids, remove the planting soil and contamination; restore the subgrade as directed by Architect and replace contaminated planting soil with new planting soil.

## 6. CLEANING

a. Protect areas adjacent to planting-soil preparation and placement areas from contamination. Keep adjacent paving and construction clean and work area in an orderly condition.

b. Remove surplus soil and waste material including excess subsoil, unsuitable materials, trash, and debris and legally dispose of them off Owner's property unless otherwise indicated.

1) Dispose of excess subsoil and unsuitable materials on-site where directed by Owner.

**END OF SECTION 32 91 13**

# SECTION 32 92 00

# LAWNS AND GRASSES

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. The provisions of the Contract Documents apply to the work of this Section.

### 1.2 SUMMARY

A. This Section includes the following:

1. Fine grading and preparing lawn areas (including courtyards)
2. Topsoil Placement
3. Soil amendments
4. Fertilizers
5. Seeding
6. Hydroseeding

### 1.3 DEFINITIONS

A. Finish Grade: Elevation of finished surface of planting soil.

B. Lawns: All areas disturbed by construction and not otherwise covered by paving, buildings or other structures. Excluding athletic fields. (See Specification 02921)

### 1.4 SUBMITTALS

A. Certification by product manufacturer that the following products supplied comply with requirements:

1. Grass Seed
   a) Certification of grass seed from seed vendor for each grass-seed 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.
   b) Blue tag certification for each bag of seed.

B. Installers qualifications

1. Provide a list, with references, of the past three projects of a similar magnitude.

C. Topsoil Amendment Plan.

1. Provide copy of topsoil testing report.
2. List of amendments proposed for topsoil, including application rates.

## 1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer, who has successfully completed lawn establishment projects similar in size and complexity to this project. The installer's primary business (defined as a minimum of 60% of total billings) shall be establishment of lawns.

## 1.6 DELIVERY, STORAGE, AND HANDLING

A. Seed: Deliver seed in original sealed, labeled, and undamaged containers.

## 1.7 COORDINATION AND SCHEDULING

A. Planting Season: Sow lawn seed during normal planting seasons for type of lawn work required:

1. Bermuda Grass Lawn Areas: April 15- August 15

B. Weather Limitations: Proceed with planting only when existing and forecast weather conditions are suitable for work.

C. Lawn Seeding Schedule

1. Refer to the drawings for early seeding requirements for specified lawn areas.
2. If job completion schedule does not allow seeding within a normal planting season, provide interim temporary seeding necessary to stabilize site. Complete permanent seeding during the next planting season.

## 1.8 LIMITS OF SEEDING

A. Spread topsoil and seed lawn areas. Hydroseed all slopes greater than 3:1.

# PART 2 – PRODUCTS

## 2.1 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" or larger in any dimension and other extraneous materials harmful to plant growth.

1. Topsoil Source: Reuse surface soil stockpiled on-site. Verify suitability of stockpiled surface soil to produce topsoil. Clean surface soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.
    a) Supplement with imported or manufactured topsoil from off-site sources when quantities are insufficient. Obtain topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 4 inches (100 mm) deep; do not obtain from agricultural land, bogs or marshes.

B. Have topsoil tested by a certified soil testing laboratory to determine the type and quantity of soil amendments necessary. Add amendments to topsoil as necessary to meet these requirements.

## 2.2 INORGANIC SOIL AMENDMENTS

A. If the topsoil analysis indicates the need for inorganic soil amendments, the following standards apply:

B. Lime: ASTM C 602, agricultural limestone containing a minimum 80 percent calcium carbonate equivalent and as follows:

1. Class: Class O, with a minimum 95 percent passing through No. 8 (2.36-mm) sieve and a minimum 55 percent passing through No. 60 (0.25-mm) sieve.

2. Provide lime in form of dolomitic limestone.

C. Sulfur: Granular, biodegradable, containing a minimum of 90 percent sulfur, with a minimum 99 percent passing through No. 6 (3.35-mm) sieve and a maximum 10 percent passing through No. 40 (0.425-mm) sieve.

D. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.

E. Aluminum Sulfate: Commercial grade, unadulterated.

F. Perlite: Horticultural perlite, soil amendment grade.

G. Agricultural Gypsum: Finely ground, containing a minimum of 90 percent calcium sulfate.

H. Sand: Clean, washed, natural or manufactured, free of toxic materials.

I. Diatomaceous Earth: Calcined, diatomaceous earth, 90 percent silica, with approximately 140 percent water absorption capacity by weight.

J. Zeolites: Mineral clinoptilolite with at least 60 percent water absorption by weight.

## 2.3 ORGANIC SOIL AMENDMENTS

A. If the topsoil analysis indicates the need for organic soil amendments, the following standards apply:

B. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 3/4-inch (19-mm) 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: 50 percent of dry weight.
2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.
3. 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.
4. Wood Derivatives: Decomposed, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture, free of chips, stones, sticks, soil, or toxic materials.
5. 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.

## 2.4 HERBICIDES

A. Selective Herbicides: EPA registered and approved, of type recommended by manufacturer for application.

## 2.5 FERTILIZER

A. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of 4 percent nitrogen and 20 percent phosphoric acid.

B. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.

C. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in topsoil analysis reports from a qualified soil-testing agency.
2. Minimum Composition: No less than 1 lb/1000 sq. ft. (0.45 kg/92.9 sq. m) of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.

## 2.6 SEED

A. Grass Seed: All grass seed must be fresh, clean, and dry.

B. Seed Species

1. Hulled Yukon Bermuda applied at 200 lbs/acre

a) Quality:
(1) Seed type shall be as listed below for solar exposure and shall bear an official “NC Certified Seed” label. Tags must be attached to each bag delivered on site.
(2) .Seed of grass species as listed below for solar exposure, with not less than 85 percent germination, not less than 95 percent pure seed, and not more

than 0.5 percentseed:

b) Full Sun:

(1) 80 percent Bermudagrass (Cynodon dactylon).

## 2.7 MULCHES

A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.

B. Pine Straw: Fresh, dry and free from debris, pine cones, or soil. Slash Pine is preferred.

C. Peat Mulch: 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.

D. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1-inch (25-mm) 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: 50 percent of dry weight.

E. 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.

## 2.8 EROSION-CONTROL MATERIALS

A. Erosion-Control Fiber Mesh: Biodegradable twisted jute or spun-coir mesh, a minimum of 0.92 lb/sq. yd. (0.5 kg/sq. m), with 50 to 65 percent open area. Include manufacturer's recommended steel wire staples, 6 inches (150 mm) long.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. Examine areas to receive lawns and grass for compliance with requirements and for conditions affecting performance of the Work. Do not proceed with installation until 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.

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.

C. Protect adjacent and adjoining areas from hydroseed overspray.

## 3.3 TOPSOIL PLACEMENT FOR LAWNS

A. Limit subgrade preparation to areas that will be planted in the immediate future.

B. Loosen subgrade to a minimum depth of 6 inches. Remove stones, sticks and roots larger than 1.5-inches in any dimension from subgrade. Completely remove trash and other extraneous debris from subgrade.

C. Have topsoil tested by a certified soil testing laboratory to determine the type and quantity of soil amendments necessary.

D. Sift topsoil to remove stones and other objects larger than 1” in any dimension. Sift topsoil to remove stones and other objects larger than ½” in any dimension in all playing fields. Maximum object size for topsoil shall be achieved by sifting not by hand removal or raking following placement of topsoil.

E. Mix soil amendments and fertilizers with topsoil at rates required by soil testing. Delay mixing fertilizer if planting does not follow placing of planting soil within 4 days. Either mix soil before spreading or apply soil amendments on surface of spread topsoil and mix thoroughly into top 4 inches (100 mm) of topsoil before planting.

F. Mix lime with dry soil prior to mixing fertilizer.

G. Mix three inches (3”) of topsoil into the top six inches (6”) of loosened soil.

## 3.4 SEEDING LAWNS

A. Sow seed with a spreader or a seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph (8 km/h). Evenly distribute seed by sowing equal quantities in 2 directions at right angles to each other.

B. Do not use wet seed or seed that is moldy or otherwise damaged in transit or storage.

C. Sow seed at the following rates:

1. Seeding Rates:

a) General Lawn Areas- 200 lbs./acre.

D. Rake seed lightly into top 1/4 inch of topsoil, roll lightly, and water with fine spray.

E. Hydroseed all slopes 3:1 or steeper.

F. Protect seeded areas 3:1 slope/grade or steeper against erosion by providing erosion-control blankets installed and stapled according to manufacturer's recommendations.

G. Protect seeded areas less than 3:1 slope/grade against erosion by spreading straw mulch after completion of seeding operations. Spread uniformly at a minimum rate of 2 tons per acre (45 kg per 100 sq. m) to form a continuous blanket 1-1/2 inches (38 mm) loose depth over seeded areas. Spread by hand, blower, or other suitable equipment.

1. Anchor straw mulch by crimping into topsoil by suitable mechanical equipment.

## 3.5 MAINTENANCE OF NEW LAWNS

A. Begin maintenance of lawns immediately after each area is planted and continue until acceptable lawn is established. Maintain seeded lawns until Substantial Completion. Maintain all grassed areas as necessary to ensure a satisfactory lawn is achieved at Substantial Completion.

B. Maintain and establish lawns 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. Replant bare areas with same materials as for lawns.

   2. Replace disturbed mulch.

C. Watering: Provide and maintain temporary hoses, and lawn-watering equipment to convey water from a water source to keep lawns uniformly moist to a depth of 4 inches.

   1. Provide a source of water for irrigation. Utilize temporary irrigation meters, a well or water trucks as necessary for the water source.

   2. Water seeded areas as necessary to promote vigorous growth of grass but at the minimum rate of 1 inch per week.

   3. Water sodded areas per the requirements of the grower. Maintain moist soil to a depth of at least four inches.

D. Mow lawns as soon as there is enough top growth to cut with mower set at indicated height. Repeat mowing as required to maintain indicated height without cutting more than 40 percent of the grass height (minimum of 3 mowings). 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 following grass height:

   1. Mow grass to a finished height of 3 inches high.

E. Apply pre-emergent herbicide to lawns areas. Apply 60 – 90 days after planting.

## 3.6 SATISFACTORY LAWN

A. Seeded lawns shall be considered satisfactory/acceptable provided requirements, including maintenance, have been met and a healthy, uniform, close stand of grass is established, free of weeds, bare spots exceeding 5 by 5 inches (125 by 125 mm), and surface irregularities.

B. Replant lawns that do not meet requirements and continue maintenance until lawns are satisfactory/acceptable.

C. Substantial Completion of the building and the remainder of the project may be achieved (pending prior Architect and Owner approval) before achieving a satisfactory/acceptable lawn. Continue to replant and maintain unsatisfactory/unacceptable lawn areas until acceptance is obtained. Warranties for lawns shall begin at the time of acceptance of the lawn.

## 3.7 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by lawn work from sidewalks and paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto surface of 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 until lawn is established.

**END OF SECTION 32 92 00**

SECTION 32 92 00 – SOIL EROSION AND SEDIMENTATION CONTROL

PART 1 - GENERAL

1.1 Contractor shall take every reasonable precaution throughout construction to prevent the erosion of soil and the sedimentation of streams, lakes, reservoirs, other water impoundments, ground surfaces, or other property as required by State and Local regulations.

1.2 The Contractor shall install all required silt fences, and construction entrances at the initiation of work, and have these measures reviewed and approved by the local permit authority prior to clearing and grading operations.

1.3 The Contractor shall, within 15 days of suspension or completion of land disturbing activities, provide permanent protective covering for disturbed areas. Temporary and permanent erosion control measures shall be coordinated to assure economical, effective, and continuous erosion and siltation control throughout the construction and post-construction period. Use the specified seed for both temporary and permanent seeding.

PART 2 - PRODUCTS

2.1 Asphalt for anchoring mulch shall be Type SS-1 Emulsion.

2.2 Fertilizer shall be 10-10-10 grade or equivalent.

2.3 Lime shall be dolomitic agricultural ground limestone containing not less than 10 percent magnesium oxide.

2.4 Mulch shall be small grain straw, hay, wood chips, asphalt emulsion, jute or other suitable material free of undesirable weed seed.

2.5 Phosphate shall be 20 percent superphosphate or equivalent.

2.6 Seed shall be 20% carpet grass, 24% Bermuda, 20% turf Fescue, 10% Creeping Red Fescue, and 24% Annual Rye grain. Bermuda seed shall be hulled for warm weather planting and unhulled for cool weather planting. Purity of seed shall be a minimum of 98 percent and germination shall be a minimum of 85 percent.

2.7 Silt fence shall consist of NCDOT Class A fabric supported by wood or metal posts spaced not more than 6 feet on center. The bottom of the fabric shall be buried a minimum of 6 inches.

2.8 Gravel for check dams shall be #57 washed stone.

2.9 Aggregate for construction entrance shall be #4 washed stone.

2.10 Stone rip rap for check dams and erosion control shall be NCDOT Class A or B as shown.

PART 3 - EXECUTION

3.1 General: Take every practicable measure during construction or suspension to work to minimize erosion and siltation. Measures should include good construction practices, temporary physical barriers to sediment travel, settling basins for new ditches, and establishment of vegetative cover.

3.2 Construction Practices

3.2.1 Avoid dumping soil or sediment into any wetland or watercourse.

3.2.2 Maintain an undisturbed vegetative buffer where possible between a natural watercourse and trenching and grading operations.

3.2.3 Avoid equipment crossings of streams, creeks, and ditches where practicable.

3.2.4 Grade all cut, fill and ditch slopes to minimum slope of 3:1, unless otherwise shown or directed.

3.3 Temporary Physical Barriers are required where sedimentation on off site property or excessive erosion is a problem.

3.3.1 Mulch shall be used for temporary stabilization of areas subject to excessive erosion and for protection of seedbeds after planting where required.

1. Apply grain straw and hay at a rate of 75 to 100 pounds per 1000 square feet and wood chips at a rate of 500 pounds per 1000 square feet. Jute and mesh should be installed as per manufacturer's instructions.

2. Asphalt emulsion for slope stabilization should be applied at a rate of 1,000 gallons per acre. Asphalt emulsion used for anchoring straw should be applied at a rate of 150 gallons per ton of straw.

3.3.2 Silt Fences shall be used at the base of slopes to restrict movement of sediment from the site. Clean silt fence of accumulated sediment after each rainfall event or when it exceeds a depth of 0.5 feet above natural grade.

3.3.3 Stone Check Dams, placed at the discharges of creeks, ditches, and swales, shall consist of Class A rip rap at minimum two feet high and three feet thick across the watercourse, with a one foot thick layer of gravel on upstream side. Remove sediment if accumulated to a depth of 1.0 feet at upstream face.

3.4 Vegetative Cover: Establish and maintain permanent vegetative cover on all unpaved areas disturbed by the work.

3.4.1 Preparation of Seedbed: Areas to be seeded shall be scarified to a depth of 4 inches and until a firm, well pulverized, uniform seedbed is prepared. Lime, phosphorous and

fertilizer shall be applied during the scarification process in accordance with the following rates:

Lime: 45 pounds per 1000 square feet
Phosphorous: 20 pounds per 1000 square feet
Fertilizer: 17 pounds per 1000 square feet

3.4.2 Seeding: Disturbed areas shall be seeded with 2 to 3 pounds per 1000 square feet of the specified seed mixture. Seed shall be worked into the bed to a depth of 1/4 inch. Regrade and seed eroded areas immediately

3.4.3 Mulch all areas immediately after seeding. Mulch shall be applied and anchored as specified hereinbefore. Reapply as necessary to retain cover until grass is established.

3.5 Construction Entrance: Provide an aggregate drive, 20 feet wide by 50 feet long by 6 inches thick at each entrance to the site used by construction vehicles, until such time as the permanent roadway is constructed. Remove soil if accumulated to a depth greater than 0.5 inches.

3.6 Maintenance: The Owner and Contractor shall be responsible for maintaining all temporary and permanent erosion control measures. Temporary structures shall be maintained until such time as vegetation is firmly established in the area protected by the structure. Permanent streambank protection and grassed areas shall be maintained until completion of the project. Areas that fail to show a suitable stand of grass or which are damaged by erosion shall be immediately repaired.

END OF SECTION 32 92 00

# SECTION 32 93 00

# EXTERIOR PLANTS

## PART 1 – GENERAL

### 1.1 RELATED DOCUMENTS

A. The provisions of the Contract Documents apply to the work of this Section.

### 1.2 SUMMARY

A. This Section includes the following:

1. Trees
2. Shrubs
3. Groundcovers
4. Other Plant Materials
5. Stakes & Guys

### 1.3 SUBMITTALS

A. Installers Qualifications: Provide a list, with references, of the past three projects of similar scope.

B. Product Data: For each type of product indicated.

C. Plant Material Certifications:

1. Certificates of inspection as required by governmental authorities.
2. Label data substantiating that plant materials comply with specified requirements.

D. Planting Schedule:

1. Typewritten planting schedule.
2. Once accepted, revise dates only as approved in writing and submitted to Architect.

E. Maintenance Schedules: Typewritten instructions recommending procedures for maintenance of landscape work for one full year. Submit prior to completion of project.

### 1.4 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer, who has successfully completed planting projects similar in size and complexity to this project. The installer's primary business (defined as a minimum of 60% of total billings) shall be exterior plant installation.

B. Installer's Field Supervision: Installer to maintain an experienced full-time supervisor on the project site when exterior planting is in progress.

C. Exterior Plant Materials:

1. Provide plant materials of quantity, size, genus, species, and variety indicated on the Drawings.

2. All plant materials and work shall comply with recommendations and requirements of ANSI Z60.1 "American Standard for Nursery Stock."

3. Do not make substitutions. If specified landscape material is not obtainable, submit proof of non-availability to Architect, together with proposal for use of equivalent material.

4. The Architect may inspect plant materials either at place of growth or on site before planting, for compliance with requirements for genus, species, variety, size, and quality. Architect retains right to further inspect trees for size and condition of balls and root systems, insects, injuries and latent defects, and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees immediately from project site.

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

## 1.5 DELIVERY, STORAGE AND HANDLING

A. Packaged Materials:

1. Deliver packaged materials in containers showing weight, analysis, and name of manufacturer or grower.

2. Protect materials from deterioration during delivery, and while stored at site.

B. Exterior Plant Materials

1. Protect bark, branches, and root systems from sun scald, drying, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of exterior plants during delivery. Do not drop exterior plants during delivery.

2. Deliver exterior plant materials after preparations for planting have been completed and plant immediately. If planting is delayed more than 6 hours after delivery, set plant materials in shade, protect from weather and mechanical damage, and keep roots moist and free from frost.

3. Do not remove container-grown stock from containers until planting time.

4. Balled and burlapped material shall be freshly dug.

5. Handle planting stock by root ball.

## 1.6 PROJECT CONDITIONS

A. Examine the subgrade, verify the elevations, and observe the conditions under which work is to be performed. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the installer.

B. Determine location of underground utilities and perform work in a manner which will avoid possible damage. Hand excavate as required.

C. When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, notify Architect before planting.

D. Provide all necessary safeguards for the protection of all planted areas until provisional inspection/acceptance is accomplished.

E. Planting Restrictions: Plant during one of the following periods.

1. Spring Planting: Unfrozen soil conditions March 1-June 1st.
2. Fall Planting: September 1-November 1st or until frozen soil conditions prevent work.
3. Summer Planting: June 1 – September 1 with approved irrigation system.

F. Coordination with Lawns: Install plant materials after finish grades are established and before planting lawns, unless otherwise acceptable to the Architect.

1. When planting exterior plants after lawns, protect lawn areas and promptly repair damage caused by planting operations.

## 1.7 WARRANTY

A. Warranty exterior plant materials for a period of one year after date of Final Completion against defects including death and unsatisfactory growth, except for defects resulting from neglect by Owner, abuse or damage by others, or unusual phenomena or incidents which are beyond Contractor’s control.

1. The Contractor shall provide written notice to the Architect of any practice which will affect the warranty if not remedied promptly. The Architect will render an opinion of the conflict if necessary.
2. Make replacements of all dead plants or plants in impaired condition (more than 25% dead or dying) condition in early spring/fall following installation. Replacements of dead or rejected plants should again be made prior to the expiration of the warranty period.

## 1.8 MAINTENANCE

A. The Owner is responsible for maintaining all exterior plant material throughout the warranty period according to the submitted Maintenance Schedule.

B. Remove all stakes and guy wires at the end of the 12-month guarantee period.

## 1.9 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt existing utilities serving facilities occupied by the Owner or others except when permitted in writing by the Civil Engineer and then only after acceptable temporary utility services have been provided.

1. Provide a minimum 48-hours' notice to the Civil Engineer and receive written notice to proceed before interrupting any utility.

B. The location of existing underground utilities indicated are approximate only. Field locate all existing underground utilities in the area of work, regardless of whether or not they are indicated on the drawings.

2. Hire a private utility locating company and /or utilize “NC one call” by calling 1-800-632-4949 prior to the start of work for assistance in the location of existing underground utilities.

# PART 2 – PRODUCTS

## 2.1 EXTERIOR PLANT MATERIALS

A. General: Provide nursery-grown plant materials complying with ANSI Z60.1, with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock free of disease, insects, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

B. Label at least one tree and one shrub of each variety and caliper with a securely attached, waterproof tag bearing legible designation of botanical and common name.

## 2.2 PLANTS

A. General: Provide healthy, disease-free plants of species and variety indicated. Provide only plants that are acclimated to outdoor conditions before delivery. Provide healthy, field-grown plants from a commercial nursery of species and variety shown or listed. Provide plants with heavy, well-branched tops and a vigorous well-developed root system.

## 2.3 FERTILIZER

A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium. Revise fertilizer mix to remedy deficiencies found in soil.

1. Composition: 1 lb/1000 sq. ft. (0.45 kg/92.9 sq. m. of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.

B. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium. Revise fertilizer mix to remedy deficiencies found in soil.

1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.

## 2.4 MULCHES

1. Organic Mulch: Six (6) month old well rotted double shredded native hardwood bark mulch not larger than 4” in length and 1/2” in width, free of woodchips and sawdust.
2. Pine Straw: Fresh, dry and free from debris, pinecones, or soil. Slash Pine is preferred. Coverage for 3" is one bale per 50sq ft.

## 2.5 WATER

1. Free of substances harmful to plant growth.

## 2.6 TOPSOIL

A. Topsoil: ASTM D 5268, pH range of 5.5 to 7, a minimum of 4 percent organic material content. Topsoil shall be fertile, friable, natural topsoil of loamy character, without admixture of subsoil material, obtained from a well-drained arable site, reasonably free from clay, lumps, coarse sands, stones, plants, roots, sticks and other foreign materials.

B. Topsoil Source:

1. Reuse surface soil stockpiled on-site. Verify suitability of stockpiled surface soil to produce topsoil. Clean surface soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.
    a) Supplement with imported or manufactured topsoil from off-site sources when quantities are insufficient. Obtain topsoil displaced from naturally well-drained sites where topsoil occurs at least 4 inches (100 mm) deep; do not obtain from agricultural land**,** bogs or marshes.
2. Import topsoil or manufactured topsoil from off-site sources. Obtain topsoil displaced from naturally well-drained sites where topsoil occurs at least 4 inches (100 mm) deep; do not obtain from agricultural land**,** bogs or marshes.
3. Amend existing in-place surface soil to produce topsoil. Verify suitability of surface soil to produce topsoil. Clean surface soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.

a) Surface soil may be supplemented with imported or manufactured topsoil from off-site sources. Obtain topsoil displaced from naturally well-drained sites where topsoil occurs at least 4 inches (100 mm) deep; do not obtain from agricultural land, bogs or marshes.

## 2.7 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 (2.36-mm) sieve and a minimum 75 percent passing through No. 60 (0.25-mm) sieve.
2. Class: Class O, with a minimum 95 percent passing through No. 8 (2.36-mm) sieve and a minimum 55 percent passing through No. 60 (0.25-mm) sieve.
3. Provide lime in form of dolomitic limestone.

B. Sulfur: Granular, biodegradable, containing a minimum of 90 percent sulfur, with a minimum 99 percent passing through No. 6 (3.35-mm) sieve and a maximum 10 percent passing through No. 40 (0.425-mm) 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.

H. Diatomaceous Earth: Calcined, diatomaceous earth, 90 percent silica, with approximately 140 percent water absorption capacity by weight.

I. Zeolites: Mineral clinoptilolite with at least 60 percent water absorption by weight.

## 2.8 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 3/4-inch (19-mm) 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: 50 to 60 percent of dry weight.
2. Feedstock: Agricultural, food, or industrial residuals; bio-solids; yard trimmings; or source-separated or compostable mixed solid waste.

B. Sphagnum peat moss: Sphagnum peat moss shall be partially decomposed, finely divided or granular texture, with a pH range of 3.4 to 4.8.

C. 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.

D. Wood Derivatives: Decomposed, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture, free of chips, stones, sticks, soil, or toxic materials.

1. In lieu of decomposed wood derivatives, mix partially decomposed wood derivatives with at least 0.15 lb (2.4 kg) of ammonium nitrate or 0.25 lb (4 kg) of ammonium sulfate per cubic foot (cubic meter) of loose sawdust or ground bark.

E. Manure: Well-rotted, unleached, poultry, 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.

## 2.9 MISCELLANEOUS PRODUCTS

a. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's written instructions.

# PART 3 – EXECUTION

## 3.1 EXAMINATION

A. Examine areas to receive exterior plants for compliance with requirements and conditions affecting installation and performance. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 PREPARATION

A. Tree save areas as indicated shall be tagged and approved by the Architect prior to any clearing and/or thinning.

B. Protect structures, utilities, sidewalks, pavements, and other facilities, and lawns and existing exterior plants from damage caused by planting operations.

C. 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.

D. Lay out individual tree and shrub locations and areas for multiple exterior plantings. Stake locations, outline areas, adjust locations when requested, and obtain Landscape Architect's acceptance of layout before planting. Make minor adjustments as required.

E. Lay out exterior plants at locations indicated. Stake locations of individual trees and shrubs and outline areas for multiple plantings.

F. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks, branches, stems, twigs, and foliage to protect during digging, handling, and transportation.

1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.

## 3.3 PLANTING BED ESTABLISHMENT

A. Loosen subgrade of planting beds to a minimum depth of 4 inches (100 mm). Remove stones larger than 1 inch (25 mm) in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off of Owner's property.

1. Apply fertilizer directly to subgrade before loosening.
2. 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.

B. Finish Grading: Grade planting beds to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

C. Restore planting beds if eroded or otherwise disturbed after finish grading and before planting.

## 3.4 TREE AND SHRUB PLANTING

A. Set all plant materials plumb and in center of pit or trench as per detail.

1. Remove burlap and wire baskets from tops of root balls and partially from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
2. Carefully remove root ball from container without damaging root ball or plant.
3. Backfill with an amended soil blend consisting of five (5) parts native soil, one (1) part organic amendment and one (1) lb. fertilizer.
4. Place planting soil mix around root ball in layers, tamping to settle mix and eliminate voids and air pockets. When pit is approximately one-half backfilled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed. Water again after placing and tamping final layer of planting soil mix.
5. Spread roots without tangling or turning toward surface, and carefully work backfill around roots by hand. Puddle with water until backfill layers are completely saturated. Plumb before backfilling and maintain plumb while working backfill around roots and placing layers above roots. Tamp final layer of backfill. Remove injured roots by cutting cleanly, do not break.
6. Form a ring of soil around the edge of each planting pit to retain water.

B. Organic Mulching: Apply 3-inch (75-mm.) average thickness of organic mulch extending 12 inches (300 mm) beyond edge of planting pit or trench. Do not place mulch within 3 inches (75 mm) of trunks or stems.

## 3.5 TREE AND SHRUB PRUNING

A. Prune, thin, and shape trees and shrubs as indicated.

## 3.6 GROUND COVER AND PLANT PLANTING

A. Set out and space ground cover and plants as indicated in details.

B. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.

## 3.7 CLEANUP AND PROTECTION

A. During exterior planting, keep adjacent pavings and construction clean and work area in an orderly condition.

B. Protect exterior plants from damage due to landscape operations, operations by other contractors and trades, and others. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged exterior planting.

## 3.8 DISPOSAL

A. Disposal: Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.

**END OF SECTION 32 93 00**

# Technical Specification 018

# WATER DISTRIBUTION SYSTEM

## 1.0 General

a) It is the intent of this specification to ensure that all water system infrastructure constructed within the service area of the Brunswick County Public Utilities Department meets or exceeds all local, state, and federal rules and regulations as applicable. This specification also provides technical guidance to contractors and engineers to ensure that all water system infrastructure is properly constructed, tested, chlorinated, and placed in service to protect the public.

## 2.0 Materials and Requirements for Water Mains

a) General

1) To the maximum extent possible all materials shall be manufactured in the United States. This includes all pipe, valves, fittings, hydrants, meter boxes, etc.

2) All pipe material shall be marked with the manufacturer, type, class, thickness, and date of production in lettering legible to the Engineer and County staff.

3) The engineer is responsible for reviewing all shop submittals for approval. County staff may assist as needed to answer any questions concerning material suitability.

4) All piping material must have a minimum pressure rating of one and one-half (1.5) times the normal working pressure of the pipe.

5) All pipes, valves, hydrants, fittings, etc., must conform to the applicable AWWA standards.

6) Water mains shall be constructed of AWWA C900 PVC, minimum DR-18, except when DIP, HDPE, or Fusible PVC mains are required.

7) All pipes shall be shipped with gaskets installed inside the pipe bell.

8) Water main installation shall conform to AWWA C600: Standard for Installation of Ductile Iron Pipe (DIP), or AWWA C605: Standard for Installation of Polyvinyl Chloride (PVC) pipe

b) Ductile Iron Pipe (DIP)

1) All sizes of pipe shall be manufactured to a nominal laying length of 18'-0" to 20'-0", except to make adjustments for bends, tees, and other fittings.

2) DIP shall conform to ANSI / AWWA C150 / A21.50 and ANSI / AWWA C151 / A21.51, with interior cement mortar lining and an exterior asphaltic coating for corrosion resistance.

3) Cement mortar linings shall conform to ANSI A21.4 / AWWA C104.

4) DIP that has an interior lining of Protecto 401 (or equivalent) for use in sewer systems shall not be permitted on potable water systems.

5) Joints shall be the push-on or mechanical joint type conforming to ANSI / AWWA C111 / A21.11 as modified by ANSI / AWWA C151 / A21.51.

6) Fittings and specials shall be cast or ductile iron conforming to ASNI 21.10 and shall be rated for one hundred and fifty (150) pounds per square inch minimum pressure.

7) Wall thickness shall be in accordance with Table 51.1 of ANSI/AWWA C151/A21.51 with working pressure of one hundred and fifty (150) psi. Final pipe class shall be determined based on specific structural calculations as they relate to conditions encountered during design. Brunswick County reserves the right to designate the final pipe thickness.

a) (4) inch – (12) inch diameter pipe: minimum pressure class 350

b) (14) inch – (20) inch diameter pipe: minimum pressure class 250

c) (24) inch pipe: minimum pressure class 200

d) Flanged pipe shall be minimum pressure Class 53

8) Rubber gaskets and lubricant shall conform to ANSI/AWWA C111/A21.11.

9) No metric sized pipe shall be permitted.

10) In corrosive, contaminated, and dredged soils, DIP and all fittings shall be wrapped in a polyethylene encasement per ANSI / AWWA A21.5 / C105 *Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids*. All fasteners shall be stainless steel Type 304, minimum grade.

11) Acceptable products are American Cast Iron Pipe Company, Griffin Pipe Company, U.S. Pipe Company, or approved equal.

c) Polyvinyl Chloride Pipe (PVC)

1) All sizes of pipe shall be manufactured to a nominal laying length of 18'-0" to 20'-0" except to make adjustments for bends, tees, and other fittings.

2) Two (2) inch PVC mains shall be SDR-21, gasketed pipe, in accordance with ASTM D2241 and shall bear the seal of the National Sanitation Foundation (NSF).

3) Four (4) inch through twelve (12) inch PVC mains shall be AWWA C900 Class 150 (DR-18) and shall bear the seal of the NSF. Joints shall conform to ASTM D3139 or ASTM D3212.

4) Fourteen (14) inch through thirty-six (36) inch PVC mains shall be AWWA C900 Class 235 (DR-18) and shall bear the seal of the NSF. Joints shall conform to ASTM D3139 or ASTM D3212.

5) PVC mains shall be manufactured with PVC material conforming to PVC 1120.

6) Fittings shall be molded PVC with joints similar to the PVC pipe. Fabricated fittings using solvent welded joints are not acceptable. Fittings may also be DIP fittings listed and approved for use with PVC pipe and shall have a cement mortar lining on the interior and an asphaltic coating on the exterior for corrosion resistance.

7) All PVC water mains shall be factory dyed industry standard blue.

8) Push on joints shall conform to ASTM D3139 with an elastomeric gasket and the joint pressure rating shall not be less than the pipe pressure rating.

9) In corrosive, contaminated, and dredged soils, all fittings shall be wrapped in a polyethylene encasement per ANSI / AWWA A21.5 / C105 *Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids*. All fasteners shall be stainless steel Type 304, minimum grade.

10) Acceptable products are Diamond Plastics Corporation, J M Eagle Manufacturing Company, National, Certainteed, North American, or approved equal.

d) Fusible Polyvinyl Chloride (Fusible PVC)

1) Fusible PVC pipe shall be in the four (4) inch to thirty-six (36) inch diameter range.

2) Fusible PVC shall be AWWA C900 with National Sanitation Foundation (NSF) certifications NSF– 61 and NSF – 14.

3) Fusible PVC shall conform to ASTM cell classification 12454.

4) Fusible PVC shall have a minimum safety factor of two (2.0).

5) Fusible PVC shall be joined by the thermal butt fusion method in accordance with ASTM F-1674 and D-638.

6) Four (4) through twenty-four (24) inch Fusible PVC (DIPS) shall be minimum DR-18.

7) Thirty (30) inch Fusible PVC (DIPS) shall be DR-25.

8) Thirty-six (36) inch Fusible PVC (DIPS) shall be DR-32.5.

9) All Fusible PVC water mains shall be factory dyed industry standard blue.

10) Fittings and specials shall be as stated in Section (4.0) of this specification.

11) Acceptable products are Fusible PVC ™ by Underground Solutions, Inc.

e) High Density Polyethylene Pipe (HDPE)

1) HDPE mains shall be high density polyethylene conforming to AWWA C906 with PE 4710 materials and shall conform to ASTM F714 specification for HDPE pipe.

2) HDPE shall be joined by the thermal butt fusion method in accordance with ASTM D3261.

3) HDPE shall be minimum DR-9 rated at a minimum two hundred (250) pounds per square inch.

4) All HDPE water mains shall have a factory standard blue stripe on the pipe.

5) Fittings and specials for HDPE mains shall be per the HDPE manufacturer's recommendations and shall be submitted as shop submittals by the utility contractor to the engineer for review and approval prior to use. All fittings and specials shall conform to ASTM D3350 for fittings materials.

6) HDPE used for horizontal directional drills (HDD) shall have the pipe diameter increased in order to maintain equivalent inside diameter as the open cut installed pipe it connects to.

7) Acceptable products are Mono-Line Pipe System by Joseph T. Ryerson and Sons, Inc.; Driscopipe 1000 by Phillips Products, Inc.; Sclairpipe by Dupont of Canada; JM Manufacturing Company Inc. or approved equal.

## 3.0 Materials and Requirements for Water Services

a) Water services that are less than fifty (50) percent of the outside diameter of the supplying main may utilize a wide band body tapping saddle. All other water service connections shall use a tapping sleeve.

b) <u>One (1) inch service lines and tapping saddles – three quarter (¾) inch & one (1) inch meters</u>

1) Service line piping shall be minimum one (1) inch diameter for (3/4) and (1) inch water meters and shall be HDPE tubing, SDR 9, 200 psi, conforming to ASTM D2737 / AWWA C901. No joints are allowed on a service line between the main service tap and the meter stop.

**In proven contaminated soils the service line shall be Type K copper with rated and approved gaskets for contaminated soils.**

2) Service saddles shall be wide band body service saddles, ACIPCO, US Pipe, McDonald, Mueller, Smith Blair, Ford, JCM, Romac, or approved equal. All fasteners shall be minimum high strength alloy steel.

3) Size of tap shall match that of the service line (1-inch minimum tap).

4) The corporation stop shall have AWWA inlet threads, ball type, outlet connection to be CTS /OD, conductive compression type (grip nut). Size of corporation stop shall match that of service line (1-inch minimum). Corporation stops shall be Mueller B 25028, Ford –Ball Corp FB 1100 or 1000, McDonald – Ball Corp 4704 –BT, or approved equal.

c) <u>Two (2) inch service lines and tapping saddles – one and one-half (1.5) inch & two (2) inch meters</u>

(NOTE: As of July 1, 2025, **<u>new</u>** one and one-half (1.5) inch water meters are **<u>not</u>** allowed)

1) Services shall be two (2) inch diameter for one and one-half (1.5) inch and two (2) inch water meters and shall be HDPE tubing, SDR 9, 200 psi, conforming to ASTM D2737 / AWWA C901. No joints are allowed on a service line between the main service tap and the meter stop.

**In proven contaminated soils the service line shall be Type K copper with rated and approved gaskets for contaminated soils**

2) Service saddles shall be wide band body service saddles, McDonald 3800 series, Mueller H 13000 or DR 2S series, Smith Blair 317, Ford FC 202, JCM 406, Romac 202, or approved equal. All fasteners shall be minimum high strength alloy steel.

3) Tapping valve shall be a two (2) inch, resilient wedge gate valve, Mueller A 2360, or approved equal, installed with a valve box and concrete collar per County Standard Detail.

4) Large meter boxes with meter setters are required for one and one-half (1.5) inch and two (2.0) inch water meters and shall be provided by the contractor and shall accommodate the Sensus AMR/AMI water meter. The contractor shall submit the proposed large meter box and lid to the Engineer for approval prior to installing the meter box.

d) Four (4) inch service lines – three (3) inch & four (4) inch meters

1) Service lines shall be four (4) inch diameter for three (3) inch and four (4) inch water meters and may be HDPE, DIP, or PVC material conforming to technical specifications for these materials per Section (3.0) of this Specification. Water meters three (3) inch and larger shall be installed in a meter vault per County Water Standard Details – Large Meter Vaults.

2) Tapping sleeves are required per County Standard Details. Tapping saddles are not allowed on any services larger than two (2) inch. See Section (12) of this specification for tapping sleeve information. All fasteners shall be minimum high strength alloy steel.

e) Services for water meters larger than four (4) inch shall be sized to match the installed meter size.

f) All services shall be installed as shown on the approved plans and the tap shall be made perpendicular to the main and run straight to the meter box or vault. Variations from this requirement due to field conditions are only by approval of the County in advance of installation.

g) Locating wire is required on water services and water mains. See Section (14) of this specification for locating wire information.

h) Service taps shall be made at the 10:00 o'clock or 2:00 o'clock position on the water main. Service taps shall be staggered from one side of the main to the other with a minimum distance of eighteen (18) inches between taps. Taps are to be a minimum twenty (20) inches apart if made on the same side of the main.

i) Services shall not be installed by the contractor until all the mains have passed hydrostatic testing, cleaning, and chlorination results are satisfactory and provided to County staff.

j) No taps are allowed on a fire hydrant leg.

k) No taps are allowed where rodding is in place.

l) No burned taps are allowed.

m) No taps are allowed on horizontally directionally drilled (HDD) pipe.

n) Brunswick County Public Utilities is standardizing on the Sensus AMR / AMI water meter. Water meters shall be Sensus AMR / AMI, or approved equal, and shall be provided with the MXU unit and touch read pad.

o) Water meter boxes for standard 5/8" x 3/4"" water meters shall be:

Single Meter Boxes:

| | |
|---|---|
| Ford | LYLV141-243-TP-NL |
| McDonald | 776-208PC2G437 |
| Mueller | H-1462-K |

1) Or approved equal – all boxes must accommodate the Sensus water meter with AMI/AMR technology to include the MXU unit and touch read pad
2) Water meter boxes for meters larger than 5/8" x 3/4" shall be provided by the contractor and sized appropriately for the meter being installed

Double Meter Boxes:

| | |
|---|---|
| Ford | DGHC118-C14439-002-NL |
| McDonald | 773N208BCGP 434TCX001 |

1) Or approved equal – all boxes must accommodate (2) Sensus ¾-inch water meters with AMI/AMR technology to include the MXU units and touch read pad.

p) All new residential subdivisions that have county public sewer shall install a double water meter box, or two single gang meter boxes, on the one (1) inch service lateral on each lot to accommodate an irrigation meter for separate billing purposes – refer to county water standard detail for water services.

q) Water meters shall be in non-traffic areas. Driveways shall not be formed around meter boxes and the nearest distance from the meter box to the driveway shall be no less than eighteen (18) inches.

r) Large water meter vaults shall be per the County Standard Details for meter vaults. Quazite or GlasMasters polymer concrete enclosures, minimum Tier 22 rating for both the box and lid, are an approved "or equal" to a standard concrete vault. Contact County Engineering with any questions concerning large water meter vaults.

## 4.0 Materials and Requirements for Fittings and Specials

a) Fittings and specials shall be class (54) ductile iron per ANSI / AWWA A21.11 / C111, ANSI / AWWA A21.53 / C153, and ANSI / AWWA A21.51 / C151, minimum class 350 for (18) inch and smaller fittings and minimum class 250 for (20) inch and larger fittings.

b) Profiles of fittings and specials may have special dimensions as required by the pipe manufacturer.

c) Ductile iron fittings and specials shall be cement mortar lined per ANSI / AWWA A21.4 / C104 and have an asphaltic coating on the exterior for corrosion resistance.

d) No metric sized fittings shall be permitted.

e) All fittings to be shipped with gaskets, glands, nuts, and bolts unless specified otherwise. Nuts and bolts shall be high strength alloy steel.

## 5.0 Materials and Requirements for Restrained Joints, Piping, and Fittings

a) Restrained joints are required to prevent movement of system piping caused by forces in or on buried piping, tees, valves, branches, bends, plugs, etc.

b) Restrained joints shall be installed as shown on the approved plans, standard details, or as directed by county staff or the Engineer.

c) Concrete thrust blocking shall be installed as shown on the approved plans, standard details, or as directed by county staff or the Engineer.

d) All carrier pipe installed inside a casing shall be pressure class 350 ductile iron pipes per county standard details with restrained joints.

e) All restrained joint systems shall have a pressure rating equal to or greater than that of the pipe on which they are installed.

f) Restraint type gaskets that provide internal restraint by means of stainless steel inserts embedded within the gasket are not permitted for use in Brunswick County.

g) Ductile Iron Pipe (DIP)

1) Install restraints in strict accordance with the manufacturer's recommendations.

2) All ductile iron horizontal directional drill and bore-and-jack installations shall use boltless, integral, positive locking restraint systems that allow for joint deflection and disassembly should the need arise. The restrained joint system shall be a manufacturer's standard restrained joint system such as American (Flex-Ring or Lok-Ring), U S Pipe (TR-Flex), or Griffin (Snap-Lok), or approved equal.

Note: the aforementioned boltless, integral, positive locking restraint systems are also acceptable for use in open cut pipe installations.

3) External bell restraint harness shall have ductile iron glands. The dimensions of the gland shall be such that it can be used with the standard mechanical joint bell. Twist off nuts with preset factory torque setting shall be used to ensure proper actuation of the restraint device. All nuts, bolts, and fasteners shall be high strength alloy steel. Mechanical joint restraints shall conform to ANSI/AWWA A21.11/C111 and ANSI/AWWA A21.53/C153, latest revision.

The restrained joint system shall be a manufacturer's standard restrained joint system manufactured by EBAA Iron, Inc., Smith-Blair, Inc., JCM, Inc., or approved equal.

4) Restraint for valves and fittings shall have ductile iron glands. Twist off nuts with preset factory torque setting shall be used to ensure proper actuation of the restraint device. All nuts, bolts, and fasteners shall be high strength alloy steel. Mechanical joint restraints shall conform to ANSI/AWWA A21.11/C111 and ANSI/AWWA A21.53/C153, latest revision.

The restrained joint system shall be a manufacturer's standard restrained joint system manufactured by EBAA Iron, Inc., Smith-Blair, Inc., JCM, Inc., or approved equal.

5) Stainless steel rodding and fasteners, Type 304 minimum, is acceptable per county standard details. Manufacturer's restraint system and/or glands are preferred in lieu of rodding.

h) Polyvinyl Chloride Pipe (PVC)

1) Install restraints in strict accordance with the manufacturer's recommendations.

2) External bell restraint harness shall have ductile iron glands. The dimensions of the gland shall be such that it can be used with the standard mechanical joint bell. Twist off nuts with preset factory torque setting shall be used to ensure proper actuation of the restraint device. All nuts, bolts, and fasteners shall be high strength alloy steel. Mechanical joint restraints shall conform to ANSI/AWWA A21.11/C111 and ANSI/AWWA A21.53/C153, latest revision.

The restrained joint system shall be a manufacturer's standard restrained joint system manufactured by EBAA Iron, Inc., Smith-Blair, Inc., JCM, Inc., or approved equal.

3) Restraint for valves and fittings shall have ductile iron glands. Twist off nuts with preset factory torque setting shall be used to ensure proper actuation of the restraint device. All nuts, bolts, and fasteners shall be high strength alloy steel. Mechanical joint restraints shall conform to

ANSI/AWWA A21.11/C111 and ANSI/AWWA A21.53/C153, latest revision.

The restrained joint system shall be a manufacturer's standard restrained joint system manufactured by EBAA Iron, Inc., Smith-Blair, Inc., JCM, Inc., or approved equal.

4) Stainless steel rodding and fasteners, Type 304 minimum, is acceptable per county standard details. Manufacturer's restraint system and/or glands are preferred in lieu of rodding.

## 6.0 Materials and Requirements for Pipe Couplings – 4 inches and larger

a) Provide couplings where needed to make piping connections.

b) Provide full-length, mechanical joint, ductile iron solid sleeve with twelve (12) inch minimum length.

c) Provide ductile iron cut-in sleeve with mechanical restrained joints where installing fittings in an existing line.

## 7.0 Materials and Requirements for Fire Hydrants

a) Hydrants shall be the dry barrel type with breakaway flange, shall open left only, conforming to AWWA Standard C502, latest revision, with a six (6) inch mechanical joint connection on the inlet end, minimum four and one-half (4.5) inch valve opening, and two (2.5) inch hose connections and one (4.5) inch pumper connection, all with American National Standard fire hose coupling threads.

b) Hydrants shall have breakaway barrel and operating stem with barrel length for three (3) foot main cover, six (6) inch bottom hub, and one and one-half (1.5) inch solid operating nut with O-ring seals.

c) Main valve seat shall have bronze to bronze threads into the hydrant shoe. Hydrant shall be grease lubricated with a thrust bearing to reduce operating torque or may be oil lubricated.

d) Hydrants shall be rated at one-hundred–fifty (150) psi working pressure and three-hundred (300) psi test pressure.

e) Hydrants shall be shop painted chrome yellow Tnemenc paint (or approved equal) and shall be touched up after installation and given one (1) field coat of chrome yellow enamel. If the hydrant is painted with color other than chrome yellow from the manufacturer, there shall be three (3) field coats of chrome yellow paint applied by the contractor after installation.

f) Hydrant shall be dry bonnet type and be provided with a drain outlet for draining when the valve is closed and shall be provided with washed stone per County Standard Detail to ensure adequate drainage.

g) All fire hydrants installed on water mains 12-inch and smaller shall be installed as shown on County Standard Detail W-1 using a swivel hydrant tee on the main and DIP and/or MJ GradeLok restrained joint (Mega-A-Lug or equal) piping between the hydrant gate valve and the hydrant. Mega-A-Lug is preferred in lieu of rodding. Thrust blocks are required per detail.

h) All fire hydrants installed on water mains larger than 12-inch shall be installed with a level invert tee on the main and DIP and/or MJ GradeLok restrained joint (Mega-A-Lug or equal) piping between the hydrant gate valve and the hydrant. Mega-A-Lug is preferred in lieu of rodding. Thrust blocks are required per detail.

i) Hydrants shall be installed plumb one-eight (1/8) inch per foot, and set so that the pumper nozzle is eighteen (18) inches minimum above the final finished grade.

j) Contractor shall be allowed one (1) barrel extension as required to maintain pumper nozzle at eighteen (18) inches above final finished grade and the fire hydrant shall not be left too high such that the breakaway will not work properly.

k) Hydrants shall be Mueller, Clow, American Darling, or approved equal.

## 8.0 Materials and Requirements for Building Fire Sprinkler Systems

a) Backflow prevention devices are required on all fire lines and sprinkler systems to prevent cross- contamination of the County's water transmission and distribution system. Refer to the Brunswick County Public Utilities Department's *Cross-Connections and Backflow Protection Policy* for additional information.

b) A lockable post indicator valve (PIV) is required at the right-of-way or easement line on all fire lines to delineate ownership of the fire line between the County and the property owner. The top of the PIV shall be thirty-six (36) inches above finished grade. Refer to County Standard Details for fire lines.

c) Backflow prevention devices shall be installed at the right-of-way or easement line immediately adjacent and downstream of the PIV. With County approval the backflow prevention device may be installed inside a building's mechanical room where the sprinkler riser is located.

e) Where a building utilizes a sprinkler system, or has a Fire Department Connection (FDC), then the required level of backflow protection is a Reduced Pressure Zone (RPZ) backflow preventer.

f) Fire hydrants shall not be installed on private fire lines.

## 9.0 Materials and Requirements for Water System Valves

a) General Information for all Valves

1) Valves shall be installed on all system branches from feeder mains, on hydrant legs, at each end of horizontal directional drills per standard detail, per a), b) and c) as follows, or as directed by county staff or the engineer:

a) Install three (3) valves at crosses

b) Install two (2) valves at tees

c) Install one (1) valve on a fire hydrant leg

2) For distribution mains isolation valves are required at approximately every one-hundred (100) feet per one (1) inch diameter of the installed main up to a maximum distance of two thousand (2,000) feet between valves. For example, for an eight (8) inch diameter main install a main line isolation valve every eight hundred (800) feet. Place mail line isolation valves in close proximity to fire hydrants. Also adjust main line isolation valve placement to take into account subdivision entrances, driveways, fences, street intersections, other underground utilities, etc, or as directed by county staff. Restrained joint pipe is required on the first joint in each direction from a main line valve as per county standard detail

3) For transmission mains - defined as twelve (12) inch and larger - install an isolation valve approximately every two hundred (200) feet per one (1) inch diameter of the installed main up to a maximum distance of five thousand (5,000) feet between valves. Place main line isolation valves near fire hydrants. Also adjust main line isolation valve placement to take into account subdivision entrances, driveways, fences, street intersections, other underground utilities, etc, or as directed by county staff. Restrained joint pipe is required on the first joint in each direction from a main line valve per county standard detail.

4) Place main line isolation valves on the downstream side of the fire hydrant tee per the direction of water flow.

5) Valves shall be located per the approved plans, at the proper elevation, and operable. Hard to operate or inoperable valves and fire hydrants are not acceptable and shall be repaired or replaced prior to system hydrostatic pressure testing.

6) All valves shall open left – no right hand open valves are allowed.

7) Valves shall be rodded to the cross or tee if within ten (10) feet of the cross or tee.

8) All valves shall have a metal screw type valve box with lid marked WATER and a concrete collar (in non-traffic areas) installed per the County Standard Detail for valves and valve boxes. Masonry blocking shall be used to support the valve box such that it does not rest on the bonnet of valve – refer to county standard details. Valve lid shall be painted blue.

9) Maximum depth of the valve stem nut shall be five (5) feet. If valve stem nut is deeper than five (5) feet below grade then a valve operating nut extension kit, manufactured by the same company that produced the valve, must be installed by the utility contractor.

b) Gate Valves

1) All valves shall be in conformance with the latest revision of all reference standards of AWWA C509 / 515: *Resilient Seated Gate Valves for Water Supply Service.*

2) Four (4) inch through twelve (12) inch mains: use resilient wedge gate valves or ¼ turn stainless steel ball valves. No valves smaller than four (4) inch diameter are allowed.

3) All valves shall open left (counter clock wise) – no right hand valves allowed.

4) Valves shall have a two (2) inch metal operating nut with arrow indicating direction of opening.

5) Valves shall be designed for a working pressure of not less than one hundred fifty (150) psi unless specifically approved by county staff or the Engineer.

6) Valves shall be equipped with a non-rising stem. Valves installed in vaults or manholes shall be provided with hand wheel actuators.

7) All valves shall have a screw type valve box and a four (4) inch thick concrete collar in non-traffic areas per county standard detail.

8) Resilient Seated Wedge Gate Valves:

a) Iron body, bronze mounted, double disc, parallel seat type, factory tested to three hundred (300) psi, valve ends to be constructed for use with mechanical joints or push on joints.

b) Bonnet and body flanges shall be fully machined to assure proper sealing of the gasket.

c) Shall have O-Ring sealed stems with one O-Ring located below the thrust collar and with two O-Rings located above the thrust collar. The thrust collar between the two lower O-Rings shall be factory

filled with a lubricant to provide permanent lubrication of the thrust collar area.

d) Provide integrally cast bronze or stainless-steel thrust collar.

e) An antifriction thrust washer shall be provided both above and below the thrust collar for ease of operation.

f) Acceptable product: Mueller, M & H, American Flow Control, Clow, or approved equal.

c) Butterfly Valves

1) Butterfly valves shall be installed on water mains sixteen (16) inch diameter and larger.

2) Butterfly valves shall meet the requirement of AWWA C504, latest revision.

3) Valves shall have mechanical joints.

4) Operating stem and nut shall be two (2) inch and open left only.

5) Resilient and elastomer seats are to be synthetic rubber (EPDM).

6) Shafts to be turned, ground and polished, constructed of 18-8 Type 304 stainless steel.

a) Shafts to be of one-piece design.

b) Attach disc to shaft with stainless steel tapered pins and locking nuts.

7) Provide operators with not less than maximum operator torque, as determined in accordance with Appendix A of AWWA C504, to operate valves under actual line pressures and velocities:

a) Provide worm and gear, or traveling nut type, self-locking to prevent the valve disc from creeping or fluttering when it is in any intermediate position between open and closed.

b) Gear operators to be permanently lubricated, totally enclosed, with adjustable stops for the open and closed position.

c) All exterior fasteners shall be minimum high strength alloy steel.

8) Epoxy coated inside and outside conforming to AWWA C550.

9) Rated for a one hundred fifty (150) psi working pressure.

10) Acceptable product: Mueller, American Darling, Pratt, or approved equal.

d) Tapping Valves – less than 30 inches

1) Tapping valves smaller than thirty (30) inches shall conform to the following:

a) Resilient seated wedge type conforming to AWWA C509 / C515.

b) Epoxy coated inside and outside conforming to AWWA C550.

c) Both ends shall be flanged with tapping boss by mechanical joint conforming to ANSI B16.1, Class 125 and ANSI / AWWA C111 / A21.11 respectively.

d) Rated for two hundred fifty (250) psi working pressure.

e) All exterior fasteners shall be minimum high strength alloy steel

f) Acceptable Product: Mueller T-2360 -16, AVK Series 25, or proved equal.

e) Tapping valves (30) inches and larger

1) Bronze seat, double disk type, conforming to AWWA C500, or resilient seated wedge conforming to AWWA C515.

2) Epoxy coated inside and out conforming to AWWA C550.

3) Equipped with four (4) inch by-pass valves.

4) Ends shall be flanged with tapping boss by mechanical joint conforming to ANSI B16.1, Class 125 and ANSI/AWWA C111/A21.11 respectively.

5) Rated for (200) psi working pressure.

6) Acceptable product: Mueller t-2360 -16, AVK Series 25 or approved equal.

## 10.0 Materials and Requirements for Valve Boxes and Concrete Collars

a) Install per county standard details at each water valve.

b) Cast iron or ductile iron, screw type, with flared base, length as required for the buried valve, Valve Box Adaptor II, by Adaptor Inc., or approved equal.

c) The word “WATER” shall be cast in the cover.

d) The contractor shall spray paint the cover blue after installation.

e) Install precast concrete ring around valve box in unpaved non-traffic areas per county standard detail.

## 11.0 Materials and Requirements for Valve Markers

a) Valve markers shall be installed in rights-of-way and utility easements as shown on the County Standard Details

b) Valve markers in public rights-of-way shall be concrete, extend thirty-six (36) inches above finished grade, with the cast MV (main valve), AV (air release valve), or BO (blow off) facing the nearest street. Valve markers in utility easements shall be fiberglass and extend sixty (60) inches above finished grade. Refer to county standard details for additional information.

c) Valve markers are not required for fire hydrant leg isolation valves.

d) Valve markers shall be painted blue for water mains.

e) Concrete valve markers shall have a bronze, stamped, insert on top of marker per county standard detail.

## 12.0 Materials and Requirements for Tapping Sleeves (services larger than 2 inch)

a) Tapping sleeves shall have outlet flange counter bored to accept a mating tapping valve for true alignment of the tapping sleeve, tapping valve, and tapping machine.

b) Sleeves shall be stainless steel, split type, with gasket and flanged outlet.

c) Sleeve fasteners shall be minimum high strength alloy steel.

d) Provide for a minimum working pressure of one hundred fifty (150) psi.

e) Provide (¾) inch NPT test plug on the tapping sleeve.

f) Tapping sleeve testing – minimum fifty (50) psig, air or water, for five (5) minutes per sleeve manufacturer's recommendations - shall be witnessed by county staff prior to the contractor performing tapping operations on county water mains. No taps are allowed without county staff present.

g) Acceptable tapping sleeves are:

1) Romac, Ford, and Mueller for mains four (4) inches through twenty-four (24) inches diameter.

2) Dresser, Cascade, and JCM for mains thirty (30) inches and larger.

## 13.0 Materials and Requirements for Curb Stops and Water Meter Boxes

a) All new residential subdivisions that have public sewer shall install a double water meter box on each lot to accommodate an irrigation meter.

b) See Section 3.0 (o) of this specification for approved water meter boxes.

c) All single gang water meter boxes will have an in-line curb stop valve and an in-line check valve per county standard detail.

d) All irrigation meters, and all non-residential water meters, must have an approved backflow prevention device installed per county standard detail.

e) Brunswick County is standardizing on the Sensus AMR / AMI water meter. All water meter boxes used in the service area of Brunswick County Public Utilities must accommodate the Sensus AMR / AMI water meter.

## 14.0 Materials and Requirements for Locating Wire, Marking Tape, and Marker Balls

a) Tape shall be three (3) inches wide, blue in color, bearing continuous message "CAUTION WATER LINE BURIED BELOW". Tape shall be made of plastic or other permanent material, and shall be buried continuously above the water main at a depth of eighteen (18) inches below finished grade.

b) All water mains shall have a #12 AWG, high strength copper clad steel conductor (HS-CCS) such as Copperhead Superflex, Pro Trace High Flex, or approved equal, with HDPE insulation, and rated for direct burial. Listed and approved underground connectors shall be used for all splices. The wire shall be brought up in valve boxes per County Standard Detail. In any event, the wire shall be brought up into a valve box at 1,000 feet maximum intervals to provide wire access points. The wire shall be taped to the top of the water main at minimum ten (10) feet intervals.

c) The contractor shall be required to perform a signal strength test of the installed tracer wire at the end of the project with county staff present. Refer to Brunswick County standard details for tracer wire information.

d) Individual water services shall have tracer wire installed from the main to the meter box.

e) In addition to the tracing wire, electronic marker balls shall be installed on the water main in accordance with Brunswick County Technical Specification TS 035: *Electronic Markers for Water and Sewer Pressure Mains.*

## 15.0 Separation of Water Mains and Sewer Mains

a) Horizontal and Vertical Separation

1) Minimum horizontal separation between water mains and sanitary sewer shall be ten (10) feet. The distance shall be measured edge of pipe to edge of pipe.

2) Should ten (10) foot separation not be feasible, then the water main may be located closer to the sewer main provided that:

   a) It is laid in a separate trench,

   b) It is laid in the same trench with the water main located at one side on a bench of undistributed earth,

   c) In either of the above cases, crown elevation of the sewer shall be at least eighteen (18) inches below invert elevation of the water line.

3) Sewers crossing water mains shall be laid to provide a minimum vertical separation of eighteen (18) inches between the invert of the water main and the crown elevation of the sewer main. The crossing shall be arranged perpendicularly so that the sewer main joints will be equidistant and at least ten (10) feet from the crossing in each direction.

4) If it is impossible to maintain the required horizontal and vertical separation as described above or anytime sewer must be laid above a water main, then both the water main and sewer main must be encased in ferrous sleeves. Sleeves shall have sealed ends. If the water main is ferrous with joints equivalent to water main standards, then the water main does not have to be encased within an additional sleeve

5) Mechanical joints will be required for the transition in the sewer main at water main / sewer main crossings. Fernco couplings are not permitted to be used. Special structural support for the water and sewer mains may be required.

## 16.0 Hydrostatic Testing

a) Conduct hydrostatic testing in accordance with AWWA C600 (DIP) or AWWA C605 (PVC) as applicable. Conduct tests on each line or valved section of line. Water mains shall be tested to one-hundred and fifty (150) percent of the pipe working pressure, but in no case shall the hydrostatic test pressure be less than (150) psig for a minimum of two (2) hours and shall be witnessed and certified by county staff and / or the Engineer.

b) Slowly fill the main to expel air from the main through the air release valves, fire hydrants, blow offs, or other appurtenances. If permanent air release valves are not located at all high points, the contractor shall install corporation cocks at such points so that air can be expelled as the line is filled with water. After all the air has been expelled, the corporation cocks shall be closed, and the test pressure

applied. At the end of the pressure test, the corporation cocks shall be removed and plugged.

c) Hydrostatic pressure testing shall not be made until seven (7) days after installation of piping to be tested is backfilled, and a minimum forty-eight (48) hour notice to county staff is required.

d) Directionally drilled pipe must be pressure tested after any manufacturer's required pipe relaxation period, as applicable, to ascertain the successful completion of the directional drill. All directionally drilled piping shall be tested again with the complete system and witnessed by county staff and /or the engineer.

e) A suitable test pump, furnished by the contractor, shall be connected to the line by means of a tap in the line, or other suitable methods, and the proper test pressure slowly applied to the line.

## 17.0 Water Main Flushing and Chlorination

a) Conduct disinfection in accordance with AWWA C651 and 15A NCAC 18C .1003 before placing a newly installed water main in service:

1) Upon completion of construction thoroughly flush the water main to remove all sediment, stone, and other foreign matter.

2) Hydrostatically pressures test the water main per Section (16) of this specification.

3) The water main shall be disinfected by the addition and thorough dispersion of a chlorine solution in concentrations sufficient to produce a chlorine residual of at least fifty (50) milligrams per liter (or ppm) in the water throughout the water main system.

4) All installed valves or other appurtenances shall be operated several times while line is filled with chlorinating agent to ensure proper filling of the entire system.

5) The chlorine solution shall remain in contact with the interior surfaces of the piping system for a minimum period of twenty-four (24) hours.

6) At end of retention period flush the system with potable water. At least (10) ppm of chlorine shall remain in the water at the extreme end of the system.

7) If the initial disinfection procedure fails to produce satisfactory laboratory results the system must be disinfected again as needed by the contractor until satisfactory results are obtained.

8) Originals of the laboratory test results shall be provided to county staff.

b) Acceptance:

1) Provide separate samples for each sample location free of coliform bacteria:

a) Contractor shall submit water samples to an approved laboratory for testing.

b) Contact County Engineering or Public Utilities for assistance and verification of sampling – a minimum forty-eight (48) hour notice is required.

c) The sample results shall include the free chlorine residual at the time the samples were collected.

d) All sample locations are to be given an identifying label.

e) The certified laboratory results shall indicate the absence of coliform bacteria in the water samples.

2) At a minimum, sample locations shall be as required by NCDENR and the following:

a) The tie-in location of new and existing water lines.

b) The end of all dead-end lines.

c) At intervals of no more than (1,200) feet for all new lines longer than (1,200) feet in length.

c) Disposal of Chlorinated Water

1) The contractor is cautioned that the spent chlorine solution must be disposed of in such a way as not to be detrimental to animal, plant, or fish life.

## 18.0 Operation of Brunswick County Water System Valves and Fire Hydrants

a) No county valves or hydrants shall be operated by the contractor without prior approval of county staff.

b) All hydrant and blow-off operations shall be done in a manner so that private property is not impacted and there shall be no flooding of streets, driveways, or roadways or any other traffic problems created.

c) The contractor shall contact county staff prior to performing system flushing or blow-off operations with a minimum forty-eight (48) hour notice.

# Technical Specification 020

# GRAVITY SANITARY SEWER SYSTEM

## 1.0 General

a) It is the intent of this specification to ensure that all gravity sewer system infrastructure constructed within the service area of Brunswick County Public Utilities meets or exceeds all local, state, and federal rules and regulations as applicable. It is also the intent of this specification to provide the technical guidance needed to the utility contractor to ensure that county gravity sewer system infrastructure is properly constructed, tested, and placed in service. Service laterals shall be installed where shown on the drawings or as directed by the county's representative. Excavation, trenching, and backfilling is covered in Brunswick County Technical Specification TS 013: *Excavating, Grading, Trenching, and Backfilling*.

## 2.0 References

a) ASTM D1784 - Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

b) ASTM D1785 - Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 20.

c) ASTM D2241 - Poly (Vinyl Chloride) (PVC) Pressure-rated pipe (SDR Series).

d) ASTM D2152 - Test Method for Degree of Fusion of Extruded Poly (Vinyl Chloride) (PVC) Pipe and Molded Fittings by Acetone Immersion.

e) ASTM D2321 - Underground Installation of Flexible Thermoplastic Sewer Pipe.

f) ASTM D2412 - External Loading Properties of Plastic Pipe by Parallel-Plate Loading.

g) ASTM D2444 - Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight).

h) ASTM D3034 - Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

i) ASTM D3212 - Elastomeric push-on joints for plastic pipe.

j) AWWA C600 - Installation of Ductile - Iron water mains and appurtenances.

k) AWWA C900 - PVC Pressure Pipe 4 inch through 60 inch.

l) ASTM D2672 - Bell-End Poly (Vinyl Chloride) (PVC) Pipe.

m) ASTM F477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

n) ASTM F478 - Precast Concrete Manhole Risers and Tops.

o) ASTM C497 - Concrete Pipe, Manhole Sections, or Tile.

p) ASTM F679 - Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.

q) ASTM A746 - Ductile Iron Gravity Sewer Pipe.

r) ASTM F794 - Poly (Vinyl Chloride) (PVC) Ribbed Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.

s) AWWA C600 - Standard for Installation of Ductile Iron Pipe Mains and Appurtenances

t) ASTM A536 – Standard Specification for Ductile Iron Castings

u) ASTM A48 – Standard Specification for Gray Iron Castings

v) ASTM F2764 – Standard Specification for 6 to 60 in [150 to 1500 mm] Polypropylene (PP) Corrugated Double and Triple Wall Pipe and Fitting for Non-Pressure Sanitary Sewer Applications

w) ASTM C478 – Standard Specification for Circular Precast Reinforced Concrete Manhole Sections

x) ASTM C1244 – Standard Test method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill

y) ASTM D3350 – Standard Specification for Polyethylene Plastics Pipe and Fittings Materials

## 3.0 Materials and Requirements for Gravity Sewer Mains

a) General

1) To the maximum extent possible all materials shall be manufactured in the United States. This includes all pipe, valves, fittings, hydrants, meter boxes, etc.

2) All pipe material shall be marked with the manufacturer, type, class, thickness, and date of production in lettering legible to county staff.

3) The engineer is responsible for reviewing all shop submittals for written approval. County staff may assist to answer any questions concerning shop submittals.

4) All pipes, manholes, fittings, etc., must conform to AWWA standards.

5) The minimum vertical ground cover over a gravity sewer main shall be thirty-six (36) inches.

6) Gravity sewer mains shall be constructed of C900 DR-18 PVC piping. Ductile iron pipe (DIP) may only be used with express written permission of Brunswick County Public Utilities or Engineering Department.

7) All pipes shall be shipped with gaskets installed inside the pipe bell.

8) Restraint type gaskets that provide internal restraint by means of stainless steel inserts embedded within the gasket are **not** permitted for use in Brunswick County.

9) PVC sewer mains shall be factory dyed industry standard green.

b) Polyvinyl Chloride Pipe (PVC)

1) Sewer mains with depth of earth cover three (3) feet to ten (10) feet:

a) Eight (8) inch through twelve (12) inch PVC mains shall be C900 DR-18 or better conforming to ASTM D3034. Joints shall conform to ASTM D3139 or ASTM D3212.

b) Fourteen (14) inch through thirty-six (36) inch PVC mains, unless specified as DIP, shall be AWWA C900 Class 235 (DR-18). Joints shall conform to ASTM D3139 of ASTM D3212.

2) Sewer mains with depth of earth cover ten (10) feet to twenty (20) feet:

a) Eight (8) inch through twelve (12) inch PVC mains shall be C900 DR-18 or better conforming to ASTM D3034. Joints shall conform to ASTM D3139 or ASTM D3212.

b) Fourteen (14) inch through thirty-six (36) inch PVC mains, unless specified as DIP, shall be AWWA C900 Class 235 (DR-18). Joints shall conform to ASTM D3139 of ASTM D3212.

3) Sewer mains with depth of earth cover greater than twenty (20) feet:

a) Pipes installed at depths greater than twenty (20) feet shall be constructed of C900 DR-18 or better per manufacturer's recommendations based on depth and soils classification. DIP may be allowed with the express written permission of Brunswick County Utilities or Engineering Department.

4) All PVC mains shall be manufactured with PVC material conforming to PVC 1120.

5) Fittings shall be molded PVC with joints similar to the PVC pipe. Fabricated fittings using solvent welded joints are not acceptable. Fittings may also be DIP fittings listed and documented as approved for use with PVC pipe and shall have an asphaltic coating on the exterior for corrosion resistance, and an interior lining of ceramic epoxy Protecto 401, Ceramapure PL90 (or equivalent), unless otherwise shown or specified.

6) Acceptable products are Diamond Plastics Corporation, J M Eagle Manufacturing Company, National, Certainteed, North American, U.S. Composite Pipe or written approved equal.

c) Ductile Iron Pipe (DIP)

1) Ductile iron pipe (DIP) may only be used with express written permission of Brunswick County Public Utilities or Engineering Department.

2) If DIP is required, it shall conform to ANSI / AWWA C150 / A21.50 and ANSI / AWWA C151 / A21.51, with an exterior asphaltic coating for corrosion resistance, and an interior lining of Protecto 401 Ceramapure PL90 (or equivalent) unless otherwise shown or specified.

3) All sizes of pipe shall be manufactured to a nominal laying length of 18'-0" or 20'-0", except to make adjustments for bends, tees, and other fittings.

4) Joints shall be the push-on or mechanical joint type conforming to ANSI / AWWA C111 / A21.11 as modified by ANSI / AWWA C151 / A21.51.

5) Rubber gaskets and lubricant shall conform to ANSI / AWWA C111 / A21.11.

6) No metric sized pipe shall be permitted.

7) If DIP is required, and the soils are found to be corrosive, then all DIP and fittings shall be wrapped in a polyethylene encasement per ANSI / AWWA A21.5 / C105 *Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids*.

8) Acceptable products are American Cast Iron Pipe Company, Griffin Pipe Company, U.S. Composite Pipe, or written approved equal.

d) Installation

1) Contractor shall install PVC gravity sewer mains in accordance with ASTM D2321. Ductile iron mains shall be installed in accordance with AWWA C600. Both types of material installations shall adhere to excavation, trenching, and backfilling standards as covered in Brunswick County Technical Specification TS 013: *Excavating, Grading, Trenching, and Backfilling*.

2) Pipe shall be installed starting from the lowest point and shall be laid with the spigot ends pointing in the direction of flow.

3) Gravity sewer trenches shall be kept free of standing water during installation by use of a pump. If deemed necessary prior to or during construction, well point systems should be used for dewatering.

4) All mains shall have locating tape, and shall be as follows:

   a) Tape shall be three (3) inches wide, green in color, bearing continuous message "CAUTION SEWER LINE BURIED BELOW".

   b) Tape shall be made of plastic or other permanent material.

   c) Tape shall be buried continuously above the gravity sewer main at a depth of eighteen (18) inches below finished grade.

5) No sewer line of any type shall pass through any storm drain structure unless first approved by county staff in writing.

6) When a transition is required from a PVC sewer main to ductile iron pipe sewer main, mechanical joints will be used. Mechanical joints shall conform to AWWA C111. Bolts shall be high strength low alloy steel per AWWA C111.

7) When installing a gravity or force main above or below a water main or storm drain, all minimum separations and material requirements must be met, as defined by 15 NCAC 02T .0305 and 15A NCAC 18C .0906 (b) and (c); outlined below:

   a) Gravity sewer mains shall be laid at least ten (10) feet horizontally from existing or proposed water mains, unless local conditions or barriers prevent a 10-foot separation, in which case;

   b) The sewer main shall be C900 DR-18 or better and shall be laid in a separate trench, with eighteen (18) inch minimum separation between the invert of the water main and the crown of the sewer main; or the water main shall be laid in the same trench as the sewer, with the water main located at one side on a bench of undisturbed earth and with the elevation of the bottom of the water main at least eighteen (18) inches above the top of the sewer.

   c) When a gravity sewer main crosses a water main, the sewer main will be built to water main rules (15A NCAC 18C .0906); where one full length of water pipe shall be located so that both joints will be as far from the sewer as possible.

d) When a gravity sewer main crosses a storm sewer or other utilities, eighteen (18) inch minimum separation must be achieved. If this separation cannot be achieved, the gravity main shall be constructed in a manner concurrent with Brunswick County standard detail S-15.

e) When a gravity sewer main crosses a reclaimed water line, eighteen (18) inch minimum vertical (reclaimed over sewer) or two (2) feet horizontal separation must be achieved.

## 4.0 Materials and Requirements for Sewer Services

a) General

1) Pipe and fittings for four (4) inch and six (6) inch gravity sewer services shall be constructed of SCH 40 PVC pipe conforming to ASTM D178 with solvent welded joints.

2) Sewer services shall be installed in accordance with county standard details.

3) All services shall be single services. No double services are to be installed.

b) Installation

1) All gravity sewer services are to be installed using a wye angled downstream of the main.

2) The service wye should be turned to the top quadrant of the gravity main – approximately (45) degrees from the top centerline of the main. In no case, shall the service laterals be stacked vertically over the gravity main.

3) Gravity sewer services shall be installed perpendicular to the gravity main.

4) Wherever possible, gravity services shall be tied into a gravity line.

5) Services shall be installed so that they meet minimum clearances from existing and proposed utilities, such as eighteen (18) inch minimum separation below a water main. If clearances cannot be met, then gravity sewer services shall be constructed of SCH 40 PVC pipe or better.

6) The minimum vertical ground cover over a gravity sewer lateral shall be twenty-four (24) inches (thirty-six (36) inches if in NCDOT right-of-way).

7) Sewer services shall terminate with a wye to a surface cleanout complete with square nut cap, cast iron box, and cover marked “C/O” or “SEWER”. The invert of the wye shall be capped with a watertight plug for future plumbing connection. See county standard details.

8) Install a 4”x4”x 6’ treated timber marker at the property or easement line behind the service cleanout for location of the service. The timber shall be installed with 2’ buried and 4’ visible above final grade.

9) Services shall be installed at a minimum grade of 1/8 inch per foot. Service termination grade shall be at adequate depth for future plumbing connection.

## 5.0 Materials and Requirements for Manholes

a) General

1) To the maximum extent possible all materials shall be manufactured in the United States. This includes all precast and drop manholes, frames, grates, covers, etc.

2) To protect against hydrogen sulfide corrosion, polypropylene and precast polymer concrete manholes are the preferred materials for gravity sewer manholes. Concrete manholes shall not be used as receiving manholes or where pressurized sewer mains enter the manhole.

3) Joint surfaces between bases, risers and cones shall be manufactured to the joint surface design and tolerance requirements of ASTM C76.

4) Flexible joint sealants shall be butyl rubber-based conforming to Federal Specification SS-S-210A, AASHTO M-198, Type B - Butyl Rubber and as follows: maximum of 1% volatile matter and suitable for application temperatures between 10- and 100-degrees F.

5) Pipe to manhole connectors shall conform to ASTM C923. The location of the pipe connectors shall vary from the location shown on the project plans by no more than (1/2) inch vertically and five (5) degrees horizontally. Provide for control of the pipe OD to within the tolerances of the connector on flexible pipes larger than twelve (12) inches.

6) Manholes shall have a minimum inside diameter of four (4) feet for sewer mains eighteen (18) inches diameter and smaller and shall be five (5) feet inside diameter for sewer mains larger than eighteen (18) inches. Larger inside diameters may be required for larger pipe sizes, more than two pipes, or when entrance/exit angles require a larger manhole.

7) The receiving manhole in a gravity sewer main line immediately before the lift station shall be polymer concrete and have a minimum inside diameter of five (5) feet.

8) Where pressurized sewer mains connect to a gravity sewer manhole structure, a minimum four (4) feet inside diameter plastic polypropylene or polymer concrete manhole structure shall be used.

9) When a watertight manhole is to be used due to flood plain location, a vent pipe shall be installed for proper ventilation of the manhole. Refer to county standard details.

10) All manhole covers are to be clearly marked "Sanitary Sewer".

11) Manhole steps shall be provided in bases, risers, and cones and aligned vertically on center. Steps shall be cast in place or, if approved by the County, secured to the wall with a compression fit in tapered holes. Steps shall not be vibrated or driven into freshly cast concrete or grouted in place. The steps shall be Copolymer Polypropylene Plastic reinforced with a ½" diameter grade 60 bar and have serrated tread and tall end lugs. Step pullout strength shall be tested per ASTM C497.

12) All manhole frames and covers shall conform to ASTM A48.

13) Sanitary sewer covers shall utilize lifting bars instead of pick holes.

14) Standard covers shall have up to four (4), one (1) inch diameter vent holes.

15) Watertight manhole covers are required for all manholes where the rim elevation is less than two (2) feet above the 100-year flood elevation or the 500-year flood elevation, whichever is lower.

16) The maximum separation between manholes shall be 400 feet, unless otherwise approved by Brunswick County in writing.

17) Outside drop manholes, for new construction, shall be provided where invert separations exceed 2.5 feet (30 inches).

18) Acceptable manufacturers of watertight manhole frames and covers are US Foundry, Capitol Foundry, East Jordan, or written approved equal.

b) Plastic Polypropylene Manhole Structures

1) Plastic polypropylene manhole structures shall have a minimum inside diameter of four (4) feet. The installation of a plastic polypropylene manhole must be according to the manufacturer's specifications and written approval by Brunswick County.

2) Plastic polypropylene manhole structures shall follow manufacturer specifications for minimum angles between adapters when connecting sewer mains.

3) Four (4) feet inside diameter and larger polypropylene manhole structures shall be fabricated from triple wall pipe made from an impact modified copolymer polypropylene meeting the material requirement of ASTM F2764. The body riser shall be provided with an integrally cast into a reinforced concrete base meeting the requirements of ASTM C478.

The base and riser shall meet the performance requirements outlined in ASTM C1244. The eccentric cone reducer shall be manufactured from polyethylene material meeting ASTM D3350 cell class 213320C. Water tight connections meet the testing requirements of ASTM D3212.

4) All plastic polypropylene manhole installations shall conform to manufacturer specifications for maximum allowable depth and deep burial installation requirements.

5) All new drop manhole structures shall be outside drop.

6) All plastic polypropylene manhole structure frames and covers shall conform to ASTM A48, unless otherwise specified by the manufacturer.

c) Concrete Manholes

1) Concrete shall conform to ASTM C478 and as follows:

a) Compressive strength: 4000 psi minimum at 28 days.

b) Air Content: 4 percent minimum.

c) Cementitious Materials: Minimum of 564 pounds per c.y.

d) Coarse Aggregates: ASTM C33.

e) Fine Aggregates: ASTM C33. Free from organic impurities.

f) Chemical Admixtures: ASTM C494. Calcium Chloride or admixtures containing calcium shall not be used.

g) Air Entraining Admixtures: ASTM C260.

2) Mortar shall be Type S conforming to ASTM C270.

3) Brick shall be used to bring concrete manhole rings to grade or filler for forming manhole inverts only and shall conform to ASTM C62 Grade SW or ASTM C32 Grade MS.

4) Concrete manholes shall have an eccentric cone. Concrete manholes four (4) feet deep or less may have a flat top.

5) Concrete manholes shall have a minimum six (6) inch extended base.

6) Concrete manholes shall not be used as receiving manholes or where pressurized sewer mains enter the manhole.

7) New concrete drop manholes shall be outside drop, unless otherwise approved by Brunswick County in writing. Where approved, inside drop manholes shall have a minimum inside diameter of five (5) feet.

8) Acceptable manufacturers of standard manhole frames and covers are US Foundry, Capitol Foundry, East Jordan, General Foundries, or written approved equal.

9) Each concrete manhole shall be equipped with an insert of high-density polymer meeting the requirements of ASTM 124. Concrete manholes located in traffic areas shall have stainless steel sewer guards.

10) Concrete manhole interiors shall be factory coated with a minimum twenty (20) mils coal tar epoxy or other County written approved coating, except where polymer concrete is used.

11) Where pressurized sewer mains connect to an existing gravity sewer manhole, the manhole shall be polymer concrete or plastic polypropylene to protect against hydrogen sulfide corrosion. Where pressurized sewer mains connect to a gravity sewer manhole, the inside diameter of the manhole shall be four (4) feet minimum.

    It may be required to replace the existing manhole with a plastic polypropylene manhole structure, or precast polymer concrete manhole.

12) All damage to pre-cast concrete sections shall be thoroughly repaired. Repair and patching of minor breaks shall be done by chipping and scarifying the defective area before application of grout. Pre-cast sections shall be subject to rejection on account of failure to conform to any of the specification requirements. In addition, individual sections of manhole sections may be rejected because of fractures or cracks passing through the wall, except for a single end crack that does not exceed the depth of the joint; defects that indicate imperfect proportioning, mixing, and molding; surface defects indicating honey-combed or open texture; damaged or cracked end, where such damage would prevent making a satisfactory joint; and/or any continuous crack having a surface which width of 0.01 inches or more and extending for a length of twelve (12) inches or more, regardless of position in the section wall.

13) For concrete manholes, all joints, cracks, lifting nooks inside the manhole are to be grouted to prevent infiltration. All interior grouting shall be covered in a field coat of coal tar epoxy. All exterior joints are to be wrapped with flat butyl rubber tape.

d) Installation

1) Setting:

a) The contractor is responsible for getting the manhole tops to proper grade. The top of the pre-cast manhole may be brought to proper grade for receiving manhole frames by using precast riser rings, unless otherwise approved for masonry in writing. Masonry construction shall be performed by experienced and qualified workmen. All work shall be laid plumb, straight, level, square, and true. Total extensions may not be made greater than six (6) inches – limited to three (3) courses. If needed, manhole riser sections with precast steps shall be used.

b) Manholes shall be set on a minimum of eight (8) inches of #57 crushed stone on a level undisturbed or well compacted subgrade.

c) Manhole structures are to be level upon completion.

d) Butyl rubber sealing shall be placed between each manhole riser section. Backing tape shall be removed prior to application and a sufficient amount of sealant shall be used to completely seal the joint.

e) Four (4) feet inside diameter polypropylene manhole structures shall be installed using conventional flexible pipe backfill materials and procedures. The backfill material and installation guidelines shall be specified by the manufacturer on the standard installation detail and may vary based on local conditions. Bedding material shall be well placed and uniformly compacted. The maximum standard burial depth of the four (4) feet polypropylene manhole structure is sixteen (16) feet.

2) Connections:

a) All in place penetrations into manholes must be by core boring methods including main line and service drops. Properly sized elastomeric boots shall be set in penetrations. The boot and the pipe must be fully mortared on the inside and the outside of the manhole.

b) The invert channels shall be (3/4) the depth of the largest pipe and shall be smooth and semicircular in shape conforming to the inside of the adjacent sewer section. Changes in direction of flow shall be made with a smooth curve of as large a radius as the size of the manhole will permit. Changes in size and grade of channels shall be made gradually and evenly. The invert channels shall be formed directly in the concrete of the manhole base or shall be built up with solid brick and Type S mortar.

c) All main or service connections made above the shelf, not exceeding thirty (30) inches, shall have a slide constructed with brick and type S mortar. Slide shall be formed at the connection in a semicircular fashion conforming to the inside of the connected pipe. The slide shall be gradually angled toward the downstream invert of the gravity main for smooth flow. Connections made above thirty (30) inches will require a drop. Refer to Brunswick County standard details.

d) All plastic polypropylene manhole structures shall be outside drop. Concrete drop manholes shall be outside drop unless otherwise approved by county staff in writing. All hardware used to anchor the drop pipe shall be Type 316 stainless steel. Refer to county standard details.

3) Frames and Covers:

a) For four (4) feet inside diameter polypropylene manhole structures in H-20 traffic load rated applications, a concrete load ring shall be poured in place around the grate and frame. The concrete slab must be designed taking into consideration local soil conditions, traffic volume, and other applicable design factors. For other considerations such as deep burials, ground water, and soft foundations refer to the manufacturer.

b) Four (4) feet inside diameter plastic polypropylene manhole structures shall have ductile iron covers and iron castings that fit the structures so that they become an integral component of the structure when installed and are supplied by Nyloplast ®.

c) Covers for four (4) feet inside diameter plastic polypropylene manhole structures shall be capable of supporting various wheel loads as specified by the manufacturer. Ductile iron used on the manufacture of the castings shall conform to ASTM A536 grade 70-50-05, and Nyloplast ® standard drawing 7001-110-222 Rev D, or written approved equal. Manhole covers shall be provided painted black.

d) For concrete and polymer concrete manholes, standard frames are to be centered over the precast opening of the manhole, sealed with butyl rubber sealant, and mortared into place inside and out. Mortar inside shall be coated with field coat of coal tar epoxy along with all other grouted surfaces.

e) For concrete and polymer concrete manholes, standard frames and covers shall have high density copolymer inserts in non-traffic areas, and stainless-steel inserts in traffic areas.

f) For watertight concrete manholes, frames are to be centered over the precast opening of the manhole, sealed with butyl rubber sealant, bolted down, and mortared into place inside and out. Mortar inside shall be coated with field coat of coal tar epoxy along with all other grouted surfaces.

g) Watertight frames and covers do not require an insert.

## 6.0 Requirements for Connections to Existing Gravity Sewer Systems

a) Connections to Existing Mains

1) Connection of a new gravity sewer collection main to an existing gravity sewer collection main shall be made by installation of a new "doghouse" manhole at the connection point. Refer to Brunswick County standard details.

2) Connection of a new gravity sewer service to an existing gravity sewer main shall be made by use of a tapping saddle in accordance with county standard details.

3) Where two or more mains of different diameters enter a sanitary sewer manhole, it is required to match the crown elevations of the different size pipes.

## 7.0 Requirements for Testing and Completion

a) Preparation

1) All personnel and materials needed for satisfactory testing of gravity systems are to be supplied by the contractor. All procedures will be performed by the contractor except where otherwise indicated.

2) Upon completion of construction of the new gravity collection system, all main lines and manholes are to be cleaned of any silt and debris.

3) All newly constructed gravity systems must be allowed a settling period of thirty (30) days from the date of completion of the system prior to any testing. In lieu of a settling period, contractor may opt to backfill trenches in one (1) foot compacted lifts upon written approval from Brunswick County. Intention must be made known at the time of the preconstruction meeting.

4) It is the contractor's responsibility to schedule all testing a minimum of (48) hours in advance. The contractor shall have all testing equipment on site and in place prior to the scheduled start time of the respective test. All lines used to pull the mandrel must be in place prior to the start of testing so that personnel are not waiting for set up to take place before testing can commence.

b) Deflection Test

1) Deflection testing shall be performed on all sections of flexible pipe.

2) The maximum allowable deflection at any point shall be five (5) percent.

3) Deflection will be measured by a pin-type mandrel "GO/No GO" gauge outfitted for the proper pipe material and diameter.

4) The mandrel shall be pulled through the pipe by means of a strong cord or cable. Mandrel shall be pulled by hand.

5) Any section not meeting the five (5) percent deflection requirement shall be excavated, backfilled, re-compacted in one (1) foot lifts, and retested.

c) Air Test

1) Each segment of line shall prove airtight.

2) Test pressure shall be five (5) psi. No pressure loss will be allowed.

3) Testing time, in minutes, shall be calculated as [0.625 x Nominal pipe diameter (in inches)]. Minimum air test time is five (5) minutes.

d) Displacement Test

1) Sewer mains will be checked by county personnel to determine whether displacement has occurred.

2) Displacement will be checked by shining light from manhole to manhole by means of flashlight or reflected sunlight. The line shall be visually inspected directly or with the aid of a mirror. A "full moon" shall be visible.

3) If any displacement is visible, the section of pipe displaced shall be excavated, backfilled, re-compacted in one (1) foot lifts, and retested for airtightness and displacement.

e) Other Testing

1) At the discretion of county staff, the following tests may also be required, at the expense of the contractor, prior to acceptance:

a) Manhole Vacuum Test

1) Vacuum testing shall be performed in accordance with the requirements outlined in ASTM C1244.

b) Soil Compaction Test

1) All trenches suspected of not meeting compaction requirements shall be tested for conformance by a written approved facility for the locations and depths specified by county staff. The facility written approval shall be by county staff.

SECTION 33 41 00 – STORMWATER DRAINAGE SYSTEM

PART 1 - GENERAL

A. The Contractor under this section is responsible for the removal, re-installation and/or installation of all storm water drainage pipes, manholes, headwalls, and other related structures per the plans. Installation will conform to the requirement as specified in the North Carolina Department of Transportation (NCDOT) "Standard Specifications for Roads and Structures" and Brunswick County Standards and Specifications.

B. Submittals:

1. Shop Drawings: Contractor shall furnish to Owner or Owner's representative shop drawings and material specification sheets of all material and items to be installed or delivered as specified in Section 017839.

2. As-builts: As-builts of storm system shall be done by surveyor and shall be submitted in accordance with Section 013301.

3. Storm drain systems within the County or NC DOT right-of-way or easements shall be camera'd and video shall be provided to the County / NC DOT for acceptance.

PART 2 - PRODUCTS

2.1 Pipe:

A. Reinforced Concrete Pipe: ASTM C76, Class III with tongue and groove joints and preformed mastic joint filler. In structural areas where less than 2 feet of cover over pipe cannot be achieved, use Class IV RCP with minimum 1' cover per NC DOT Standards. Pipe shall be installed per manufacturer's recommendations and shall meet NC DOT Standards.

B. NC DOT High Density Polyethylene Pipe (NC DOT HP): HP pipe shall be corrugated double wall, smooth interior pipe in accordance with ASTM F2648. Pipe structural strength shall support H-25 loads with 1' of cover. Install in strict accordance with manufactures recommendations. HP pipe shall conform to NCDOT and Brunswick County Standards and Specifications.

2.2 Drainage Structures: Manhole and inlet structures shall be precast concrete with preformed holes or knockout panels unless otherwise approved. All manholes and inlet structures shall be H20 load rated. Specifications for replacement item shall be as follows:

A. Precast Concrete Manholes: ASTM 478 with eccentric cone tops and precast base sections, unless shown otherwise. Manholes less than 4 feet deep shall have flat slab top. Minimum inside diameter of base section shall be 4 feet, with

actual diameter to be determined by the Contractor and manhole supplier based on the number, size, and angle of pipe connections for each manhole. All manholes shall be H20 load rated. Manholes greater than 6 FT in depth shall have an 8" extended base.

B. Precast Concrete Inlet Boxes: Boxes shall be constructed in accordance with ACI 318, designed for H20 live loads, with knockout panels all four sides. Minimum inside area of box shall be 5 square feet. Boxes greater than 6 FT in depth shall have an 8" extended base.

C. Steps: ASTM C478, polypropylene encapsulated Grade 60 steel bars.

D. Frames, Grates, and Covers: Cast Iron conforming to ASTM A48, Class 30B. Dimensions shall conform to the Drawings in essential details.

2.3 FLARED END SECTIONS

A. Concrete: reinforced concrete AASHTO M170.

2.4 Filter Fabric: Filter fabric shall be non-woven synthetic fabric conforming to NCDOT Section 956-1.

Part 3 - Execution

3.1 Related Work: Excavated, trenching, backfilling, and compaction shall be in with Technical Specification 312000, "Excavation Grading, Trenching, and Backfilling for Utility and Stormwater Pipe Systems. Proper clearance of water, sewer and other utilities shall be provided.

3.2 Pipe: Pipe shall be new pipe, free of defects. Store in an acceptable manner until ready for installation. The pipe shall be installed from the lowest point of the system, true to line and grade, with bell or groove and facing upstream. The trench shall be maintained free of surface or ground water. Installation shall conform to the respective recommendations of the pipe manufacturers or trade association) except as modified hereafter. All RCP pipe joints shall be wrapped with non-woven filter fabric overlapped by 2 FT on top and zip tied together.

A. Concrete Pipe: ACPA "Concrete Pipe Installation Manual."

B. Provide minimum 1 foot over pipe prior to allowing traffic over trench. Clean pipe of all debris and soil after construction.

C. HP Pipe: Refer to manufacturers recommendations and NCDOT Standards and Specifications.

3.3 Structures

A. Bedding: Provide minimum 6 inches of #57 washed stone beneath structures to 6 inches outside of structure.

B. Precast structures shall be set plumb, with pipes centered within knockout panels. Provide opening of minimum size to accommodate pipe. Grout pipe in place with non-shrink grout.

C. Inverts shall be performed or formed with concrete or brick and concrete. Provide 1 inch per foot slope to the flow line of the structure.

D. Steps: For structures greater than 3 feet deep, provide steps 12 inches apart with alternate steps offset 6 inches horizontally, beginning two feet below top of frame. Install in conformance with manufacturers recommendations.

E. Frames and Grates: Frame and grates shall be heavy duty H20 load rated. Center frame castings above structure opening. Adjust to grade with precast concrete grade rings, brick, or mortar for a maximum adjustment of 12 inches.

Payment: No separate payment will be made for Stormwater Drainage System. All costs incurred by the contractor for this work should be included in the lump sum price for the item of work to which it pertains.

END OF SECTION 33 41 00

# ATTACHMENT A – HYDRANT FLOW TEST REPORT



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(704) 309-4545 | mobile

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**From:** Mark Palmer <mark.palmer@brunswickcountync.gov>
**Sent:** Wednesday, July 23, 2025 2:06 PM
**To:** Andrew Thompson <andrew.thompson@brunswickcountync.gov>; Alex Deaton <adeaton@EdificeInc.com>
**Cc:** Anthony Norris <anthony.norris@brunswickcountync.gov>; Tim Bender <tbender@edificeinc.com>
**Subject:** RE: Brunswick County Complex GIS (003).pdf

Alex,

The Results for the Test are as Follows: Static=58, Residual=50, Flow= 1000 GPM @ 35 psi, Flow = 2320 GPM@20 Psi.

If you have any further questions please do not hesitate to contact me.
Thank You,
Mark Palmer

**Mark Palmer | Deputy Fire Marshal / Fire Inspector**
**Brunswick County Fire Marshal's Office**
75 Courthouse Drive NE | Bldg I | PO Box 249 | Bolivia, NC 28422
Phone: 910-526-1047 | Fax: 910-253-2024
Email: mark.palmer@brunswickcountync.gov
Website: www.brunswickcountync.gov

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**From:** Andrew Thompson <andrew.thompson@brunswickcountync.gov>
**Sent:** Wednesday, July 23, 2025 1:57 PM
**To:** Alex Deaton <adeaton@EdificeInc.com>
**Cc:** Mark Palmer <mark.palmer@brunswickcountync.gov>; Anthony Norris <anthony.norris@brunswickcountync.gov>; Tim Bender <tbender@edificeinc.com>
**Subject:** RE: Brunswick County Complex GIS (003).pdf

Mark,
Can you please reach out with the results? I've emailed Joel for IT support as I was unable to locate the summary NFPA 291 flow test report in Laserfiche.

Andrew

**Andrew Thompson | Deputy Code Administrator / Fire Marshal**
**Brunswick County Fire Marshal's Office**
75 Courthouse Drive NE | Bldg I | PO Box 249 | Bolivia, NC 28422
Phone: 910-253-1980 | Fax: 910-253-2024
Email: andrew.thompson@brunswickcountync.gov
Website: www.brunswickcountync.gov

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---

**From:** Alex Deaton <adeaton@EdificeInc.com>
**Sent:** Wednesday, July 23, 2025 1:55 PM
**To:** Andrew Thompson <andrew.thompson@brunswickcountync.gov>
**Cc:** Mark Palmer <mark.palmer@brunswickcountync.gov>; Anthony Norris <anthony.norris@brunswickcountync.gov>; Tim Bender <tbender@edificeinc.com>
**Subject:** RE: Brunswick County Complex GIS (003).pdf

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Hey guys, just checking in on the flow test. Do you think we will be able to perform this week?

**Alex Deaton**
*Project Manager*

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---

**From:** Alex Deaton
**Sent:** Friday, July 18, 2025 9:53 AM
**To:** Andrew Thompson <andrew.thompson@brunswickcountync.gov>
**Cc:** Mark Palmer <mark.palmer@brunswickcountync.gov>; Anthony Norris <anthony.norris@brunswickcountync.gov>
**Subject:** RE: Brunswick County Complex GIS (003).pdf

The 2 hydrants 2119 & 2686 can be used. Once for static and one for flow.

**Alex Deaton**
*Project Manager*

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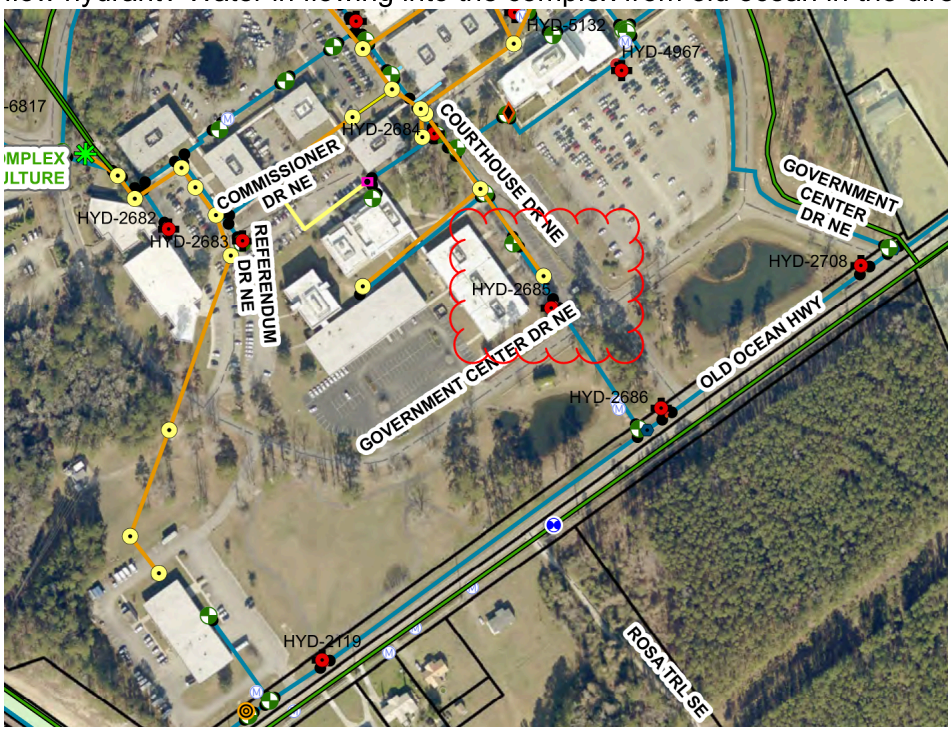
**From:** Andrew Thompson <andrew.thompson@brunswickcountync.gov>
**Sent:** Friday, July 18, 2025 7:43 AM
**To:** Alex Deaton <adeaton@EdificeInc.com>
**Cc:** Mark Palmer <mark.palmer@brunswickcountync.gov>; Anthony Norris <anthony.norris@brunswickcountync.gov>; Andrew Thompson <andrew.thompson@brunswickcountync.gov>
**Subject:** FW: Brunswick County Complex GIS (003).pdf

Hi, Alex,
Good morning, based on the hydrant numbers do you have a preference for the static hydrant and the flow hydrant? Water in flowing into the complex from old ocean in the direction of #2685.




**Andrew Thompson | Deputy Code Administrator / Fire Marshal**
**Brunswick County Fire Marshal's Office**
75 Courthouse Drive NE | Bldg I | PO Box 249 | Bolivia, NC 28422
Phone: 910-253-1980 | Fax: 910-253-2024
Email: andrew.thompson@brunswickcountync.gov
Website: www.brunswickcountync.gov

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**From:** Andrew Thompson <andrew.thompson@brunswickcountync.gov>
**Sent:** Friday, July 18, 2025 7:39 AM
**To:** Anthony Norris <anthony.norris@brunswickcountync.gov>; Mark Palmer <mark.palmer@brunswickcountync.gov>
**Subject:** FW: Brunswick County Complex GIS (003).pdf

Map for hydrants at complex

**Andrew Thompson | Deputy Code Administrator / Fire Marshal**
**Brunswick County Fire Marshal's Office**
75 Courthouse Drive NE | Bldg I | PO Box 249 | Bolivia, NC 28422
Phone: 910-253-1980 | Fax: 910-253-2024
Email: andrew.thompson@brunswickcountync.gov
Website: www.brunswickcountync.gov

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---

**From:** Andrew Thompson <andrew.thompson@brunswickcountync.gov>
**Sent:** Thursday, July 10, 2025 8:41 AM
**To:** Travis Fulton <travis.fulton@brunswickcountync.gov>
**Subject:** FW: Brunswick County Complex GIS (003).pdf

Travis,
Here is the fire hydrant map per our conversation.

Andrew

**Andrew Thompson | Deputy Code Administrator / Fire Marshal**
**Brunswick County Fire Marshal's Office**
75 Courthouse Drive NE | Bldg I | PO Box 249 | Bolivia, NC 28422
Phone: 910-253-1980 | Fax: 910-253-2024
Email: andrew.thompson@brunswickcountync.gov
Website: www.brunswickcountync.gov

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---

**From:** Alex Deaton <adeaton@EdificeInc.com>
**Sent:** Thursday, July 10, 2025 8:36 AM
**To:** Andrew Thompson <andrew.thompson@brunswickcountync.gov>
**Subject:** Brunswick County Complex GIS (003).pdf

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Andrew, see attached. We will be tapping into the existing waterline around Hydrant 2685. I am keeping an eye out for the invoice today. I will pay once it comes through.

Call me if you have any questions.

Alex Deaton
Edifice
704-330-9422

## ATTACHMENT B – GEOTECH REPORT AND SEISMIC TESTING REPORT



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# GEOTECHNICAL ENGINEERING REPORT

## BRUNSWICK COUNTY HHS & EOC
## 3325 OLD OCEAN HIGHWAY
## BOLIVIA, NORTH CAROLINA

**JOB NUMBER: 72753**

## PREPARED FOR:

## EDIFICE GENERAL CONTRACTORS
## 4111 SOUTH BOULEVARD
## CHARLOTTE, NORTH CAROLINA 28209

**July 16, 2025**

TIMMONS GROUP

YOUR VISION ACHIEVED THROUGH OURS.

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## EXECUTIVE SUMMARY

For your convenience, this report is summarized in outline form below. This brief summary should not be used for planning purposes without reviewing the more detailed conclusions and recommendations contained in this report.

This report recommends building support on a shallow foundation system. It is important to note that significantly higher structural loads or deeper foundation embedment could cause estimated settlement of shallow foundations to increase to intolerable levels. If structural loads increase or anticipated foundation bearing elevations decrease from those expected, we must be contacted for review and comment, and possible revisions to our recommendations.

1. The subsurface exploration included a visual site reconnaissance, performance of 24 soil test borings to depths ranging from 10 to 50 feet below the ground surface, and laboratory testing of soil samples.

2. The borings encountered ground cover consisting of topsoil, crushed stone, or a mix of these materials. Below ground surface cover materials, "undisturbed" soils were encountered to boring termination depths up to approximately 50 feet. These soils typically consisted of soft to hard clays (CL, CH) with varying amounts of sand or very loose to very dense silty or clayey sands (SM, SC). At the time of exploration, water was encountered in 11 of the 24 borings at depths ranging from approximately 10 to 23 feet below the ground surface.

3. We recommend that site grading be conducted during the typically warmer summer months. Most near-surface soils encountered in the borings are moisture sensitive. If near-surface soils are wet at the time of construction, repair of these soils could be needed. Some near-surface are of relatively low consistency and are expected to require repair.

4. Several borings encountered soft soils that are anticipated to require repair during site grading. Repair depths could be on the order of 12 to 24 inches.

5. An area of organic laden fill was encountered on the site (Boring B-18) in a proposed drive aisle. Test pit excavations should be performed to further explore these soils and determine if undercutting/replacement is required.

6. Soils encountered in the borings, with the exception of topsoil and any debris-laden soils, should be suitable for reuse as structural fill. However, we recommend that highly plastic soils not be re-used at shallow depths in building and pavement areas.

7. The building area will be raised up to approximately 5 feet with new structural fill. The weight of fill is expected to cause the underlying loose soils to settle. As such, we recommend a settlement monitoring period prior to building foundation construction.

8. The proposed building may be supported on shallow foundations bearing in approved undisturbed soils or new structural fill. **If structural loads increase or anticipated**

**foundation bearing elevations decrease from those stated in the report, we must be contacted for review and comment.**

9. Based on exploration of the site, we recommend the site be considered Seismic Site Classification E in accordance with the current North Carolina Building Code. It is our opinion that the encountered soils have a low potential for liquefaction during the design seismic event.

10. Recommended pavement sections are provided in this report.

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5410 Trinity Road
Suite 102
Raleigh, NC 27607

P 919.866.4951
F 919.859.5663
www.timmons.com

July 16, 2025

Edifice General Contractors
4111 South Boulevard
Charlotte, North Carolina 28209

Attention: Mr. Tim Bender

Re: **Geotechnical Engineering Report**
Brunswick County HHS & EOC
3325 Old Ocean Highway
Bolivia, North Carolina
Timmons Group Project No. 72753

Mr. Bender:

Timmons Group is pleased to submit this geotechnical engineering report for the referenced project. The objectives of our services were to explore subsurface conditions and provide our geotechnical recommendations for site grading, foundation support, and pavement support.

This report recommends building support on a shallow foundation system. It is important to note that significantly higher structural loads or deeper foundation embedment could cause estimated settlement of shallow foundations to increase to intolerable levels. If structural loads increase or anticipated foundation bearing elevations decrease, we must be contacted for review and comment, and possible revisions to our recommendations.

## 1. PROJECT INFORMATION

The site is located at 3325 Old Ocean Highway in Bolivia, North Carolina. A Site Vicinity Map is shown in Figure 1. The site currently consists of an open grass lot with a greenway walking path. The site is bounded by government office buildings to the north and west, Old Ocean Highway to the south, and a pond to the east. Ground surface elevations in the area of exploration range from approximately 32 to 40 feet. Site grades generally slope downward from west to east.

The proposed construction is anticipated to consist of a four-story government office building, asphalt pavements, and associated utilities. The building's final floor elevation will be approximately 41 feet. We understand that the maximum column and wall loads for the building

will be 300 kips and 6 KLF, respectively. We expect maximum fill depths of 5 feet or less will be required to reach finished grade.

## 2. FIELD EXPLORATION

The field exploration included a visual site reconnaissance by a representative of Timmons Group and performance of eighteen soil test borings (B-01 through B-18). Boring locations were selected by Timmons Group. A representative from Timmons Group established boring locations in the field using GPS equipment. Approximate boring locations are shown on Figure 2 in the Appendix.

Borings were performed to depths ranging from approximately 10 to 50 feet below the existing ground surface with mud rotary drilling techniques. Split-spoon samples of subsurface soils were taken within soil test borings at approximate 2-foot depth intervals above a depth of 10 feet and at 5-foot intervals below 10 feet. Bulk samples of auger cuttings were also collected. Standard Penetration Tests were conducted in conjunction with split-spoon sampling in general accordance with ASTM D 1586.

Water levels were measured in open boreholes at the time of drilling. Upon completion, boreholes were then backfilled up to the original ground surface with drill cuttings. Representative portions of split-spoon soil samples were returned to our laboratory for quantitative testing and visual classification in general accordance with Unified Soil Classification System guidelines.

Boring logs and generalized soil profiles (Figures 3A and 3B), which present specific information from the borings, are included in the Appendix. Stratification lines shown on the boring logs and profiles are intended to represent approximate depths of changes in soil types. Naturally, transitional changes in soil types are often gradual and cannot be defined at particular depths. Ground surface elevations shown on the boring logs and profiles were obtained from the county GIS site and should be considered very approximate.

## 3. SITE GEOLOGY

According to the North Carolina Geological Survey (1988), the project site is located in the Coastal Plain Physiographic Province. The coastal plain is characterized by marine to fluvial sediments, varying from clay to gravel, poorly to well sorted, with lateral variation in thickness, although generally increasing in thickness towards the east. Vertical variation within the geologic formations of the coastal plain is often controlled by cyclic sequences that fine or coarsen with depth, with formations separated by unconformities. Regionally, the stratigraphy of the coastal plain can be generalized as a wedge of sediments composed of fluvial and coastal plain sands and gravels of Quaternary and upper Tertiary age, underlain by marine, deltaic, and fluvial clays, silts, and sands of lower Tertiary age, underlain by fluvial-deltaic to shallow-shelf sands and clays of

Cretaceous age, underlain by crystalline bedrock. Depth to bedrock varies from tens of feet near the western extent of the coastal plain to over 3,000 feet near the Atlantic coastline.

According to the referenced Survey, the site is underlain by the Tertiary-aged Waccamaw Formation. The Waccamaw Formation is described as: fossiliferous sand with silt and clay, bluish gray to tan, loosely consolidated. Straddles Pleistocene-Pliocene boundary.

## 4. LABORATORY TESTING

Laboratory testing was performed on representative split-spoon and bulk soil samples obtained from the borings. This testing consisted of natural moisture content, Atterberg limits, grain size analyses, Standard Proctor, and CBR tests. Laboratory tests were performed in general accordance with applicable ASTM procedures. Individual laboratory test data sheets are provided in the Appendix. Summaries of laboratory test data are provided in the tables below.

**Natural Moisture and Classification Tests**

| Boring | Depth (Feet) | Natural Moisture Content (%) | Atterberg Limits | | | Grain Size Analysis | | USCS Classification |
|---|---|---|---|---|---|---|---|---|
| | | | LL | PL | PI | % Sand And Gravel | % Fines* | |
| B-01 | 6-7.5 | 21.1 | 30 | 15 | 15 | 61.8 | 38.2 | SC |
| B-03 | 1-2.5 | 19.4 | 29 | 16 | 13 | 39.5 | 60.5 | CL |
| B-03 | 6-7.5 | 32.4 | 37 | 17 | 21 | 58.4 | 41.6 | SC |
| B-05 | 3.5-5 | 22.7 | 35 | 15 | 20 | 31.3 | 68.7 | CL |
| B-07 | 8.5-10 | 36.7 | 29 | 18 | 11 | 54.5 | 45.5 | SC |
| B-09 | 8.5-10 | 23.1 | NP | NP | NP | 90.4 | 9.6 | SP |
| B-12 | 1-5 | 25.2 | 38 | 16 | 22 | 60.6 | 39.4 | SC |
| B-12 | 3.5-5 | 23.4 | 57 | 24 | 33 | 45.2 | 54.8 | CH |
| B-15 | 8.5-10 | 29.7 | 29 | 16 | 13 | 26.7 | 73.3 | CL |
| B-17 | 1-5 | 20.9 | 25 | 14 | 11 | 52.6 | 47.4 | SC |
| B-18 | 1-2.5 | 20.8 | 26 | 16 | 10 | 58.9 | 41.1 | SC |

*Material passing No. 200 sieve (clay and silt)

**Standard Proctor and CBR Testing**

| Boring | Depth (Feet) | Natural Moisture Content (%) | Standard Proctor | | CBR (0.1") | %Swell | USCS Classification |
|---|---|---|---|---|---|---|---|
| | | | Optimum Moisture Content (%) | Maximum Dry Density (pcf) | | | |
| B-12 | 1-5 | 25.2 | 16.1 | 108.0 | 2.1 | 3.4 | SC |
| B-17 | 1-5 | 20.9 | 15.5 | 109.0 | 5.5 | 1.1 | SC |

Based on the Atterberg limits testing, encountered soils are generally of low plasticity. Based on comparison of natural moisture contents of near-surface soils to the optimum moisture contents of the bulk samples, near-surface soils appear wet of optimum moisture. The amount of moisture manipulation will likely depend on prevailing weather conditions.

# 5. SUBSURFACE CONDITIONS

## 5.1 Ground Surface Cover

The borings encountered approximately 2 to 4 inches of surficial topsoil. It is important to note that topsoil thicknesses can vary considerably on a particular site and could extend outside the range we encountered (either higher or lower).

## 5.2 Existing Fill Soils

Below topsoil in Boring B-18, existing fill soil was encountered to boring termination depth of 10 feet below ground surface. The fill consisted of loose to medium dense clayey sand (SC) sometimes contaminated by chunks of wood. Standard Penetration Test (SPT) N-values within the fill soil ranged from 6 to 11 blows per foot

## 5.3 Undisturbed Soils

Below topsoil in all borings other than B-18, "undisturbed" soils were encountered to boring termination depths ranging from approximately 10 to 50 feet. The typical soil profile consists of firm to stiff clays and silts (CL, CH, ML) with varying amounts of sand or very loose to medium dense sands (SM, SC, SP) with varying amounts of fines. Standard Penetration Test (SPT) N-values within the soil profile ranged from 0 to 25 blows per foot, with typical values of 5 to 15 blows per foot.

### 5.4 Borehole Water Levels

At the time of drilling, water was observed in 8 of the 18 borings at depths ranging from approximately 3 to 17 feet below the ground surface. Additionally, after an approximate 24-hour waiting period, water was observed in 6 of the 18 borings at depths ranging from approximately 12 to 29 feet below the ground surface. It is important to realize that groundwater levels will fluctuate with changes in rainfall and evaporation rates. In addition, perched groundwater could be encountered within near-surface soils, particularly after rainfall.

## 6. CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations are based upon our borings, engineering analysis, and past experience with similar projects and subsurface conditions.

When reviewing our recommendations, it is important to note that prior grading activities have occurred on this site. Existing fill was encountered in Borings B-18, sometimes contaminated by chunks of wood. Based on our experience with previously graded sites, unexpected subsurface conditions could exist, including buried debris, soft fills, abandoned underground utilities, and others. These conditions can be addressed by on-site engineering evaluation during construction

### 6.1 Site Preparation

#### *6.1.1 General*

Site grading will be difficult during periods of extended rainfall and low temperatures that generally occur during the late autumn to early spring months. Near-surface soils are very moisture sensitive, particularly the silts and clays. If grading is conducted during a wet time period, soils at this site will be particularly susceptible to rutting and pumping under rubber-tired traffic and provide poor subgrade support for foundations, floor slabs, and pavements. Heavy rubber-tired construction equipment should not be allowed to operate on wet or unstable subgrades at this site due to the potential for rutting and other damage to the soils. To reduce potential earthwork problems, site preparation and grading should be scheduled during the typically warmer summer months, if possible. We recommend that exposed subgrades be sloped and sealed at the end of each day to promote runoff and reduce infiltration from rainfall.

Site preparation should begin with the demolition of existing pavement (where planned), clearing and grubbing of trees, stripping of topsoil, and removal of any other unsuitable materials. Any existing water supply wells or septic tanks should be abandoned in accordance with the North Carolina Department of Environment and Natural Resources (NCDENR) requirements. Approximately 2 to 4 inches of topsoil was encountered in the borings. However, stripping activities often mix these materials with underlying “clean” soils and cause stripping depths to be

greater than actual topsoil depths, particularly during wet periods of the year. Topsoil, demolished pavement, and vegetation should be wasted from the site or permanently stockpiled outside the proposed construction limits. Demolition debris and vegetation should be wasted from the site.

### 6.1.2 Existing Utilities

We recommend that any existing underground utilities be relocated outside the proposed building footprints. Abandoned utilities should be removed from the site. Past experience indicates that poorly compacted fill soils are often located within utility trenches. For utilities that are to be removed, we recommend that trenches be cleaned of all backfill soils and backfilled with structural fill compacted to levels recommended in this report. If certain utility lines must remain in place in their current location, we recommend that the suitability of trench backfill be evaluated on a case-by-case basis.

### 6.1.3 Subgrade Evaluation

After stripping, soil subgrades in areas to receive fill and those at finished subgrade should be evaluated by the Geotechnical Engineer or his representative. To aid the engineer during this evaluation, exposed soil subgrades should be proofrolled with a loaded tandem axle dump truck or equivalent. Proofrolling will help to reveal the presence of unstable or otherwise unsuitable surface materials. The following methods are typically used to repair soil subgrades that are observed to rut, pump, or deflect excessively during proofrolling:

- Undercut the unstable soils to firm soils and replace them with suitable, well compacted fill.

- In-place repair of near-surface soils by scarifying, drying and recompacting, when weather conditions are favorable. In poor weather conditions, our experience has been that the addition of lime (defined by AASHTO M216) can facilitate drying of soils. If lime is used for drying soils, its application and mixing with the soils should be in accordance with the latest edition of the NCDOT Standard Specifications for Road and Structures.

### 6.1.4 Undercut Potential

Relatively soft clays and silts were encountered in Borings B-01, B-03, B-04, B-05, B-06, B-09, and B-10. Repair of soft near-surface soils should be expected at this site. As previously stated, we recommend that site grading be conducted during the typically warmer summer months, when ambient air conditions are typically more favorable for in-place repair of soils. If site grading is conducted during the typically colder late autumn to early spring months, when scarifying and air drying of soils is often difficult, undercutting and replacement of soft near-surface soils (with off-site borrow materials) or treating of the near-surface soils quicklime/Portland cement (to dry them to optimum compaction moisture) will likely be required. Even in favorable weather conditions,

some undercutting or lime/Portland cement treatment of soils will likely be needed to adequately prepare soil subgrades.

#### *6.1.5 Existing Fill*

Existing fill was encountered in Boring B-18 to considerable depth, and it contained organic materials. Test pit excavations should be performed prior to or during construction, in the presence of the geotechnical engineer or his representative, to further explore the fill material and determine if undercutting and replacement with new structural fill is necessary.

### 6.2 Excavations

Borings typically encountered low to moderate consistency soils, which can likely be excavated by routine earth-moving equipment. Soil types with respect to trench safety must be evaluated on a case-by-case basis. The Contractor should be responsible for all site safety, including the determination of appropriate trench safety measures according to OSHA guidelines. Water was encountered in 8 of the 18 borings at depths ranging from approximately 3 to 17 feet below ground surface. The contractor is responsible for controlling and removing runoff or groundwater that occurs within excavations.

### 6.3 Re-use of On-Site Materials as Structural Fill

Low-plasticity soils encountered in the borings, excluding topsoil and those with more than 5 percent organics/debris, should be suitable for re-use as structural fill, provided the moisture content. Highly plastic soils, if encountered, may be re-used as structural fill but should not be placed within 3 feet of finished subgrade in building and pavement areas.

Based on visual observation and comparison of the measured natural moisture contents of the bulk soil samples to their optimum moisture contents from the Standard Proctor tests, near-surface soils appear wet of optimum moisture. As such, some drying of on-site soils should be anticipated prior to their re-use as structural fill. Prevailing weather conditions will have a significant impact on the amount of moisture manipulation (i.e., drying or wetting) required prior to fill placement. Highly plastic soils are often difficult to dry and manipulate, even during favorable weather conditions.

### 6.4 Structural Fill Placement

On-site soils used as structural fill should be free of debris, contain less than 5 percent organics, have a maximum particle size of 2 inches, have a liquid limit (LL) less than 50, and a plasticity index (PI) less than 25. If any off-site borrow material is used, it should meet the material requirements above, have a liquid limit (LL) less than 35, and have a plasticity index less than 15. Suitable USCS soil types for structural fill are SM, SC, SP, or GW. Highly plastic soils may be re-used as structural fill deeper in the fill mass, as described previously.

Structural fill should be placed in maximum 8 to 10-inch loose lifts and compacted to at least 95 percent of the Standard Proctor maximum dry density (ASTM D 698). The final 12 inches of structural fill relative to finished subgrade should be compacted to at least 98 percent of the standard Proctor maximum dry density. Structural fill should be maintained within 3 percent points of optimum moisture during placement and compaction.

Site preparation, including fill placement and compaction, should be observed by a qualified soils technician working under the direction of the Geotechnical Engineer. During fill placement, a sufficient amount of in-place density tests should be conducted to confirm that compaction and fill moisture is in accordance with our recommendations.

## 6.5 Monitoring of Fill-Induced Settlement

Maximum fill depths of about 5 feet will be required in the building area. The weight of fill is expected to cause the loose underlying soils to consolidate and settle. Settlement due to the weight of fill should be monitored and should cease prior to construction of building foundations. Foundation construction should not begin until it has been confirmed that settlement due to fill has ceased. Based on the results of our borings and our past experience, we estimate that the time for settlement to cease could be on the order of 15 days. The actual time required for settlement to cease can only be determined by a monitoring process.

Typically, confirmation that settlement has ceased is obtained by establishing hubs at the design subgrade elevation and measuring their vertical movement using survey techniques. The settlement hubs may consist of a rigid bar (e.g. #8 rebar) or cylindrical-shaped cast-in-place concrete (minimum 12-inches in diameter) that is embedded at least 3 feet below the ground surface. Settlement hubs should be protected from disturbance. We recommend a minimum of four settlement hubs for the project. Settlement measurements should be taken twice per week and reported to the geotechnical engineer. Again, the actual time required for settlement to cease can only be determined by a monitoring process.

## 6.6 Building Foundations

Based on the borings, provided structural loads (previously summarized), and our analysis, the proposed building can be supported on shallow foundation bearing in approved undisturbed soils or new structural fill underlain by approved undisturbed soils. **It is important to note that significantly higher structural loads or deeper foundation embedment could cause estimated settlement of shallow foundations to increase to intolerable levels. If structural loads increase or anticipated foundation bearing elevations decrease, we must be contacted for review and comment, and possible revisions to our recommendations. Our expectation is that building foundations will bear above elevation 37 feet.**

Shallow foundations can be designed using an allowable bearing pressure of 2,000 pounds per square foot (psf). Individual column foundations and continuous wall foundations should be at least 24 inches and 18 inches wide, respectively. This recommendation is made to prevent a localized or "punching" shear failure condition which can occur with very narrow footings. Foundations should be embedded at least 18 inches below finished exterior grade for frost protection. Where highly plastic soils are encountered at the foundation bearing level, the foundation bearing soils should be over-excavated 18 inches below the foundation bearing level and backfilled with lean concrete (minimum 28-day compressive strength of 500 psi).

Foundation excavations should be evaluated by the Geotechnical Engineer or his representative prior to reinforcing steel and concrete placement. The evaluation should involve probing of foundation bearing surfaces, advancing shallow hand auger borings, and dynamic cone penetrometer (DCP) testing. Where loose/soft soils, existing fill, or unsuitable soils are present at bearing elevations, neatline over-excavation and replacement of foundation bearing soils with NCDOT No. 57 stone will be required. If bearing soils are highly plastic, the backfill should consist of lean concrete.

If groundwater or surface water runoff collects in any excavation, it should be removed promptly. Care should be exercised during construction of foundations in order not to disturb bearing soils and reduce their bearing strength. Concrete for the foundations should be placed as soon as practical following excavation.

## 6.7 Foundation Settlement

Based on anticipated structural loads and our analysis, we expect that total foundation settlements for the building foundations will be one inch or less, provided the recommendations of this report, including the settlement monitoring due to the weight of new building structural fill, is properly implemented. Our settlement estimate is based on an applied bearing pressure of 2,000 psf, assumes foundations bear on approved materials, and assumes that any existing fill is removed from beneath foundations. Differential settlements should be less should be less than ½ inches for footings bearing on similar materials.

## 6.8 Seismic Considerations

Based on our test borings and our past experience, it is our opinion that the site should be considered Seismic Site Classification E in accordance with the current North Carolina Building Code.

Based on our analysis and considering the Tertiary-aged nature of soils at this site, it is our opinion that the loose sand layer at this site has a low potential for liquefaction during the design seismic event.

## 6.9 Slab-On-Grade

The building slab-on-grade can be adequately supported on suitable in-place soils or new structural fill. It is our opinion that a modulus of subgrade reaction of 100 pci is applicable for slab-on-grade design. This design modulus is applicable to point loading or light distributed loads. We recommend that the slab-on-grade be separated from foundations to allow for relative displacement.

In addition, we recommend that a minimum of 6 inches of NCDOT CABC stone be considered for placement beneath concrete slabs to provide greater uniformity in slab subgrade support. We recommend that the stone be compacted to at least 98 percent of its standard Proctor maximum dry density (ASTM D 698). A vapor barrier should be installed beneath the slab in accordance with ACI 302.1 (Guide to Concrete Floor and Slab Construction).

Exposure to the environment and construction activities will weaken the floor slab subgrade soils. Therefore, we recommend that subgrade soils in slab areas be evaluated prior to crushed stone placement. If deterioration of soils has occurred, undercutting may be necessary.

## 6.10 Pavements

Details regarding proposed vehicular traffic types and their frequencies were unknown at the time of this report. Based on our past experience with similar soils and our laboratory tests, a design California Bearing Ratio (CBR) value of 2 percent should be available for pavement design assuming the in-place subgrade soil is compacted to at least 98 percent of its Standard Proctor maximum dry density (ASTM D698).

The table below presents typical sections for heavy-duty drives and light-duty parking stalls. The heavy-duty section should be adequate to support anticipated truck traffic (dual-axle box trucks, occasional tractor trailers, and occasional municipal waste trucks) and channelized light-duty traffic. The light-duty section in the table below should be adequate for light-duty (car) parking stalls.

**Asphalt Pavement Sections**

| Drives and Drive Aisles | Light-Duty Parking Stalls |
|---|---|
| 1.5 Inches NCDOT S9.5B<br>(placed in a single lift) | 3 Inches NCDOT S9.5B<br>(placed in two lifts) |
| 3 Inches NCDOT I19.0C | ---- |
| 8 Inches NCDOT<br>ABC Stone | 8 Inches NCDOT<br>ABC Stone |

Our experience indicates that an overlay of asphalt pavements may be needed in approximately 10 to 12 years due to normal weathering (oxidation). Also, some areas could require repair in a shorter time period.

All materials and construction methods should conform to the latest edition of the NCDOT Standard Specifications for Roads and Structures. To confirm that the base course stone has been uniformly compacted and meets NCDOT density requirements, in-place density tests should be performed by a qualified soils technician and the area should be thoroughly proofrolled under his observation.

Important factors regarding pavement performance are the condition of subgrade soils at time of construction and post construction drainage. We recommend that all pavement subgrade areas be evaluated prior to base course stone placement. Any areas which deflect or rut during proofrolling must be repaired prior to stone placement. Sufficient testing and observation should be performed during pavement construction to confirm that the required thickness, density, and quality requirements of the specifications are followed.

## 7. LIMITATIONS OF REPORT

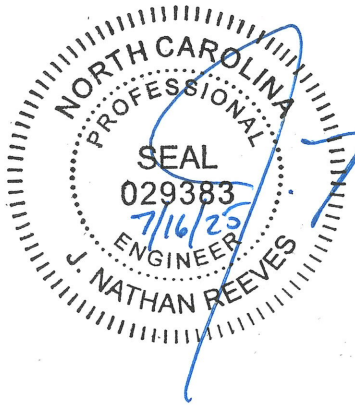
The recommendations contained in this report are made on the basis of the site information made available to us and the surface and subsurface conditions that existed at the time of the exploration. While this exploration has been conducted in accordance with generally accepted geotechnical engineering practices, there remains some potential for variation of the subsurface conditions in unexplored areas of the site. If the subsurface conditions encountered during construction vary significantly from those presented in this report, we should be notified to reevaluate our recommendations. No other warranty, expressed or implied, is made as to the professional advice included in this report.

## 8. CLOSURE

We appreciate this opportunity to be of service to you on this project. If you have any questions regarding this report or if we can be of further assistance, please contact us at (919) 866-4951.

Respectfully submitted,
**TIMMONS GROUP**

Jesse L. Israel, E.I.
Geotechnical Project Manager

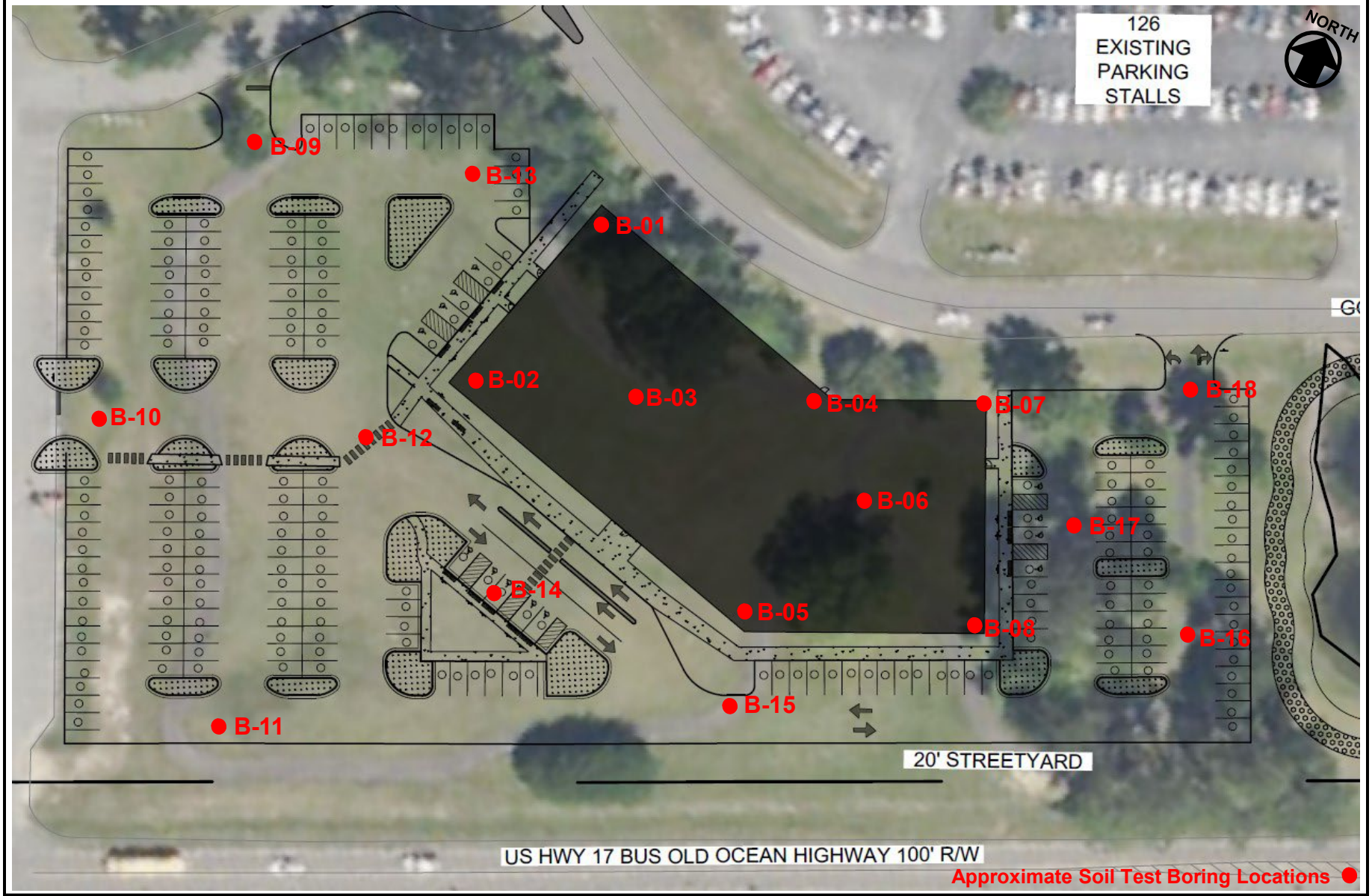



J. Nathan Reeves, P.E.
Senior Geotechnical Engineer
NC Registration No. 29383

# APPENDIX A

# FIGURES

| | | | |
|---|---|---|---|
| SCALE: NTS | TIMMONS GROUP<br>YOUR VISION ACHIEVED THROUGH OURS. | **SITE VICINITY MAP**<br>BRUNSWICK CO HHS & EOC<br>3325 OLD OCEAN HIGHWAY<br>BOLIVIA, NORTH CAROLINA | DRAWING<br>1 |
| CHECKED BY: JNR | | | |
| PLOTTED BY: JLI | | | |
| DATE: 6/25/2025 | PROJECT NUMBER: 72753 | | |

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| Scale: | Not to scale |
| Date: | 6/25/2025 |
| Drawn By: | JLI |
| Project No.: | 72753 |

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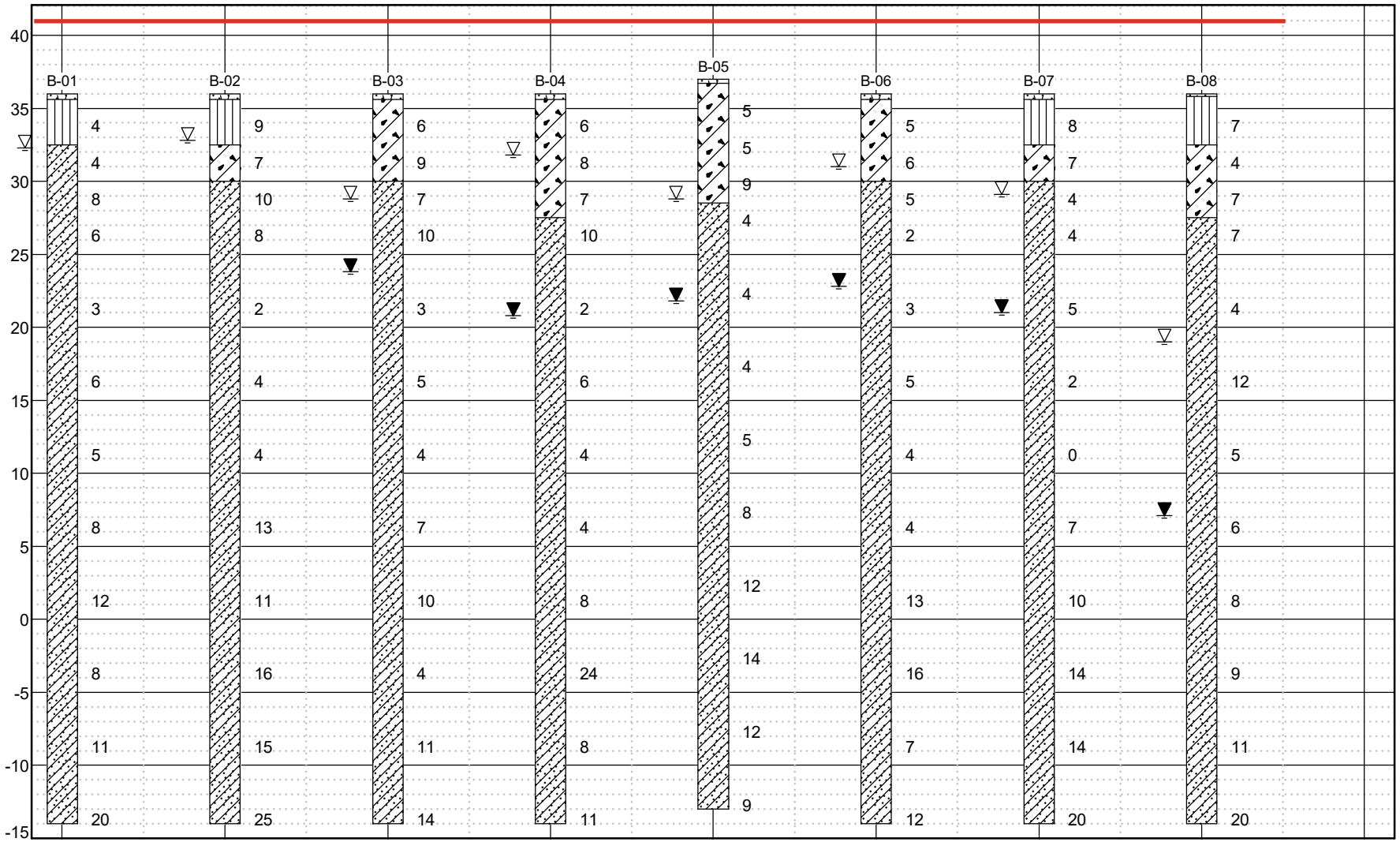
# Boring Location Plan

Brunswick County HHS & EOC
Bolivia, North Carolina

Figure No.
2




## Lithology Symbols

- Topsoil
- Silt
- Clayey Sand
- Low Plasticity Clay

## Groundwater Symbols

- At End of Drilling
- At 24 Hours

## Exploration Symbols

B-01 (Exploration ID)

13 (N-Value)

53% 98% (RQD REC)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Timmons Group
5410 Trinity Road
Raleigh, NC 27607
Telephone: 919-866-4951


# Soil Profile

## Brunswick Co HHS & EOC

Bolivia, NC

| PROJECT NUMBER | DRAWN BY | DATE DRAWN |
|---|---|---|
| 72753 | JLI | 7/9/25 |
| HORIZONTAL SCALE | APPROVED BY | FIGURE |
| VERTICAL SCALE | JNR | 3A |


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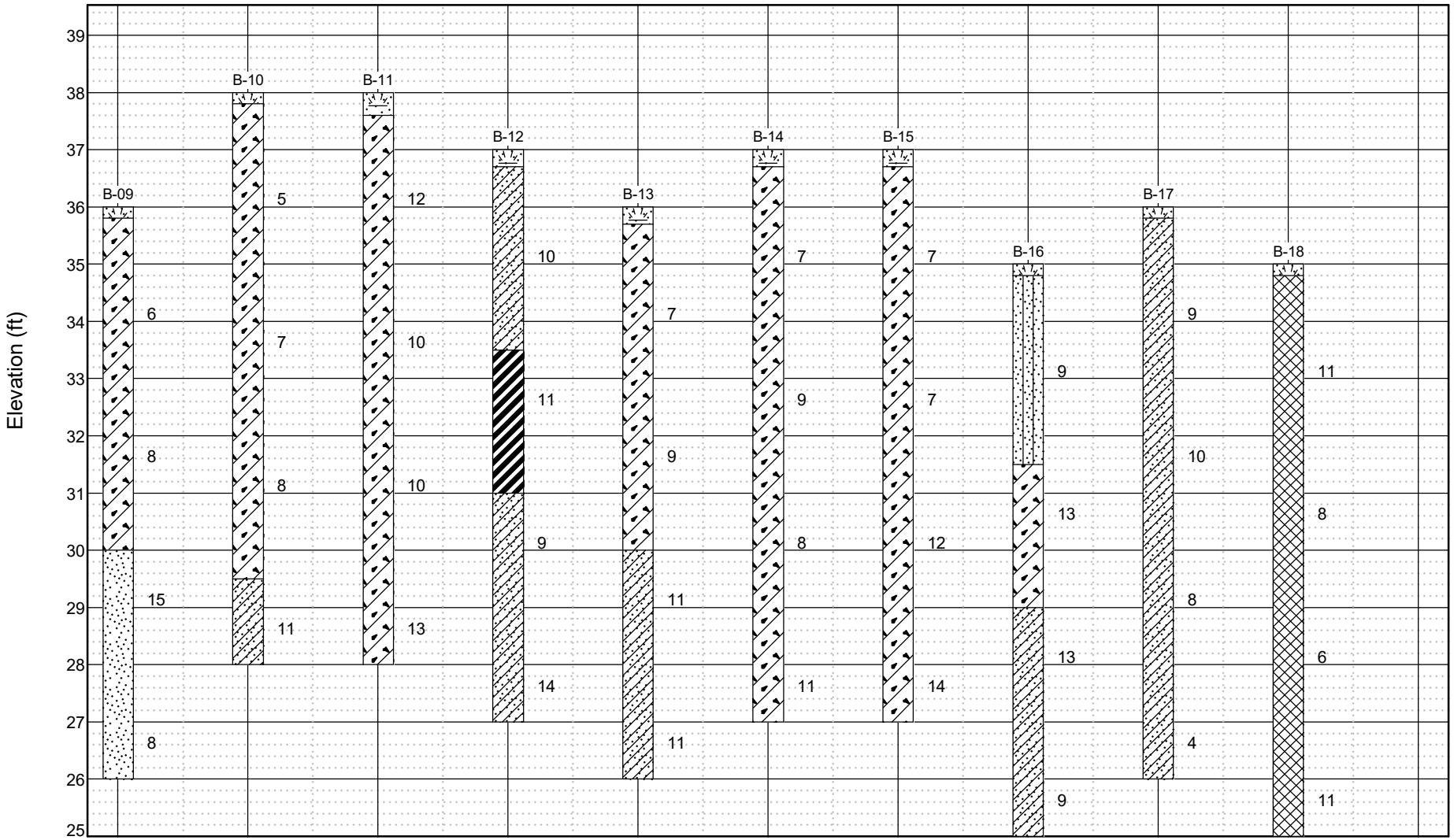


Lithology Symbols

- Topsoil
- Low Plasticity Clay
- Poorly-graded Sand
- Clayey Sand
- High Plasticity Clay
- Silty Sand
- Fill (made ground)

Groundwater Symbols

- At End of Drilling
- At 24 Hours

Exploration Symbols

B-01 (Exploration ID)

13 (N-Value)

53% 98% (RQD REC)


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**Soil Profile**

**Brunswick Co HHS & EOC**
Bolivia, NC

| PROJECT NUMBER | DRAWN BY | DATE DRAWN |
|---|---|---|
| 72753 | JLI | 7/9/25 |
| HORIZONTAL SCALE | APPROVED BY | FIGURE |
| VERTICAL SCALE | JNR | 3B |

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# APPENDIX B

# BORING LOGS

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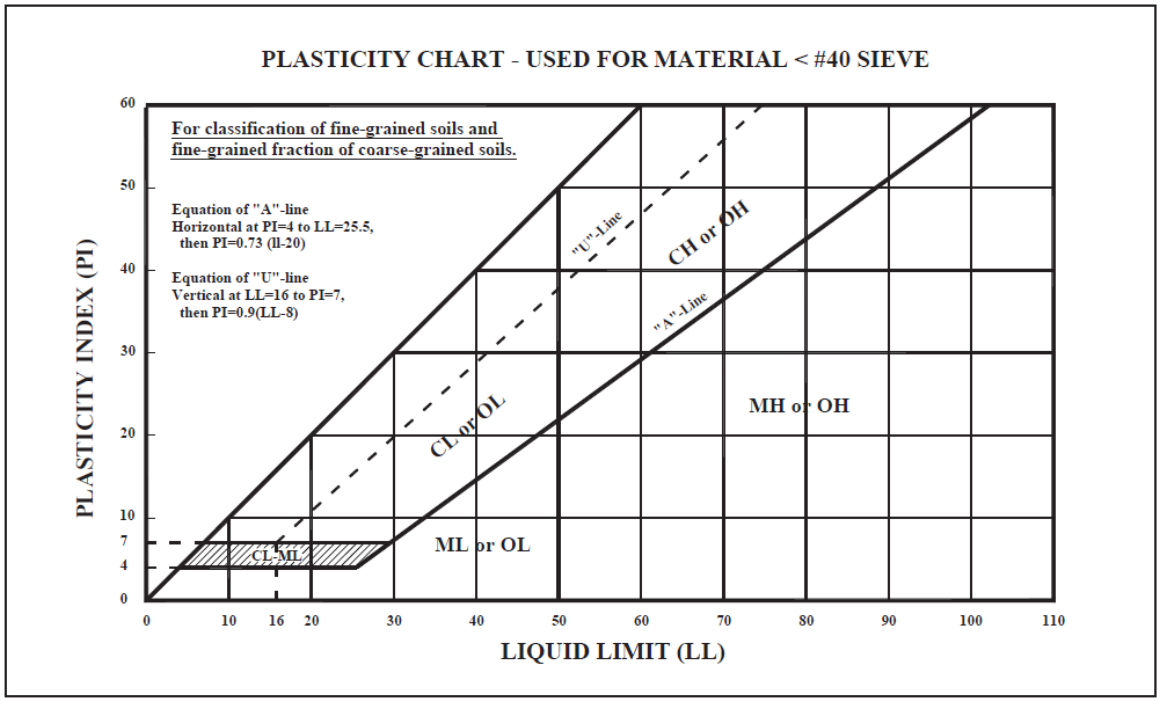
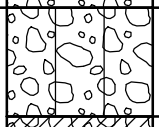
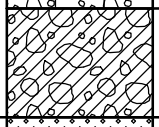
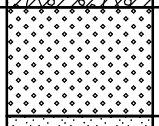
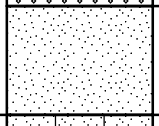
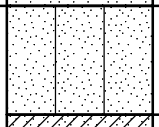
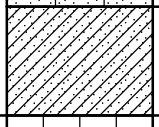
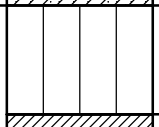
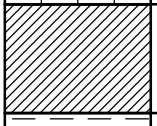
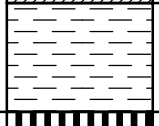
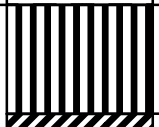
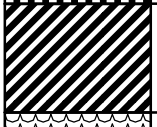
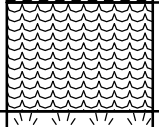
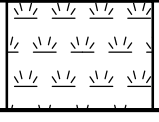
# KEY TO BORING LOG TERMINOLOGY

| Relative Density – Used for soils with less than 50% passing No. 200 sieve | | Consistency – Used for soils with 50 percent or more passing No. 200 sieve | |
|---|---|---|---|
| **Relative Density** | **SPT N-Value (blows/ft)** | **Consistency** | **SPT N-Value (blows/foot)** |
| Very Loose | 0 to 3 | Very Soft | 0 to 2 |
| Loose | 4 to 10 | Soft | 3 to 4 |
| Medium Dense | 11 to 30 | Firm | 4 to 8 |
| Dense | 31 to 49 | Stiff | 9 to 15 |
| Very Dense | Greater than 50 | Very Stiff | 15 to 30 |
| | | Hard | 31 to 49 |
| | | Very Hard | Greater than 50 |

| Grain Size Terminology (U.S. Standard Sieves) | | Natural Moisture Content | |
|---|---|---|---|
| **Term** | **Particle Size** | | |
| Boulder | 12 inches + | Dry | Very little apparent moisture, dusty |
| Cobble | 3 to 12 inches | | |
| Coarse Gravel | ¾ to 3 inches | Moist | Damp, but no free water visible |
| Fine Gravel | #4 to ¾ inches | | |
| Coarse Sand | #10 to #4 | | |
| Medium Sand | #40 to #10 | Wet | Visible free water, or in cohesive soil, clearly saturated |
| Fine Sand | #200 to #40 | | |
| Silt and Clay | <#200 | | |



# SOIL CLASSIFICATION CHART

| MAJOR DIVISIONS | | | SYMBOLS | | TYPICAL DESCRIPTIONS |
|---|---|---|---|---|---|
| | | | GRAPH | LETTER | |
| COARSE GRAINED SOILS<br>MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE | GRAVEL AND GRAVELLY SOILS<br>MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE | CLEAN GRAVELS<br>(LITTLE OR NO FINES) | | GW | WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES |
| | | | | GP | POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES |
| | | GRAVELS WITH FINES<br>(APPRECIABLE AMOUNT OF FINES) |  | GM | SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES |
| | | |  | GC | CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES |
| | SAND AND SANDY SOILS<br>MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE | CLEAN SANDS<br>(LITTLE OR NO FINES) |  | SW | WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES |
| | | |  | SP | POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES |
| | | SANDS WITH FINES<br>(APPRECIABLE AMOUNT OF FINES) |  | SM | SILTY SANDS, SAND - SILT MIXTURES |
| | | |  | SC | CLAYEY SANDS, SAND - CLAY MIXTURES |
| FINE GRAINED SOILS<br>MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE | SILTS AND CLAYS | LIQUID LIMIT LESS THAN 50 |  | ML | INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY |
| | | |  | CL | INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS |
| | | |  | OL | ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY |
| | SILTS AND CLAYS | LIQUID LIMIT GREATER THAN 50 |  | MH | INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS |
| | | |  | CH | INORGANIC CLAYS OF HIGH PLASTICITY |
| | | |  | OH | ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS |
| HIGHLY ORGANIC SOILS | | |  | PT | PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS |

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

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Timmons Group
5410 Trinity Road
Raleigh, NC 27607
Telephone: 919-866-4951

# BORING B-01



**PROJECT NUMBER** 72753 **PROJECT NAME** Brunswick County HHS & EOC

**CLIENT** Edifice General Contractors **PROJECT LOCATION** Bolivia, NC

**DATE STARTED** 5/28/2025 **COMPLETED** 5/28/2025 **GROUND ELEVATION** 36 ft **HOLE DEPTH** 50 feet

**DRILLING CONTRACTOR** Bridger Drilling **BOREHOLE WATER LEVELS:**

**DRILLING METHOD** Mud Rotary ▽ **AT END OF DRILLING** 3.70 ft / Elev 32.30 ft

**LOGGED BY** J. Israel, E.I. **CHECKED BY** N. Reeves, P.E. ▼ **AT 24 HOURS DRILLING** ---

**NOTES** **CAVE DEPTH**

| DEPTH (ft) | ELEVATION (ft) | MATERIAL DESCRIPTION | SYMBOL | SAMPLING BLOW COUNTS (N-VALUE) | POCKET PEN. (tsf) | LAB TESTS | REMARKS |
|---|---|---|---|---|---|---|---|
| 0 | 35 | TOPSOIL - 4"<br>SANDY SILT: (ML): gray, fine to medium grained, firm | | 1, SPT 2-2-2 (4) | | | |
| 5 | 30 | ▽ CLAYEY SAND: (SC): orangeish tan to gray, fine to coarse grained, very loose to medium dense, W/ SHELL AND ROCK FRAGMENTS | | 2, SPT 3-2-2 (4)<br>3, SPT 2-3-5 (8) | | | |
| 10 | 25 | | | 4, SPT 4-4-2 (6) | | | |
| 15 | 20 | | | 5, SPT 2-1-2 (3) | | | |
| 20 | 15 | | | 6, SPT 3-4-2 (6) | | | |
| 25 | 10 | | | 7, SPT 3-2-3 (5) | | | |
| 30 | 5 | | | 8, SPT 3-4-4 (8) | | | |
| 35 | | | | 9, SPT 3-5-7 | | | |

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# BORING B-01



**PROJECT NUMBER** 72753 **PROJECT NAME** Brunswick County HHS & EOC

**CLIENT** Edifice General Contractors **PROJECT LOCATION** Bolivia, NC

**DATE STARTED** 5/28/2025 **COMPLETED** 5/28/2025 **GROUND ELEVATION** 36 ft **HOLE DEPTH** 50 feet

**DRILLING CONTRACTOR** Bridger Drilling **BOREHOLE WATER LEVELS:**

**DRILLING METHOD** Mud Rotary **AT END OF DRILLING** 3.70 ft / Elev 32.30 ft

**LOGGED BY** J. Israel, E.I. **CHECKED BY** N. Reeves, P.E. **AT 24 HOURS DRILLING** ---

**NOTES** **CAVE DEPTH**

| DEPTH (ft) | ELEVATION (ft) | MATERIAL DESCRIPTION | SYMBOL | SAMPLING BLOW COUNTS (N-VALUE) | POCKET PEN. (tsf) | LAB TESTS | REMARKS |
|---|---|---|---|---|---|---|---|
| 35 | 0 | CLAYEY SAND: (SC): orangeish tan to gray, fine to coarse grained, very loose to medium dense, W/ SHELL AND ROCK FRAGMENTS *(continued)* | | (12) | | | |
| 40 | -5 | | | 10, SPT 3-3-5 (8) | | | |
| 45 | -10 | | | 11, SPT 8-6-5 (11) | | | |
| 50 | | | | 12, SPT 10-7-13 (20) | | | |

Bottom of borehole at 50.0 feet.

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# BORING B-02



**PROJECT NUMBER** 72753 **PROJECT NAME** Brunswick County HHS & EOC

**CLIENT** Edifice General Contractors **PROJECT LOCATION** Bolivia, NC

**DATE STARTED** 5/28/2025 **COMPLETED** 5/28/2025 **GROUND ELEVATION** 36 ft **HOLE DEPTH** 50 feet

**DRILLING CONTRACTOR** Bridger Drilling **BOREHOLE WATER LEVELS:**

**DRILLING METHOD** Mud Rotary ▽ **AT END OF DRILLING** 3.20 ft / Elev 32.80 ft

**LOGGED BY** J. Israel, E.I. **CHECKED BY** N. Reeves, P.E. ▼ **AT 24 HOURS DRILLING** ---

**NOTES** **CAVE DEPTH**

| DEPTH (ft) | ELEVATION (ft) | MATERIAL DESCRIPTION | SYMBOL | SAMPLING BLOW COUNTS (N-VALUE) | POCKET PEN. (tsf) | LAB TESTS | REMARKS |
|---|---|---|---|---|---|---|---|
| 0 | 35 | TOPSOIL - 4" | | | | | |
| | | SANDY SILT: (ML): brown, fine grained, stiff, W/ TRACE ROOTS | | 1, SPT 5-4-5 (9) | | | |
| | | ▽ | | | | | |
| 5 | 30 | SANDY CLAY: (CL): orangeish brown, fine grained, firm | | 2, SPT 1-3-4 (7) | | | |
| | | CLAYEY SAND: (SC): gray to light tannish gray, fine to coarse grained, very loose to medium dense, W/ SHELL AND ROCK FRAGMENTS | | 3, SPT 4-6-4 (10) | | | |
| 10 | 25 | | | 4, SPT 3-4-4 (8) | | | |
| 15 | 20 | | | 5, SPT 3-1-1 (2) | | | |
| 20 | 15 | | | 6, SPT 2-2-2 (4) | | | |
| 25 | 10 | | | 7, SPT 2-2-2 (4) | | | |
| 30 | 5 | | | 8, SPT 4-6-7 (13) | | | |
| 35 | | | | 9, SPT 5-7-4 | | | |

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# BORING B-02



**PROJECT NUMBER** 72753 **PROJECT NAME** Brunswick County HHS & EOC

**CLIENT** Edifice General Contractors **PROJECT LOCATION** Bolivia, NC

**DATE STARTED** 5/28/2025 **COMPLETED** 5/28/2025 **GROUND ELEVATION** 36 ft **HOLE DEPTH** 50 feet

**DRILLING CONTRACTOR** Bridger Drilling **BOREHOLE WATER LEVELS:**

**DRILLING METHOD** Mud Rotary **AT END OF DRILLING** 3.20 ft / Elev 32.80 ft

**LOGGED BY** J. Israel, E.I. **CHECKED BY** N. Reeves, P.E. **AT 24 HOURS DRILLING** ---

**NOTES** **CAVE DEPTH**

| DEPTH (ft) | ELEVATION (ft) | MATERIAL DESCRIPTION | SYMBOL | SAMPLING BLOW COUNTS (N-VALUE) | POCKET PEN. (tsf) | LAB TESTS | REMARKS |
|---|---|---|---|---|---|---|---|
| 35 | 0 | CLAYEY SAND: (SC): gray to light tannish gray, fine to coarse grained, very loose to medium dense, W/ SHELL AND ROCK FRAGMENTS *(continued)* | | (11) | | | |
| 40 | -5 | | | 10, SPT 4-9-7 (16) | | | |
| 45 | -10 | | | 11, SPT 7-8-7 (15) | | | |
| 50 | | | | 12, SPT 9-13-12 (25) | | | |

Bottom of borehole at 50.0 feet.

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# BORING B-03



**PROJECT NUMBER** 72753 **PROJECT NAME** Brunswick County HHS & EOC

**CLIENT** Edifice General Contractors **PROJECT LOCATION** Bolivia, NC

**DATE STARTED** 6/4/2025 **COMPLETED** 6/4/2025 **GROUND ELEVATION** 36 ft **HOLE DEPTH** 50 feet

**DRILLING CONTRACTOR** Bridger Drilling **BOREHOLE WATER LEVELS:**

**DRILLING METHOD** Mud Rotary ▽ **AT END OF DRILLING** 7.20 ft / Elev 28.80 ft

**LOGGED BY** J. Israel, E.I. **CHECKED BY** N. Reeves, P.E. ▼ **AT 24 HOURS DRILLING** 12.20 ft / Elev 23.80 ft

**NOTES** **CAVE DEPTH**

| DEPTH (ft) | ELEVATION (ft) | MATERIAL DESCRIPTION | SYMBOL | SAMPLING BLOW COUNTS (N-VALUE) | POCKET PEN. (tsf) | LAB TESTS | REMARKS |
|---|---|---|---|---|---|---|---|
| 0 | 35 | TOPSOIL - 4" | | | | | |
| | | SANDY CLAY: (CL): tannish gray, fine grained, firm to stiff | | 1, SPT 2-3-3 (6) | | | |
| 5 | 30 | | | 2, SPT 3-4-5 (9) | | | |
| | | ▽ CLAYEY SAND: (SC): light tannish gray to gray, fine to coarse grained, very loose to medium dense, W/ SHELL AND ROCK FRAGMENTS | | 3, SPT 4-3-4 (7) | | | |
| 10 | 25 | | | 4, SPT 4-5-5 (10) | | | |
| | | ▼ | | | | | |
| 15 | 20 | | | 5, SPT 1-1-2 (3) | | | |
| 20 | 15 | | | 6, SPT 2-2-3 (5) | | | |
| 25 | 10 | | | 7, SPT 2-2-2 (4) | | | |
| 30 | 5 | | | 8, SPT 2-4-3 (7) | | | |
| 35 | | | | 9, SPT 6-5-5 | | | |

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# BORING B-03



**PROJECT NUMBER** 72753 **PROJECT NAME** Brunswick County HHS & EOC

**CLIENT** Edifice General Contractors **PROJECT LOCATION** Bolivia, NC

**DATE STARTED** 6/4/2025 **COMPLETED** 6/4/2025 **GROUND ELEVATION** 36 ft **HOLE DEPTH** 50 feet

**DRILLING CONTRACTOR** Bridger Drilling **BOREHOLE WATER LEVELS:**

**DRILLING METHOD** Mud Rotary ▽ **AT END OF DRILLING** 7.20 ft / Elev 28.80 ft

**LOGGED BY** J. Israel, E.I. **CHECKED BY** N. Reeves, P.E. ▼ **AT 24 HOURS DRILLING** 12.20 ft / Elev 23.80 ft

**NOTES** **CAVE DEPTH**

| DEPTH (ft) | ELEVATION (ft) | MATERIAL DESCRIPTION | SYMBOL | SAMPLING BLOW COUNTS (N-VALUE) | POCKET PEN. (tsf) | LAB TESTS | REMARKS |
|---|---|---|---|---|---|---|---|
| 35 | | | | | | | |
| | 0 | CLAYEY SAND: (SC): light tannish gray to gray, fine to coarse grained, very loose to medium dense, W/ SHELL AND ROCK FRAGMENTS *(continued)* | | (10) | | | |
| 40 | | | | 10, SPT 6-1-3 (4) | | | |
| | -5 | | | | | | |
| 45 | | | | 11, SPT 5-6-5 (11) | | | |
| | -10 | | | | | | |
| 50 | | | | 12, SPT 5-7-7 (14) | | | |

Bottom of borehole at 50.0 feet.

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# BORING B-04



**PROJECT NUMBER** 72753 **PROJECT NAME** Brunswick County HHS & EOC

**CLIENT** Edifice General Contractors **PROJECT LOCATION** Bolivia, NC

**DATE STARTED** 5/31/2025 **COMPLETED** 5/31/2025 **GROUND ELEVATION** 36 ft **HOLE DEPTH** 50 feet

**DRILLING CONTRACTOR** Bridger Drilling **BOREHOLE WATER LEVELS:**

**DRILLING METHOD** Mud Rotary ▽ **AT END OF DRILLING** 4.20 ft / Elev 31.80 ft

**LOGGED BY** J. Israel, E.I. **CHECKED BY** N. Reeves, P.E. ▼ **AT 24 HOURS DRILLING** 15.20 ft / Elev 20.80 ft

**NOTES** **CAVE DEPTH**

| DEPTH (ft) | ELEVATION (ft) | MATERIAL DESCRIPTION | SYMBOL | SAMPLING BLOW COUNTS (N-VALUE) | POCKET PEN. (tsf) | LAB TESTS | REMARKS |
|---|---|---|---|---|---|---|---|
| 0 | 35 | TOPSOIL - 4" | | | | | |
| | | SANDY CLAY: (CL): brown to tannish gray, fine grained, firm | | 1, SPT 4-3-3 (6) | | | |
| 5 | 30 | ▽ | | 2, SPT 2-3-5 (8) | | | |
| | | | | 3, SPT 3-3-4 (7) | | | |
| 10 | 25 | CLAYEY SAND: (SC): light tannish gray to gray, fine to coarse grained, very loose to medium dense, W/ SHELL AND ROCK FRAGMENTS | | 4, SPT 3-4-6 (10) | | | |
| 15 | 20 | ▼ | | 5, SPT 7-1-1 (2) | | | |
| 20 | 15 | | | 6, SPT 3-4-2 (6) | | | |
| 25 | 10 | | | 7, SPT 2-2-2 (4) | | | |
| 30 | 5 | | | 8, SPT 2-3-1 (4) | | | |
| 35 | | | | 9, SPT 2-2-6 | | | |

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# BORING B-04



**PROJECT NUMBER** 72753 **PROJECT NAME** Brunswick County HHS & EOC

**CLIENT** Edifice General Contractors **PROJECT LOCATION** Bolivia, NC

**DATE STARTED** 5/31/2025 **COMPLETED** 5/31/2025 **GROUND ELEVATION** 36 ft **HOLE DEPTH** 50 feet

**DRILLING CONTRACTOR** Bridger Drilling **BOREHOLE WATER LEVELS:**

**DRILLING METHOD** Mud Rotary **AT END OF DRILLING** 4.20 ft / Elev 31.80 ft

**LOGGED BY** J. Israel, E.I. **CHECKED BY** N. Reeves, P.E. **AT 24 HOURS DRILLING** 15.20 ft / Elev 20.80 ft

**NOTES** **CAVE DEPTH**

| DEPTH (ft) | ELEVATION (ft) | MATERIAL DESCRIPTION | SYMBOL | SAMPLING BLOW COUNTS (N-VALUE) | POCKET PEN. (tsf) | LAB TESTS | REMARKS |
|---|---|---|---|---|---|---|---|
| 35 | 0 | CLAYEY SAND: (SC): light tannish gray to gray, fine to coarse grained, very loose to medium dense, W/ SHELL AND ROCK FRAGMENTS *(continued)* | | (8) | | | |
| 40 | -5 | | | 10, SPT 4-11-13 (24) | | | |
| 45 | -10 | | | 11, SPT 3-4-4 (8) | | | |
| 50 | | | | 12, SPT 5-4-7 (11) | | | |

Bottom of borehole at 50.0 feet.

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# BORING B-05



**PROJECT NUMBER** 72753 **PROJECT NAME** Brunswick County HHS & EOC

**CLIENT** Edifice General Contractors **PROJECT LOCATION** Bolivia, NC

**DATE STARTED** 6/4/2025 **COMPLETED** 6/4/2025 **GROUND ELEVATION** 37 ft **HOLE DEPTH** 50 feet

**DRILLING CONTRACTOR** Bridger Drilling **BOREHOLE WATER LEVELS:**

**DRILLING METHOD** Mud Rotary ▽ **AT END OF DRILLING** 8.20 ft / Elev 28.80 ft

**LOGGED BY** J. Israel, E.I. **CHECKED BY** N. Reeves, P.E. ▼ **AT 24 HOURS DRILLING** 15.20 ft / Elev 21.80 ft

**NOTES** **CAVE DEPTH**

| DEPTH (ft) | ELEVATION (ft) | MATERIAL DESCRIPTION | SYMBOL | SAMPLING BLOW COUNTS (N-VALUE) | POCKET PEN. (tsf) | LAB TESTS | REMARKS |
|---|---|---|---|---|---|---|---|
| 0 | 37 | TOPSOIL - 3" | | | | | |
| | 35 | SANDY CLAY: (CL): brown to orangeish brown, fine grained, firm to stiff, W/ TRACE ROOTS | | 1, SPT 3-2-3 (5) | | | |
| 5 | | | | 2, SPT 2-2-3 (5) | | | |
| | 30 | | | 3, SPT 4-4-5 (9) | | | |
| | | ▽ | | | | | |
| 10 | | CLAYEY SAND: (SC): light tannish gray to dark gray, fine to coarse grained, loose to medium dense, W/ SHELL AND ROCK FRAGMENTS | | 4, SPT 2-2-2 (4) | | | |
| | 25 | | | | | | |
| 15 | | ▼ | | 5, SPT 3-2-2 (4) | | | |
| | 20 | | | | | | |
| 20 | | | | 6, SPT 2-2-2 (4) | | | |
| | 15 | | | | | | |
| 25 | | | | 7, SPT 3-2-3 (5) | | | |
| | 10 | | | | | | |
| 30 | | | | 8, SPT 3-4-4 (8) | | | |
| | 5 | | | | | | |
| 35 | | | | 9, SPT 5-7-5 | | | |

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# BORING B-05



**PROJECT NUMBER** 72753 **PROJECT NAME** Brunswick County HHS & EOC

**CLIENT** Edifice General Contractors **PROJECT LOCATION** Bolivia, NC

**DATE STARTED** 6/4/2025 **COMPLETED** 6/4/2025 **GROUND ELEVATION** 37 ft **HOLE DEPTH** 50 feet

**DRILLING CONTRACTOR** Bridger Drilling **BOREHOLE WATER LEVELS:**

**DRILLING METHOD** Mud Rotary **AT END OF DRILLING** 8.20 ft / Elev 28.80 ft

**LOGGED BY** J. Israel, E.I. **CHECKED BY** N. Reeves, P.E. **AT 24 HOURS DRILLING** 15.20 ft / Elev 21.80 ft

**NOTES** **CAVE DEPTH**

| DEPTH (ft) | ELEVATION (ft) | MATERIAL DESCRIPTION | SYMBOL | SAMPLING BLOW COUNTS (N-VALUE) | POCKET PEN. (tsf) | LAB TESTS | REMARKS |
|---|---|---|---|---|---|---|---|
| 35 | | | | (12) | | | |
| | 0 | CLAYEY SAND: (SC): light tannish gray to dark gray, fine to coarse grained, loose to medium dense, W/ SHELL AND ROCK FRAGMENTS *(continued)* | | | | | |
| 40 | | | | 10, SPT 5-7-7 (14) | | | |
| | -5 | | | | | | |
| 45 | | | | 11, SPT 4-7-5 (12) | | | |
| | -10 | | | | | | |
| 50 | | | | 12, SPT 5-4-5 (9) | | | |

Bottom of borehole at 50.0 feet.

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# BORING B-06



**PROJECT NUMBER** 72753 **PROJECT NAME** Brunswick County HHS & EOC

**CLIENT** Edifice General Contractors **PROJECT LOCATION** Bolivia, NC

**DATE STARTED** 5/23/2025 **COMPLETED** 5/23/2025 **GROUND ELEVATION** 36 ft **HOLE DEPTH** 50 feet

**DRILLING CONTRACTOR** Bridger Drilling **BOREHOLE WATER LEVELS:**

**DRILLING METHOD** Mud Rotary ▽ **AT END OF DRILLING** 5.00 ft / Elev 31.00 ft

**LOGGED BY** J. Israel, E.I. **CHECKED BY** N. Reeves, P.E. ▼ **AT 24 HOURS DRILLING** 13.20 ft / Elev 22.80 ft

**NOTES** **CAVE DEPTH**

| DEPTH (ft) | ELEVATION (ft) | MATERIAL DESCRIPTION | SYMBOL | SAMPLING BLOW COUNTS (N-VALUE) | POCKET PEN. (tsf) | LAB TESTS | REMARKS |
|---|---|---|---|---|---|---|---|
| 0 | 35 | TOPSOIL - 4" | | | | | |
| | | SANDY CLAY: (CL): brown, fine grained, firm | | 1, SPT 2-2-3 (5) | | | |
| | | | | 2, SPT 2-2-4 (6) | | | |
| 5 | 30 | ▽ | | | | | |
| | | CLAYEY SAND: (SC): light grayish tan to gray, fine to coarse grained, very loose to medium dense, W/ SHELL AND ROCK FRAGMENTS | | 3, SPT 2-2-3 (5) | | | |
| | | | | 4, SPT 2-1-1 (2) | | | |
| 10 | 25 | | | | | | |
| | | ▼ | | 5, SPT 2-1-2 (3) | | | |
| 15 | 20 | | | | | | |
| | | | | 6, SPT 4-3-2 (5) | | | |
| 20 | 15 | | | | | | |
| | | | | 7, SPT 2-2-2 (4) | | | |
| 25 | 10 | | | | | | |
| | | | | 8, SPT 3-2-2 (4) | | | |
| 30 | 5 | | | | | | |
| | | | | 9, SPT 5-6-7 | | | |
| 35 | | | | | | | |

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# BORING B-06



**PROJECT NUMBER** 72753 **PROJECT NAME** Brunswick County HHS & EOC

**CLIENT** Edifice General Contractors **PROJECT LOCATION** Bolivia, NC

**DATE STARTED** 5/23/2025 **COMPLETED** 5/23/2025 **GROUND ELEVATION** 36 ft **HOLE DEPTH** 50 feet

**DRILLING CONTRACTOR** Bridger Drilling **BOREHOLE WATER LEVELS:**

**DRILLING METHOD** Mud Rotary **AT END OF DRILLING** 5.00 ft / Elev 31.00 ft

**LOGGED BY** J. Israel, E.I. **CHECKED BY** N. Reeves, P.E. **AT 24 HOURS DRILLING** 13.20 ft / Elev 22.80 ft

**NOTES** **CAVE DEPTH**

| DEPTH (ft) | ELEVATION (ft) | MATERIAL DESCRIPTION | SYMBOL | SAMPLING BLOW COUNTS (N-VALUE) | POCKET PEN. (tsf) | LAB TESTS | REMARKS |
|---|---|---|---|---|---|---|---|
| 35 | 0 | CLAYEY SAND: (SC): light grayish tan to gray, fine to coarse grained, very loose to medium dense, W/ SHELL AND ROCK FRAGMENTS *(continued)* | | (13) | | | |
| 40 | -5 | | | 10, SPT 5-7-9 (16) | | | |
| 45 | -10 | | | 11, SPT 4-3-4 (7) | | | |
| 50 | | | | 12, SPT 5-5-7 (12) | | | |

Bottom of borehole at 50.0 feet.

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# BORING B-07



**PROJECT NUMBER** 72753 **PROJECT NAME** Brunswick County HHS & EOC

**CLIENT** Edifice General Contractors **PROJECT LOCATION** Bolivia, NC

**DATE STARTED** 5/23/2025 **COMPLETED** 5/23/2025 **GROUND ELEVATION** 36 ft **HOLE DEPTH** 50 feet

**DRILLING CONTRACTOR** Bridger Drilling **BOREHOLE WATER LEVELS:**

**DRILLING METHOD** Mud Rotary ▽ **AT END OF DRILLING** 6.90 ft / Elev 29.10 ft

**LOGGED BY** J. Israel, E.I. **CHECKED BY** N. Reeves, P.E. ▼ **AT 24 HOURS DRILLING** 15.00 ft / Elev 21.00 ft

**NOTES** **CAVE DEPTH**

| DEPTH (ft) | ELEVATION (ft) | MATERIAL DESCRIPTION | SYMBOL | SAMPLING BLOW COUNTS (N-VALUE) | POCKET PEN. (tsf) | LAB TESTS | REMARKS |
|---|---|---|---|---|---|---|---|
| 0 | 35 | TOPSOIL - 4" | | | | | |
| | | SANDY SILT: (ML): dark gray, fine grained, stiff | | 1, SPT 2-4-4 (8) | | | |
| 5 | 30 | SANDY CLAY: (CL): grayish tan, fine grained, firm | | 2, SPT 2-3-4 (7) | | | |
| | | ▽ CLAYEY SAND: (SC): light tannish gray to light gray, fine to coarse grained, very loose to medium dense, W/ SHELL AND ROCK FRAGMENTS | | 3, SPT 2-2-2 (4) | | | |
| 10 | 25 | | | 4, SPT 2-3-1 (4) | | | |
| 15 | 20 | ▼ | | 5, SPT 2-3-2 (5) | | | |
| 20 | 15 | | | 6, SPT 1-1-1 (2) | | | |
| 25 | 10 | | | 7, SPT 0-0-0 (0) | | | |
| 30 | 5 | | | 8, SPT 4-3-4 (7) | | | |
| 35 | | | | 9, SPT 3-5-5 | | | |

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# BORING B-07



**PROJECT NUMBER** 72753 **PROJECT NAME** Brunswick County HHS & EOC

**CLIENT** Edifice General Contractors **PROJECT LOCATION** Bolivia, NC

**DATE STARTED** 5/23/2025 **COMPLETED** 5/23/2025 **GROUND ELEVATION** 36 ft **HOLE DEPTH** 50 feet

**DRILLING CONTRACTOR** Bridger Drilling **BOREHOLE WATER LEVELS:**

**DRILLING METHOD** Mud Rotary **AT END OF DRILLING** 6.90 ft / Elev 29.10 ft

**LOGGED BY** J. Israel, E.I. **CHECKED BY** N. Reeves, P.E. **AT 24 HOURS DRILLING** 15.00 ft / Elev 21.00 ft

**NOTES** **CAVE DEPTH**

| DEPTH (ft) | ELEVATION (ft) | MATERIAL DESCRIPTION | SYMBOL | SAMPLING BLOW COUNTS (N-VALUE) | POCKET PEN. (tsf) | LAB TESTS | REMARKS |
|---|---|---|---|---|---|---|---|
| 35 | | | | (10) | | | |
| | 0 | CLAYEY SAND: (SC): light tannish gray to light gray, fine to coarse grained, very loose to medium dense, W/ SHELL AND ROCK FRAGMENTS *(continued)* | | | | | |
| | | | | 10, SPT 4-5-9 (14) | | | |
| 40 | -5 | | | | | | |
| | | | | 11, SPT 6-7-7 (14) | | | |
| 45 | -10 | | | | | | |
| | | | | 12, SPT 8-9-11 (20) | | | |
| 50 | | Bottom of borehole at 50.0 feet. | | | | | |

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# BORING B-08



**PROJECT NUMBER** 72753 **PROJECT NAME** Brunswick County HHS & EOC

**CLIENT** Edifice General Contractors **PROJECT LOCATION** Bolivia, NC

**DATE STARTED** 5/27/2025 **COMPLETED** 5/27/2025 **GROUND ELEVATION** 36 ft **HOLE DEPTH** 50 feet

**DRILLING CONTRACTOR** Bridger Drilling **BOREHOLE WATER LEVELS:**

**DRILLING METHOD** Mud Rotary ▽ **AT END OF DRILLING** 17.00 ft / Elev 19.00 ft

**LOGGED BY** J. Israel, E.I. **CHECKED BY** N. Reeves, P.E. ▼ **AT 24 HOURS DRILLING** 28.90 ft / Elev 7.10 ft

**NOTES** **CAVE DEPTH**

| DEPTH (ft) | ELEVATION (ft) | MATERIAL DESCRIPTION | SYMBOL | SAMPLING BLOW COUNTS (N-VALUE) | POCKET PEN. (tsf) | LAB TESTS | REMARKS |
|---|---|---|---|---|---|---|---|
| 0 | 35 | TOPSOIL - 2"<br>SANDY SILT: (ML): dark gray, fine grained, firm | | 1, SPT 1-4-3 (7) | | | |
| 5 | 30 | SANDY CLAY: (CL): orangeish brown to grayish tan, fine grained, firm | | 2, SPT 2-2-2 (4)<br>3, SPT 2-3-4 (7) | | | |
| 10 | 25 | CLAYEY SAND: (SC): light grayish tan to light gray, fine to coarse grained, loose to medium dense, W/ SHELL AND ROCK FRAGMENTS | | 4, SPT 3-3-4 (7) | | | |
| 15 | 20 | ▽ | | 5, SPT 1-2-2 (4) | | | |
| 20 | 15 | | | 6, SPT 3-5-7 (12) | | | |
| 25 | 10 | | | 7, SPT 3-3-2 (5) | | | |
| 30 | 5 | ▼ | | 8, SPT 2-2-4 (6) | | | |
| 35 | | | | 9, SPT 4-4-4 | | | |

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# BORING B-08



**PROJECT NUMBER** 72753 **PROJECT NAME** Brunswick County HHS & EOC

**CLIENT** Edifice General Contractors **PROJECT LOCATION** Bolivia, NC

**DATE STARTED** 5/27/2025 **COMPLETED** 5/27/2025 **GROUND ELEVATION** 36 ft **HOLE DEPTH** 50 feet

**DRILLING CONTRACTOR** Bridger Drilling **BOREHOLE WATER LEVELS:**

**DRILLING METHOD** Mud Rotary **AT END OF DRILLING** 17.00 ft / Elev 19.00 ft

**LOGGED BY** J. Israel, E.I. **CHECKED BY** N. Reeves, P.E. **AT 24 HOURS DRILLING** 28.90 ft / Elev 7.10 ft

**NOTES** **CAVE DEPTH**

| DEPTH (ft) | ELEVATION (ft) | MATERIAL DESCRIPTION | SYMBOL | SAMPLING BLOW COUNTS (N-VALUE) | POCKET PEN. (tsf) | LAB TESTS | REMARKS |
|---|---|---|---|---|---|---|---|
| 35 | 0 | CLAYEY SAND: (SC): light grayish tan to light gray, fine to coarse grained, loose to medium dense, W/ SHELL AND ROCK FRAGMENTS *(continued)* | | (8) | | | |
| 40 | -5 | | | 10, SPT 4-6-3 (9) | | | |
| 45 | -10 | | | 11, SPT 4-5-6 (11) | | | |
| 50 | | | | 12, SPT 5-9-11 (20) | | | |

Bottom of borehole at 50.0 feet.

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# BORING B-09



**PROJECT NUMBER** 72753 **PROJECT NAME** Brunswick County HHS & EOC

**CLIENT** Edifice General Contractors **PROJECT LOCATION** Bolivia, NC

**DATE STARTED** 5/22/2025 **COMPLETED** 5/22/2025 **GROUND ELEVATION** 36 ft **HOLE DEPTH** 10 feet

**DRILLING CONTRACTOR** Bridger Drilling **BOREHOLE WATER LEVELS:**

**DRILLING METHOD** Mud Rotary **AT END OF DRILLING** --- DRY

**LOGGED BY** J. Israel, E.I. **CHECKED BY** N. Reeves, P.E. **AT 24 HOURS DRILLING** ---

**NOTES** **CAVE DEPTH**

| DEPTH (ft) | ELEVATION (ft) | MATERIAL DESCRIPTION | SYMBOL | SAMPLING BLOW COUNTS (N-VALUE) | POCKET PEN. (tsf) | LAB TESTS | REMARKS |
|---|---|---|---|---|---|---|---|
| 0 | 35 | TOPSOIL - 2" | | | | | |
| | | SANDY CLAY: (CL): grayish brown, fine to medium grained, firm to stiff, W/ TRACE ROOTS | | 1, SPT 3-3-3 (6) | | | |
| | | | | 2, SPT 3-4-4 (8) | | | |
| 5 | 30 | SAND: (SP): gray to light gray, fine grained, loose to medium dense | | 3, SPT 5-6-9 (15) | | | |
| | | | | 4, SPT 3-4-4 (8) | | | |
| 10 | | Bottom of borehole at 10.0 feet. | | | | | |

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# BORING B-10



**PROJECT NUMBER** 72753 **PROJECT NAME** Brunswick County HHS & EOC

**CLIENT** Edifice General Contractors **PROJECT LOCATION** Bolivia, NC

**DATE STARTED** 5/22/2025 **COMPLETED** 5/22/2025 **GROUND ELEVATION** 38 ft **HOLE DEPTH** 10 feet

**DRILLING CONTRACTOR** Bridger Drilling **BOREHOLE WATER LEVELS:**

**DRILLING METHOD** Mud Rotary **AT END OF DRILLING** --- DRY

**LOGGED BY** J. Israel, E.I. **CHECKED BY** N. Reeves, P.E. **AT 24 HOURS DRILLING** ---

**NOTES** **CAVE DEPTH**

| DEPTH (ft) | ELEVATION (ft) | MATERIAL DESCRIPTION | SYMBOL | SAMPLING BLOW COUNTS (N-VALUE) | POCKET PEN. (tsf) | LAB TESTS | REMARKS |
|---|---|---|---|---|---|---|---|
| 0 | 38 | TOPSOIL - 2" | | | | | |
| | | SANDY CLAY: (CL): orangeish brown to grayish tan, fine grained, firm to stiff | | 1, SPT 2-2-3 (5) | | | |
| | 35 | | | | | | |
| 5 | | | | 2, SPT 2-3-4 (7) | | | |
| | | | | 3, SPT 2-4-4 (8) | | | |
| | 30 | | | | | | |
| 10 | | CLAYEY SAND: (SC): light gray, fine to medium grained, medium dense | | 4, SPT 4-6-5 (11) | | | |

Bottom of borehole at 10.0 feet.

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# BORING B-11



**PROJECT NUMBER** 72753 **PROJECT NAME** Brunswick County HHS & EOC

**CLIENT** Edifice General Contractors **PROJECT LOCATION** Bolivia, NC

**DATE STARTED** 5/20/2025 **COMPLETED** 5/20/2025 **GROUND ELEVATION** 38 ft **HOLE DEPTH** 10 feet

**DRILLING CONTRACTOR** Bridger Drilling **BOREHOLE WATER LEVELS:**

**DRILLING METHOD** Mud Rotary **AT END OF DRILLING** --- DRY

**LOGGED BY** J. Israel, E.I. **CHECKED BY** N. Reeves, P.E. **AT 24 HOURS DRILLING** ---

**NOTES** **CAVE DEPTH**

| DEPTH (ft) | ELEVATION (ft) | MATERIAL DESCRIPTION | SYMBOL | SAMPLING BLOW COUNTS (N-VALUE) | POCKET PEN. (tsf) | LAB TESTS | REMARKS |
|---|---|---|---|---|---|---|---|
| 0 | 38 | TOPSOIL - 4" | | | | | |
| | | SANDY CLAY: (CL): brownish gray to gray, fine to medium grained, stiff, W/ TRACE ROOTS TO 6 FT | | 1, SPT 3-4-8 (12) | | | |
| | 35 | | | | | | |
| 5 | | | | 2, SPT 6-4-6 (10) | | | |
| | | | | 3, SPT 5-5-5 (10) | | | |
| | 30 | | | | | | |
| 10 | | | | 4, SPT 4-6-7 (13) | | | |

Bottom of borehole at 10.0 feet.

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# BORING B-12



**PROJECT NUMBER** 72753 **PROJECT NAME** Brunswick County HHS & EOC

**CLIENT** Edifice General Contractors **PROJECT LOCATION** Bolivia, NC

**DATE STARTED** 5/28/2025 **COMPLETED** 5/28/2025 **GROUND ELEVATION** 37 ft **HOLE DEPTH** 10 feet

**DRILLING CONTRACTOR** Bridger Drilling **BOREHOLE WATER LEVELS:**

**DRILLING METHOD** Mud Rotary **AT END OF DRILLING** --- DRY

**LOGGED BY** J. Israel, E.I. **CHECKED BY** N. Reeves, P.E. **AT 24 HOURS DRILLING** ---

**NOTES** **CAVE DEPTH**

| DEPTH (ft) | ELEVATION (ft) | MATERIAL DESCRIPTION | SYMBOL | SAMPLING BLOW COUNTS (N-VALUE) | POCKET PEN. (tsf) | LAB TESTS | REMARKS |
|---|---|---|---|---|---|---|---|
| 0 | 37 | TOPSOIL - 3" | | | | | |
| | 35 | CLAYEY SAND: (SC): grayish brown, fine grained, medium dense | | 1, SPT 8-6-4 (10) | | | |
| 5 | | SANDY FAT CLAY: (CH): grayish orange-brown, fine grained, stiff | | 2, SPT 3-5-6 (11) | | | |
| | 30 | CLAYEY SAND: (SC): light tannish gray to light gray, fine to medium grained, loose to medium dense | | 3, SPT 4-5-4 (9) | | | |
| 10 | | | | 4, SPT 6-7-7 (14) | | | |

Bottom of borehole at 10.0 feet.

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# BORING B-13



**PROJECT NUMBER** 72753 **PROJECT NAME** Brunswick County HHS & EOC

**CLIENT** Edifice General Contractors **PROJECT LOCATION** Bolivia, NC

**DATE STARTED** 5/22/2025 **COMPLETED** 5/22/2025 **GROUND ELEVATION** 36 ft **HOLE DEPTH** 10 feet

**DRILLING CONTRACTOR** Bridger Drilling **BOREHOLE WATER LEVELS:**

**DRILLING METHOD** Mud Rotary **AT END OF DRILLING** --- DRY

**LOGGED BY** J. Israel, E.I. **CHECKED BY** N. Reeves, P.E. **AT 24 HOURS DRILLING** ---

**NOTES** **CAVE DEPTH**

| DEPTH (ft) | ELEVATION (ft) | MATERIAL DESCRIPTION | SYMBOL | SAMPLING BLOW COUNTS (N-VALUE) | POCKET PEN. (tsf) | LAB TESTS | REMARKS |
|---|---|---|---|---|---|---|---|
| 0 | 35 | TOPSOIL - 3" | | | | | |
| | | SANDY CLAY: (CL): gray to grayish orange-brown, fine grained, firm to stiff, W/ TRACE ROOTS | | 1, SPT 3-3-4 (7) | | | |
| | | | | 2, SPT 3-4-5 (9) | | | |
| 5 | 30 | CLAYEY SAND: (SC): light tannish gray, fine to medium grained, medium dense | | 3, SPT 2-5-6 (11) | | | |
| | | | | 4, SPT 6-5-6 (11) | | | |
| 10 | | Bottom of borehole at 10.0 feet. | | | | | |

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Raleigh, NC 27607
Telephone: 919-866-4951

# BORING B-14



**PROJECT NUMBER** 72753 **PROJECT NAME** Brunswick County HHS & EOC

**CLIENT** Edifice General Contractors **PROJECT LOCATION** Bolivia, NC

**DATE STARTED** 5/20/2025 **COMPLETED** 5/20/2025 **GROUND ELEVATION** 37 ft **HOLE DEPTH** 10 feet

**DRILLING CONTRACTOR** Bridger Drilling **BOREHOLE WATER LEVELS:**

**DRILLING METHOD** Mud Rotary **AT END OF DRILLING** --- DRY

**LOGGED BY** J. Israel, E.I. **CHECKED BY** N. Reeves, P.E. **AT 24 HOURS DRILLING** ---

**NOTES** **CAVE DEPTH**

| DEPTH (ft) | ELEVATION (ft) | MATERIAL DESCRIPTION | SYMBOL | SAMPLING BLOW COUNTS (N-VALUE) | POCKET PEN. (tsf) | LAB TESTS | REMARKS |
|---|---|---|---|---|---|---|---|
| 0 | 37 | TOPSOIL - 3" | | | | | |
| | 35 | SANDY CLAY: (CL): brown to grayish orange-brown, fine grained, firm to stiff, W/ TRACE ROOTS TO 3.5 FT | | 1, SPT 3-3-4 (7) | | | |
| 5 | | | | 2, SPT 3-3-6 (9) | | | |
| | 30 | | | 3, SPT 4-4-4 (8) | | | |
| 10 | | | | 4, SPT 3-5-6 (11) | | | |

Bottom of borehole at 10.0 feet.

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# BORING B-15



**PROJECT NUMBER** 72753 **PROJECT NAME** Brunswick County HHS & EOC

**CLIENT** Edifice General Contractors **PROJECT LOCATION** Bolivia, NC

**DATE STARTED** 5/28/2025 **COMPLETED** 5/28/2025 **GROUND ELEVATION** 37 ft **HOLE DEPTH** 10 feet

**DRILLING CONTRACTOR** Bridger Drilling **BOREHOLE WATER LEVELS:**

**DRILLING METHOD** Mud Rotary **AT END OF DRILLING** --- DRY

**LOGGED BY** J. Israel, E.I. **CHECKED BY** N. Reeves, P.E. **AT 24 HOURS DRILLING** ---

**NOTES** **CAVE DEPTH**

| DEPTH (ft) | ELEVATION (ft) | MATERIAL DESCRIPTION | SYMBOL | SAMPLING BLOW COUNTS (N-VALUE) | POCKET PEN. (tsf) | LAB TESTS | REMARKS |
|---|---|---|---|---|---|---|---|
| 0 | 37 | TOPSOIL - 3" | | | | | |
| | 35 | SANDY CLAY: (CL): grayish tan to grayish orange-brown, fine grained, firm to stiff, W/ TRACE ROOTS TO 3.5 FT | | 1, SPT 2-3-4 (7) | | | |
| 5 | | | | 2, SPT 4-3-4 (7) | | | |
| | 30 | | | 3, SPT 4-5-7 (12) | | | |
| 10 | | | | 4, SPT 4-6-8 (14) | | | |

Bottom of borehole at 10.0 feet.

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# BORING B-16



**PROJECT NUMBER** 72753 **PROJECT NAME** Brunswick County HHS & EOC

**CLIENT** Edifice General Contractors **PROJECT LOCATION** Bolivia, NC

**DATE STARTED** 5/22/2025 **COMPLETED** 5/22/2025 **GROUND ELEVATION** 35 ft **HOLE DEPTH** 10 feet

**DRILLING CONTRACTOR** Bridger Drilling **BOREHOLE WATER LEVELS:**

**DRILLING METHOD** Mud Rotary **AT END OF DRILLING** --- DRY

**LOGGED BY** J. Israel, E.I. **CHECKED BY** N. Reeves, P.E. **AT 24 HOURS DRILLING** ---

**NOTES** **CAVE DEPTH**

| DEPTH (ft) | ELEVATION (ft) | MATERIAL DESCRIPTION | SYMBOL | SAMPLING BLOW COUNTS (N-VALUE) | POCKET PEN. (tsf) | LAB TESTS | REMARKS |
|---|---|---|---|---|---|---|---|
| 0 | 35 | TOPSOIL - 2" | | | | | |
| | | SILTY SAND: (SM): gray, fine to medium grained, loose | | 1, SPT 2-3-6 (9) | | | |
| 5 | 30 | SANDY CLAY: (CL): grayish brown, fine to medium grained, stiff | | 2, SPT 3-6-7 (13) | | | |
| | | CLAYEY SAND: (SC): light gray to light tannish gray, fine to medium grained, loose to medium dense | | 3, SPT 6-7-6 (13) | | | |
| 10 | 25 | | | 4, SPT 4-5-4 (9) | | | |

Bottom of borehole at 10.0 feet.

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# BORING B-17



**PROJECT NUMBER** 72753 **PROJECT NAME** Brunswick County HHS & EOC

**CLIENT** Edifice General Contractors **PROJECT LOCATION** Bolivia, NC

**DATE STARTED** 5/28/2025 **COMPLETED** 5/28/2025 **GROUND ELEVATION** 36 ft **HOLE DEPTH** 10 feet

**DRILLING CONTRACTOR** Bridger Drilling **BOREHOLE WATER LEVELS:**

**DRILLING METHOD** Mud Rotary **AT END OF DRILLING** --- DRY

**LOGGED BY** J. Israel, E.I. **CHECKED BY** N. Reeves, P.E. **AT 24 HOURS DRILLING** ---

**NOTES** **CAVE DEPTH**

| DEPTH (ft) | ELEVATION (ft) | MATERIAL DESCRIPTION | SYMBOL | SAMPLING BLOW COUNTS (N-VALUE) | POCKET PEN. (tsf) | LAB TESTS | REMARKS |
|---|---|---|---|---|---|---|---|
| 0 | 35 | TOPSOIL - 2" | | | | | |
| | | CLAYEY SAND: (SC): grayish red-brown to light grayish tan, fine to medium grained, loose | | 1, SPT 5-4-5 (9) | | | |
| 5 | 30 | | | 2, SPT 5-5-5 (10) | | | |
| | | | | 3, SPT 3-4-4 (8) | | | |
| 10 | | | | 4, SPT 2-2-2 (4) | | | |

Bottom of borehole at 10.0 feet.

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# BORING B-18



**PROJECT NUMBER** 72753 **PROJECT NAME** Brunswick County HHS & EOC

**CLIENT** Edifice General Contractors **PROJECT LOCATION** Bolivia, NC

**DATE STARTED** 5/22/2025 **COMPLETED** 5/22/2025 **GROUND ELEVATION** 35 ft **HOLE DEPTH** 10 feet

**DRILLING CONTRACTOR** Bridger Drilling **BOREHOLE WATER LEVELS:**

**DRILLING METHOD** Mud Rotary **AT END OF DRILLING** --- DRY

**LOGGED BY** J. Israel, E.I. **CHECKED BY** N. Reeves, P.E. **AT 24 HOURS DRILLING** ---

**NOTES** **CAVE DEPTH**

| DEPTH (ft) | ELEVATION (ft) | MATERIAL DESCRIPTION | SYMBOL | SAMPLING BLOW COUNTS (N-VALUE) | POCKET PEN. (tsf) | LAB TESTS | REMARKS |
|---|---|---|---|---|---|---|---|
| 0 | 35 | TOPSOIL - 2" | | | | | |
| | | CLAYEY SAND: (SC): dark grayish black to grayish orange-brown, fine to medium grained, loose to medium dense, FILL W/ TRACE ROOTS TO 3.5 FT AND LARGE WOOD CHUNKS AT 8.5 FT | | 1, SPT 3-5-6 (11) | | | |
| | | | | 2, SPT 5-4-4 (8) | | | |
| 5 | 30 | | | 3, SPT 4-2-4 (6) | | | |
| | | | | 4, SPT 3-5-6 (11) | | | |
| 10 | 25 | Bottom of borehole at 10.0 feet. | | | | | |

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# APPENDIX C

# LABORATORY TEST RESULTS

*Form No. TR-Class*
*Revision No. 1.2*
*Revision Date: 9/18/22*

# Material Classification

*ASTM D2487*

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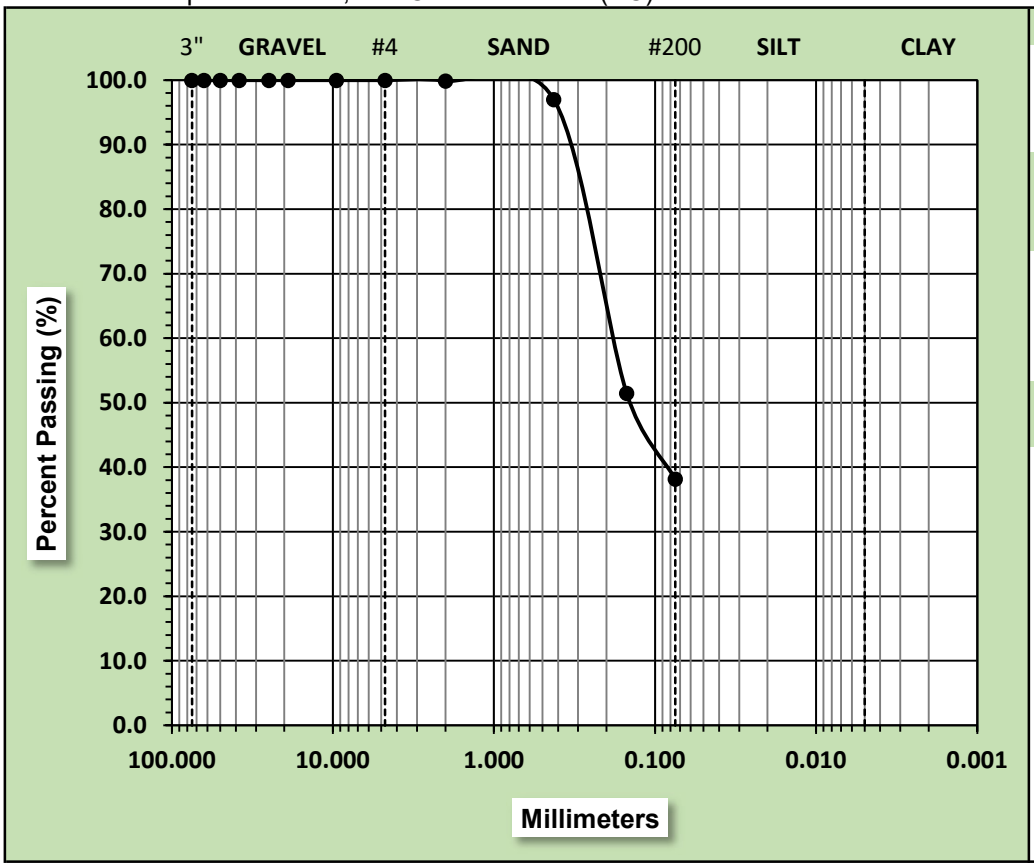
## PROJECT INFORMATION

| | | | |
|---|---|---|---|
| Project #: | 72753 | Report Date: | 6/27/2025 |
| Project Name: | Brunswick Co. HHS & EOC | Tested By: | CAS |
| Project Location: | Bolivia, NC | | |
| Client Name: | Edifice General Contractors | | |

## SAMPLE INFORMATION

| | | | | | |
|---|---|---|---|---|---|
| Location: | B-1 | Sample #: | S-3 | Sample Date: | 6/4/2025 |
| Depth: | 6 to 7.5 feet | Offset: | N/A | Lab Control #: | 3 |

Material Description: Tan, fine CLAYEY SAND (SC)




| Soil Properties | |
|---|---|
| Natural Moisture Content | 21.1% |
| Specific Gravity | --- |
| Liquid Limit | 30 |
| Plastic Limit | 15 |
| Plastic Index | 15 |
| Group Symbol | SC |
| %Passing | |
| 3" | |
| 2.5" | |
| 2" | |
| 1.5" | |
| 1" | |
| 3/4" | |
| 3/8" | |
| #4 | 100.0 |
| #10 | 99.9 |
| #40 | 97.0 |
| #100 | 51.5 |
| #200 | 38.2 |

**Maximum Particle Size #4 Gravel 0.0% Sand 61.8% Silt and Clay 38.2%**

**$C_u$** --- **$C_c$** ---

**Description of Sand & Gravel Particles:** Rounded, Angular, Hard

***Notes:*** 3

***References:*** ASTM D2216 Method A tested on 1/00/00 by CAS
ASTM D422 tested on 1//00/00 by CAS
ASTM D4318 Method A tested on 6/9/25 by CAS

| Chris Smith | | Laboratory Manager | 6/27/25 |
|---|---|---|---|
| *Technical Responsibility* | *Signature* | *Position* | *Date* |

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*Form No. TR-Class*
*Revision No. 1.2*
*Revision Date: 9/18/22*

# Material Classification

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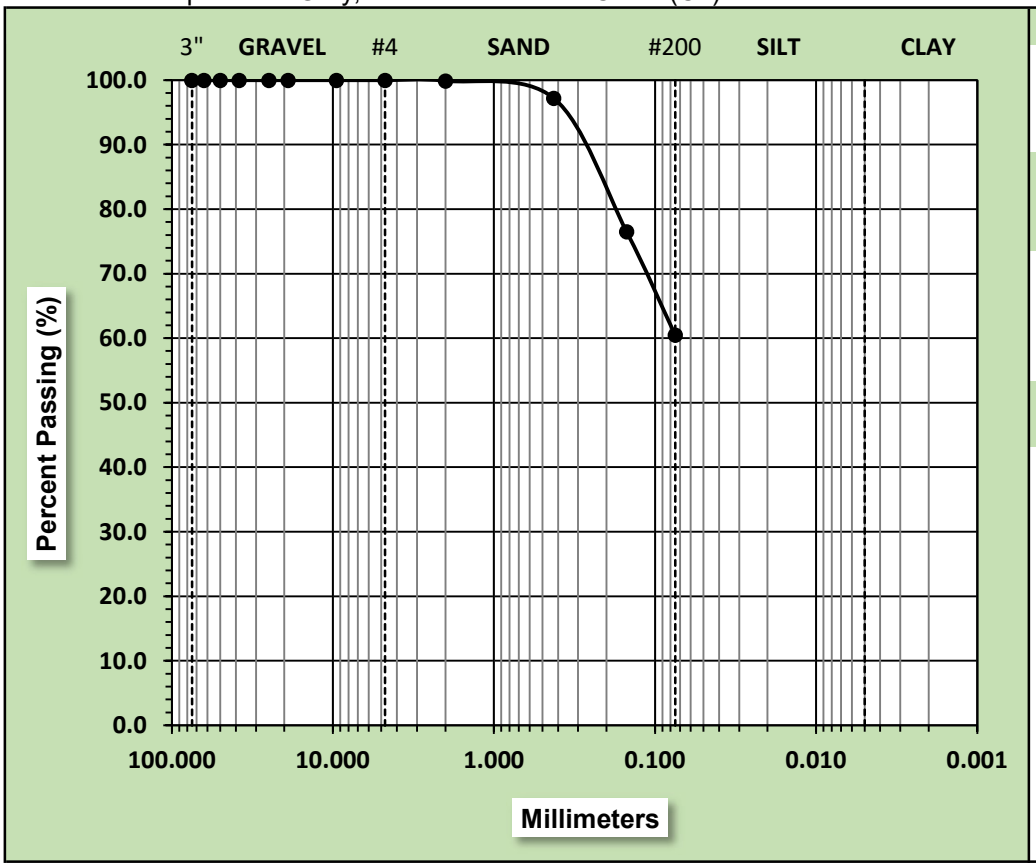
## PROJECT INFORMATION

| | | | |
|---|---|---|---|
| Project #: | 72753 | Report Date: | 6/27/2025 |
| Project Name: | Brunswick Co. HHS & EOC | Tested By: | CAS |
| Project Location: | Bolivia, NC | | |
| Client Name: | Edifice General Contractors | | |

## SAMPLE INFORMATION

| | | | | | |
|---|---|---|---|---|---|
| Location: | B-3 | Sample #: | S-1 | Sample Date: | 6/4/2025 |
| Depth: | 1 to 2.5 feet | Offset: | N/A | Lab Control #: | 4 |

Material Description: Gray, fine SANDY LEAN CLAY (CL)




| Soil Properties | |
|---|---|
| Natural Moisture Content | 19.4% |
| Specific Gravity | --- |
| Liquid Limit | 29 |
| Plastic Limit | 16 |
| Plastic Index | 13 |
| Group Symbol | CL |
| %Passing | |
| 3" | |
| 2.5" | |
| 2" | |
| 1.5" | |
| 1" | |
| 3/4" | |
| 3/8" | |
| #4 | 100.0 |
| #10 | 99.9 |
| #40 | 97.2 |
| #100 | 76.5 |
| #200 | 60.5 |

**Maximum Particle Size** **#4** **Gravel 0.0%** **Sand 39.5%** **Silt and Clay 60.5%**

**$C_u$** --- **$C_c$** ---

**Description of Sand & Gravel Particles:** Rounded, Angular, Hard

***Notes:*** 4

***References:*** ASTM D2216 Method A tested on 1/00/00 by CAS
ASTM D422 tested on 1//00/00 by CAS
ASTM D4318 Method A tested on 6/9/25 by CAS

| Chris Smith | | Laboratory Manager | 6/27/25 |
|---|---|---|---|
| *Technical Responsibility* | *Signature* | *Position* | *Date* |

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*Revision Date: 9/18/22*

# Material Classification

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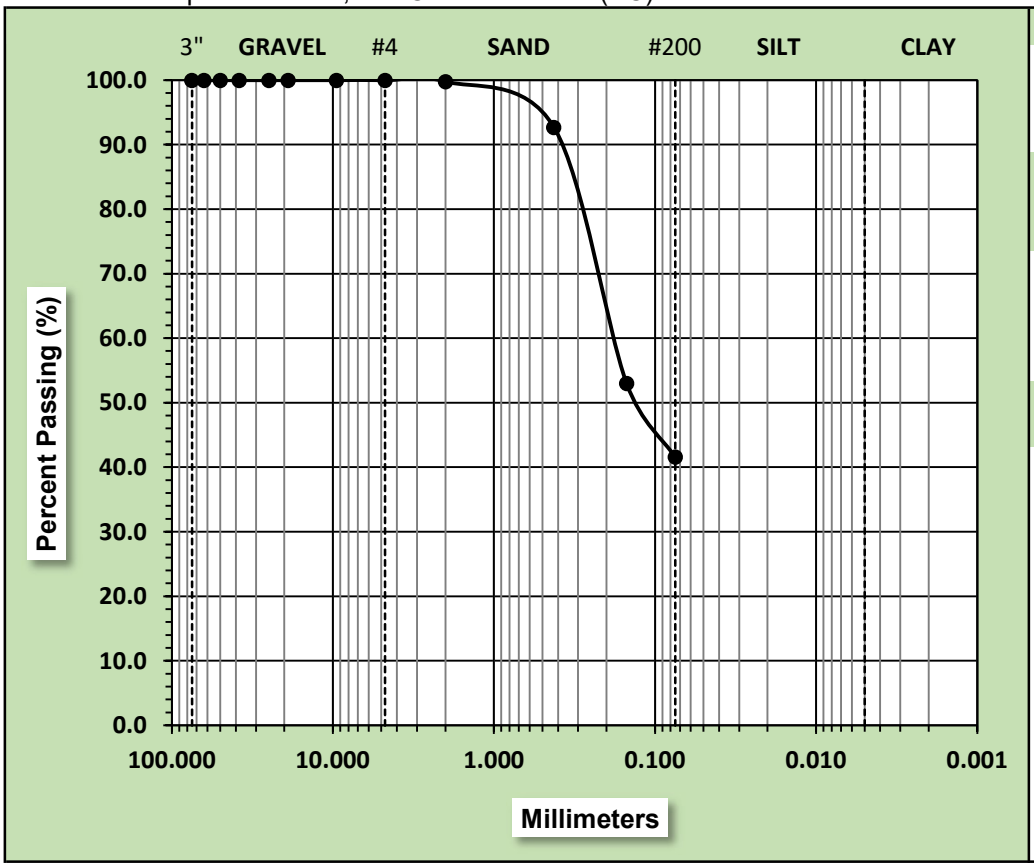
## PROJECT INFORMATION

| | | | |
|---|---|---|---|
| Project #: | 72753 | Report Date: | 6/27/2025 |
| Project Name: | Brunswick Co. HHS & EOC | Tested By: | CAS |
| Project Location: | Bolivia, NC | | |
| Client Name: | Edifice General Contractors | | |

## SAMPLE INFORMATION

| | | | | | |
|---|---|---|---|---|---|
| Location: | B-3 | Sample #: | S-3 | Sample Date: | 6/4/2025 |
| Depth: | 6 to 7.5 feet | Offset: | N/A | Lab Control #: | 5 |

Material Description: Tan, fine CLAYEY SAND (SC)




| Soil Properties | |
|---|---|
| Natural Moisture Content | 32.4% |
| Specific Gravity | --- |
| Liquid Limit | 37 |
| Plastic Limit | 17 |
| Plastic Index | 21 |
| Group Symbol | SC |
| %Passing | |
| 3" | |
| 2.5" | |
| 2" | |
| 1.5" | |
| 1" | |
| 3/4" | |
| 3/8" | |
| #4 | 100.0 |
| #10 | 99.8 |
| #40 | 92.7 |
| #100 | 53.0 |
| #200 | 41.6 |

**Maximum Particle Size** **#4** **Gravel** **0.0%** **Sand** **58.4%** **Silt and Clay** **41.6%**

**$C_u$** --- **$C_c$** ---

**Description of Sand & Gravel Particles:** Rounded, Angular, Hard

***Notes:*** 5

***References:*** ASTM D2216 Method A tested on 1/00/00 by CAS
ASTM D422 tested on 1//00/00 by CAS
ASTM D4318 Method A tested on 6/9/25 by CAS

| Chris Smith | | Laboratory Manager | 6/27/25 |
|---|---|---|---|
| *Technical Responsibility* | *Signature* | *Position* | *Date* |

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*Revision No. 1.2*
*Revision Date: 9/18/22*

# Material Classification

*ASTM D2487*

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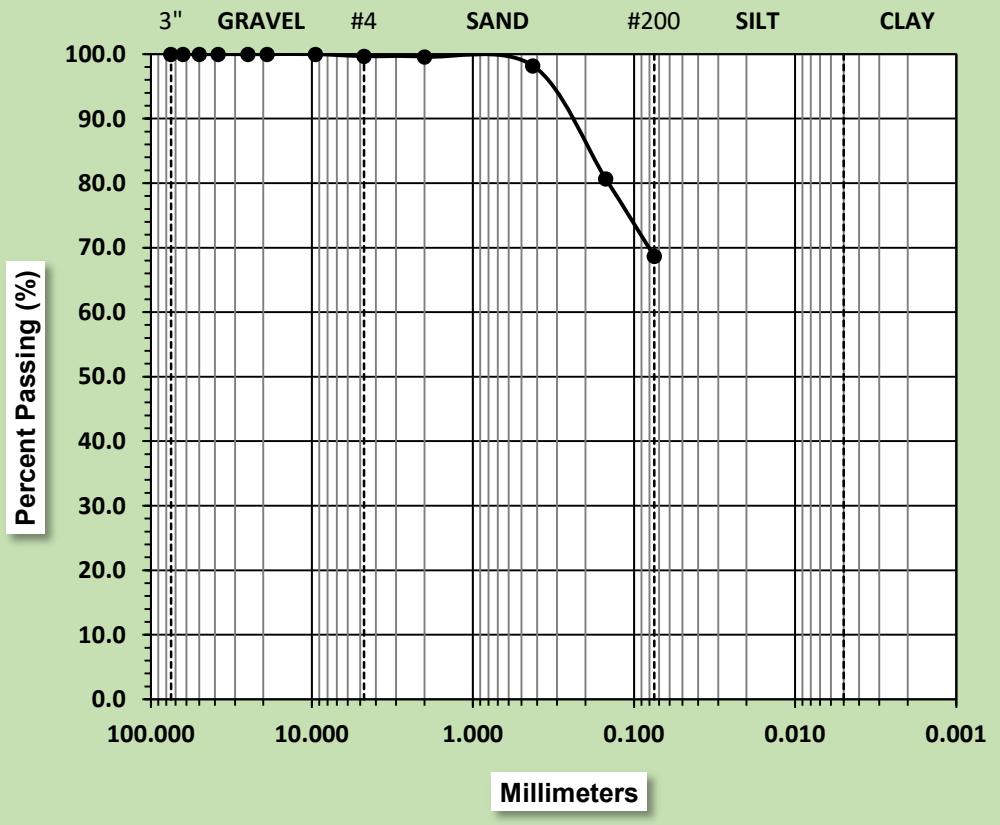
## PROJECT INFORMATION

| | | | |
|---|---|---|---|
| Project #: | 72753 | Report Date: | 6/27/2025 |
| Project Name: | Brunswick Co. HHS & EOC | Tested By: | CAS |
| Project Location: | Bolivia, NC | | |
| Client Name: | Edifice General Contractors | | |

## SAMPLE INFORMATION

| | | | | | |
|---|---|---|---|---|---|
| Location: | B-5 | Sample #: | S-2 | Sample Date: | 6/4/2025 |
| Depth: | 3.5 to 5 feet | Offset: | N/A | Lab Control #: | 6 |

Material Description: Brown, fine SANDY LEAN CLAY (CL)




| Soil Properties | |
|---|---|
| Natural Moisture Content | 22.7% |
| Specific Gravity | --- |
| Liquid Limit | 35 |
| Plastic Limit | 15 |
| Plastic Index | 20 |
| Group Symbol | CL |
| %Passing | |
| 3" | |
| 2.5" | |
| 2" | |
| 1.5" | |
| 1" | |
| 3/4" | |
| 3/8" | 100.0 |
| #4 | 99.7 |
| #10 | 99.6 |
| #40 | 98.2 |
| #100 | 80.7 |
| #200 | 68.7 |

**Maximum Particle Size** 3/8" **Gravel** 0.3% **Sand** 31.0% **Silt and Clay** 68.7%

$C_u$ --- $C_c$ ---

**Description of Sand & Gravel Particles:** Rounded, Angular, Hard

***Notes:*** 6

***References:*** ASTM D2216 Method A tested on 1/00/00 by CAS
ASTM D422 tested on 1//00/00 by CAS
ASTM D4318 Method A tested on 6/9/25 by CAS

| Chris Smith | | Laboratory Manager | 6/27/25 |
|---|---|---|---|
| *Technical Responsibility* | *Signature* | *Position* | *Date* |

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# Material Classification

*ASTM D2487*

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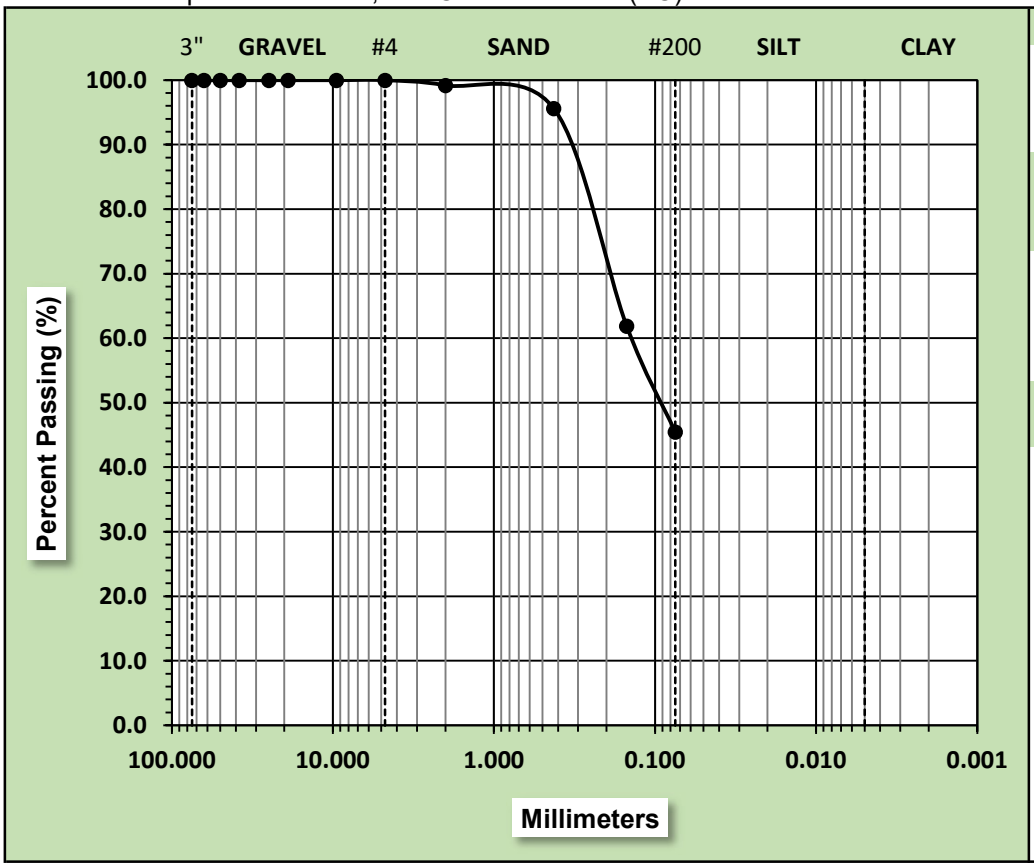
## PROJECT INFORMATION

| | | | |
|---|---|---|---|
| Project #: | 72753 | Report Date: | 6/27/2025 |
| Project Name: | Brunswick Co. HHS & EOC | Tested By: | CAS |
| Project Location: | Bolivia, NC | | |
| Client Name: | Edifice General Contractors | | |

## SAMPLE INFORMATION

| | | | | | |
|---|---|---|---|---|---|
| Location: | B-7 | Sample #: | S-4 | Sample Date: | 6/4/2025 |
| Depth: | 8.5 to 10 feet | Offset: | N/A | Lab Control #: | 7 |

Material Description: Brown, fine CLAYEY SAND (SC)




| Soil Properties | |
|---|---|
| Natural Moisture Content | 36.7% |
| Specific Gravity | --- |
| Liquid Limit | 29 |
| Plastic Limit | 18 |
| Plastic Index | 11 |
| Group Symbol | SC |
| %Passing | |
| 3" | |
| 2.5" | |
| 2" | |
| 1.5" | |
| 1" | |
| 3/4" | |
| 3/8" | |
| #4 | 100.0 |
| #10 | 99.2 |
| #40 | 95.6 |
| #100 | 61.9 |
| #200 | 45.5 |

**Maximum Particle Size #4 Gravel 0.0% Sand 54.5% Silt and Clay 45.5%**

**$C_u$** --- **$C_c$** ---

**Description of Sand & Gravel Particles:** Rounded

***Notes:*** 7

***References:*** ASTM D2216 Method A tested on 1/00/00 by CAS
ASTM D422 tested on 1//00/00 by CAS
ASTM D4318 Method A tested on 6/9/25 by CAS

| Chris Smith | | Laboratory Manager | 6/27/25 |
|---|---|---|---|
| *Technical Responsibility* | *Signature* | *Position* | *Date* |

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*Revision No. 1.2*
*Revision Date: 9/18/22*

# Material Classification

*ASTM D2487*

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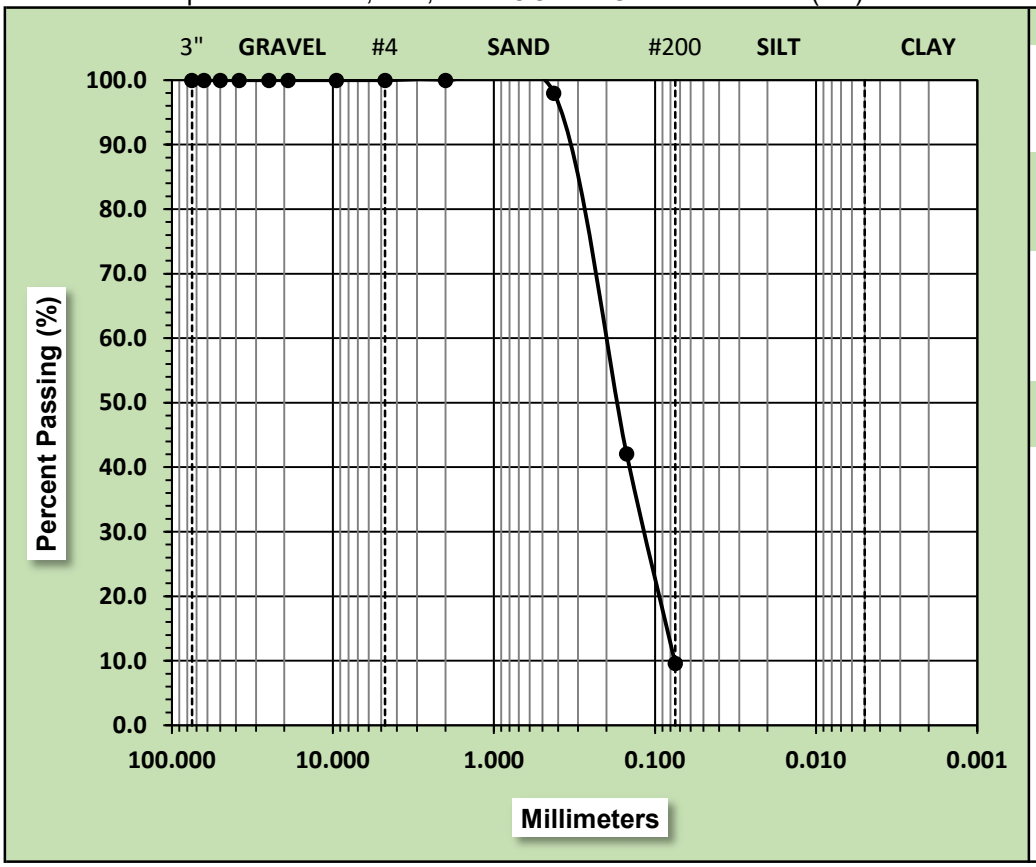
## PROJECT INFORMATION

| | | | |
|---|---|---|---|
| Project #: | 72753 | Report Date: | 6/27/2025 |
| Project Name: | Brunswick Co. HHS & EOC | Tested By: | CAS |
| Project Location: | Bolivia, NC | | |
| Client Name: | Edifice General Contractors | | |

## SAMPLE INFORMATION

| | | | | | |
|---|---|---|---|---|---|
| Location: | B-9 | Sample #: | S-4 | Sample Date: | 6/4/2025 |
| Depth: | 8.5 to 10 feet | Offset: | N/A | Lab Control #: | 8 |

Material Description: White, Tan, fine POORLY GRADED SAND (SP)




| Soil Properties | |
|---|---|
| Natural Moisture Content | 23.1% |
| Specific Gravity | --- |
| Liquid Limit | --- |
| Plastic Limit | NP |
| Plastic Index | --- |
| Group Symbol | SP |
| %Passing | |
| 3" | |
| 2.5" | |
| 2" | |
| 1.5" | |
| 1" | |
| 3/4" | |
| 3/8" | |
| #4 | |
| #10 | 100.0 |
| #40 | 98.0 |
| #100 | 42.1 |
| #200 | 9.6 |

**Maximum Particle Size #10 Gravel 0.0% Sand 90.4% Silt and Clay 9.6%**

**$C_u$** --- **$C_c$** ---

**Description of Sand & Gravel Particles:**

***Notes:*** 8

***References:*** ASTM D2216 Method A tested on 1/00/00 by CAS
ASTM D422 tested on 1//00/00 by CAS

| Chris Smith | | Laboratory Manager | 6/27/25 |
|---|---|---|---|
| *Technical Responsibility* | *Signature* | *Position* | *Date* |

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*Form No. TR-Class*
*Revision No. 1.2*
*Revision Date: 9/18/22*

# Material Classification

*ASTM D2487*

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

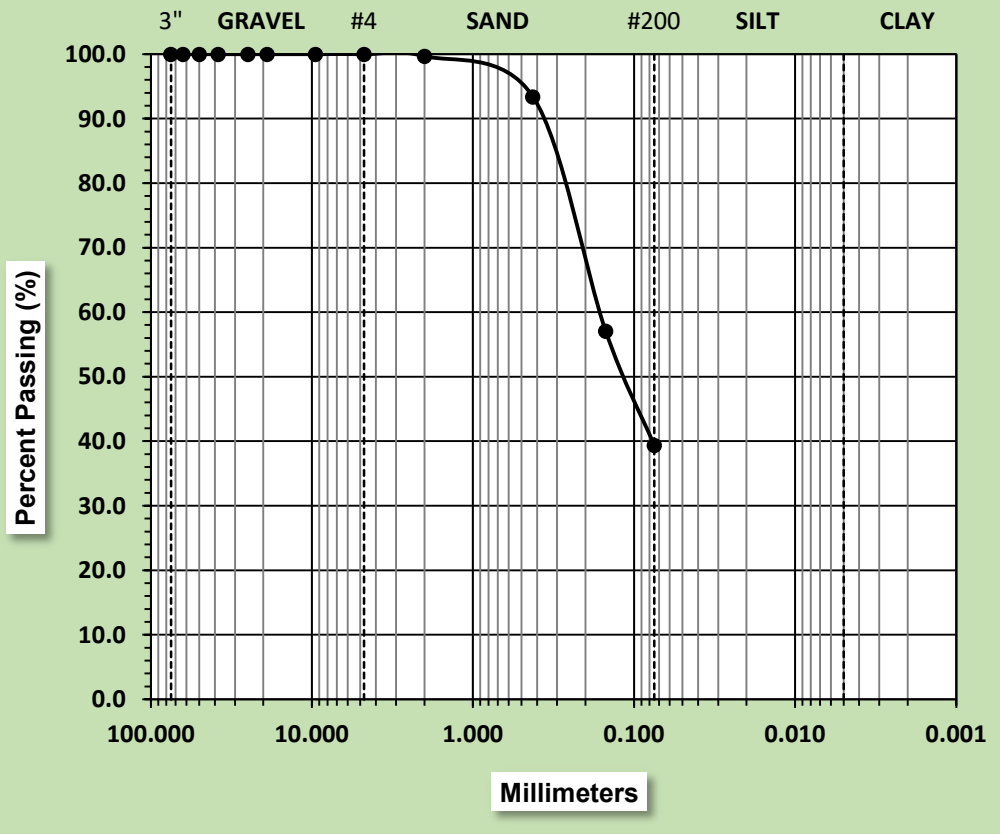
## PROJECT INFORMATION

| | | | |
|---|---|---|---|
| Project #: | 72753 | Report Date: | 6/27/2025 |
| Project Name: | Brunswick Co. HHS & EOC | Tested By: | CAS |
| Project Location: | Bolivia, NC | | |
| Client Name: | Edifice General Contractors | | |

## SAMPLE INFORMATION

| | | | | | |
|---|---|---|---|---|---|
| Location: | B-12 | Sample #: | Bulk | Sample Date: | 6/4/2025 |
| Depth: | 1 to 5 feet | Offset: | N/A | Lab Control #: | 1 |

Material Description: Tan, fine CLAYEY SAND (SC)




| Soil Properties | |
|---|---|
| As-Received Moisture Content | 25.2% |
| Specific Gravity | --- |
| Liquid Limit | 38 |
| Plastic Limit | 16 |
| Plastic Index | 22 |
| Group Symbol | SC |
| %Passing | |
| 3" | |
| 2.5" | |
| 2" | |
| 1.5" | |
| 1" | |
| 3/4" | |
| 3/8" | |
| #4 | 100.0 |
| #10 | 99.7 |
| #40 | 93.4 |
| #100 | 57.1 |
| #200 | 39.4 |

**Maximum Particle Size** #4 **Gravel** 0.0% **Sand** 60.6% **Silt and Clay** 39.4%

$C_u$ --- $C_c$ ---

**Description of Sand & Gravel Particles:** Rounded, Angular, Hard

***Notes:*** 1

***References:*** ASTM D2216 Method A tested on 1/00/00 by CAS
ASTM D422 tested on 1//00/00 by CAS
ASTM D4318 Method A tested on 6/9/25 by CAS

| Chris Smith | | Laboratory Manager | 6/27/25 |
|---|---|---|---|
| *Technical Responsibility* | *Signature* | *Position* | *Date* |

*Information included in this report relates only to material sampled at the time of testing.*
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*Form No. TR-Class*
*Revision No. 1.2*
*Revision Date: 9/18/22*

# Material Classification

*ASTM D2487*

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

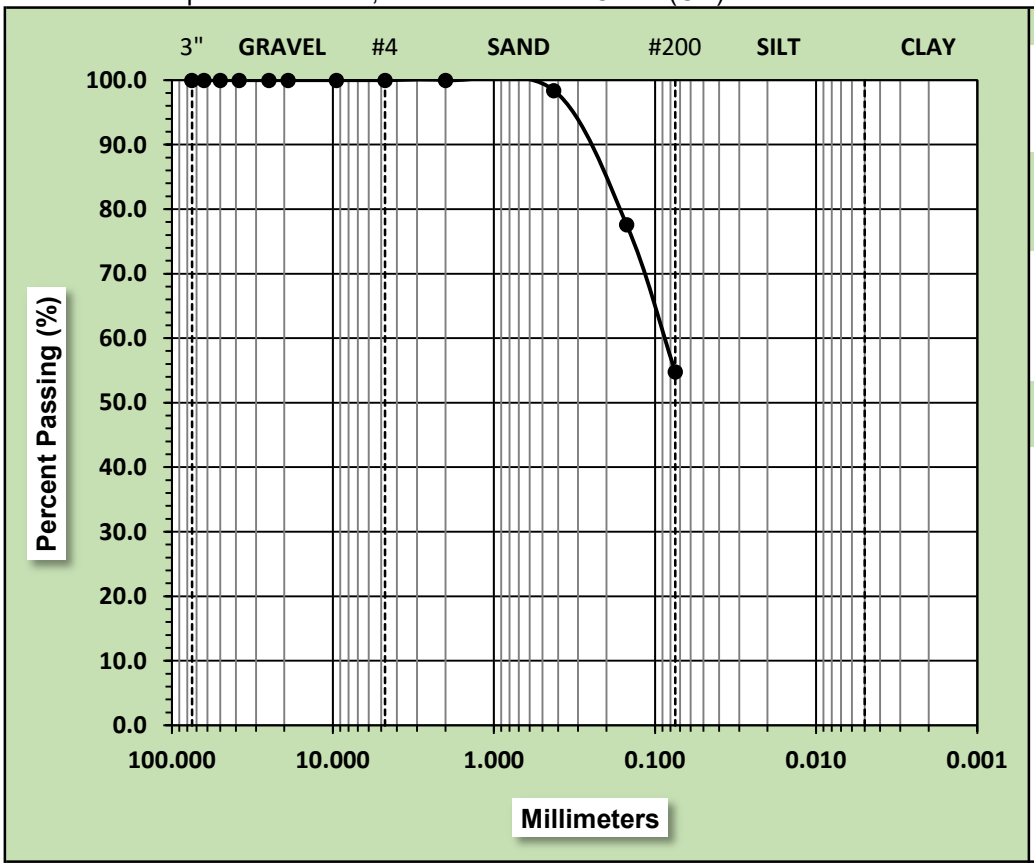
## PROJECT INFORMATION

| | | | |
|---|---|---|---|
| Project #: | 72753 | Report Date: | 6/27/2025 |
| Project Name: | Brunswick Co. HHS & EOC | Tested By: | CAS |
| Project Location: | Bolivia, NC | | |
| Client Name: | Edifice General Contractors | | |

## SAMPLE INFORMATION

| | | | | | |
|---|---|---|---|---|---|
| Location: | B-12 | Sample #: | S-2 | Sample Date: | 6/4/2025 |
| Depth: | 3.5 to 5 feet | Offset: | N/A | Lab Control #: | 9 |

Material Description: Brown, fine SANDY FAT CLAY (CH)




| Soil Properties | |
|---|---|
| Natural Moisture Content | 23.4% |
| Specific Gravity | --- |
| Liquid Limit | 57 |
| Plastic Limit | 24 |
| Plastic Index | 33 |
| Group Symbol | CH |
| %Passing | |
| 3" | |
| 2.5" | |
| 2" | |
| 1.5" | |
| 1" | |
| 3/4" | |
| 3/8" | |
| #4 | |
| #10 | 100.0 |
| #40 | 98.4 |
| #100 | 77.6 |
| #200 | 54.8 |

**Maximum Particle Size #10 Gravel 0.0% Sand 45.2% Silt and Clay 54.8%**

**$C_u$** --- **$C_c$** ---

**Description of Sand & Gravel Particles:**

***Notes:*** 9

***References:*** ASTM D2216 Method A tested on 1/00/00 by CAS
ASTM D422 tested on 1//00/00 by CAS
ASTM D4318 Method A tested on 6/9/25 by CAS

| Chris Smith | | Laboratory Manager | 6/27/25 |
|---|---|---|---|
| *Technical Responsibility* | *Signature* | *Position* | *Date* |

*Information included in this report relates only to material sampled at the time of testing.*
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*Form No. TR-Class*
*Revision No. 1.2*
*Revision Date: 9/18/22*

# Material Classification

*ASTM D2487*

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

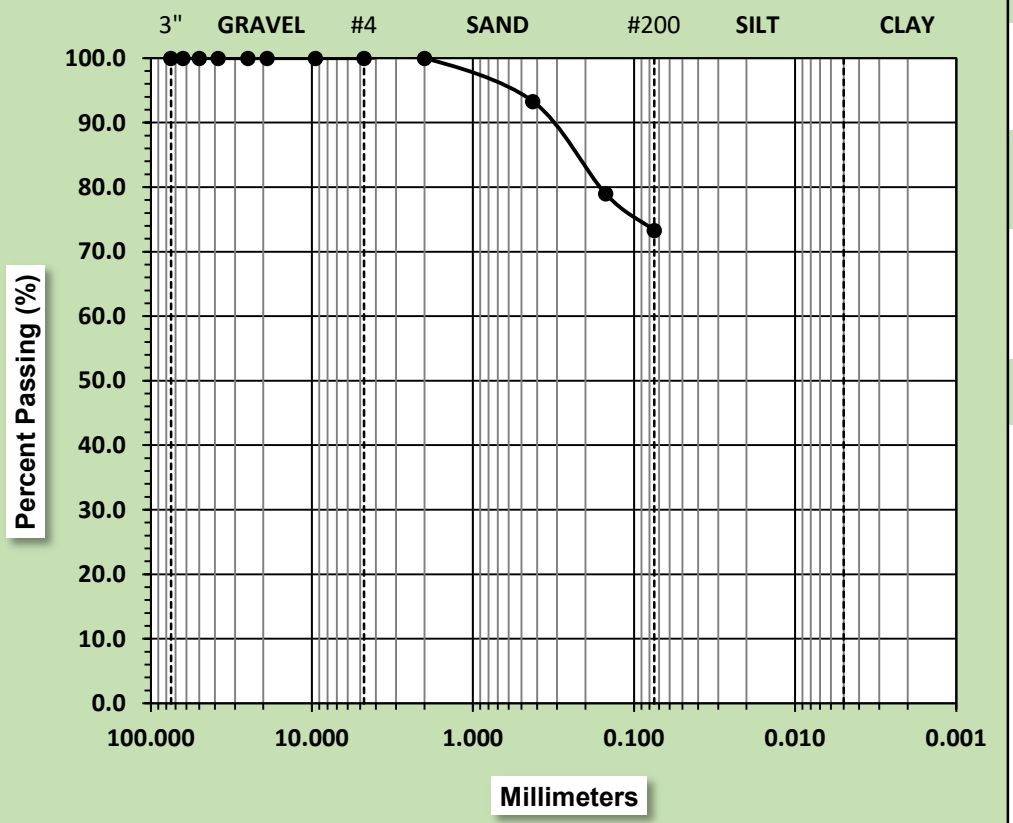
## PROJECT INFORMATION

| | | | |
|---|---|---|---|
| Project #: | 72753 | Report Date: | 6/27/2025 |
| Project Name: | Brunswick Co. HHS & EOC | Tested By: | CAS |
| Project Location: | Bolivia, NC | | |
| Client Name: | Edifice General Contractors | | |

## SAMPLE INFORMATION

| | | | | | |
|---|---|---|---|---|---|
| Location: | B-15 | Sample #: | S-4 | Sample Date: | 6/4/2025 |
| Depth: | 8.5 to 10 feet | Offset: | N/A | Lab Control #: | 10 |

Material Description: Brown, fine SANDY LEAN CLAY (CL)




| Soil Properties | |
|---|---|
| Natural Moisture Content | 29.7% |
| Specific Gravity | --- |
| Liquid Limit | 29 |
| Plastic Limit | 16 |
| Plastic Index | 13 |
| Group Symbol | CL |
| %Passing | |
| 3" | |
| 2.5" | |
| 2" | |
| 1.5" | |
| 1" | |
| 3/4" | |
| 3/8" | |
| #4 | |
| #10 | 100.0 |
| #40 | 93.3 |
| #100 | 79.0 |
| #200 | 73.3 |

**Maximum Particle Size #10 Gravel 0.0% Sand 26.7% Silt and Clay 73.3%**

**$C_u$** --- **$C_c$** ---

**Description of Sand & Gravel Particles:**

***Notes:*** 10

***References:*** ASTM D2216 Method A tested on 1/00/00 by CAS
ASTM D422 tested on 1//00/00 by CAS
ASTM D4318 Method A tested on 6/9/25 by CAS

| Chris Smith | | Laboratory Manager | 6/27/25 |
|---|---|---|---|
| *Technical Responsibility* | *Signature* | *Position* | *Date* |

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*Form No. TR-Class*
*Revision No. 1.2*
*Revision Date: 9/18/22*

# Material Classification

*ASTM D2487*

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

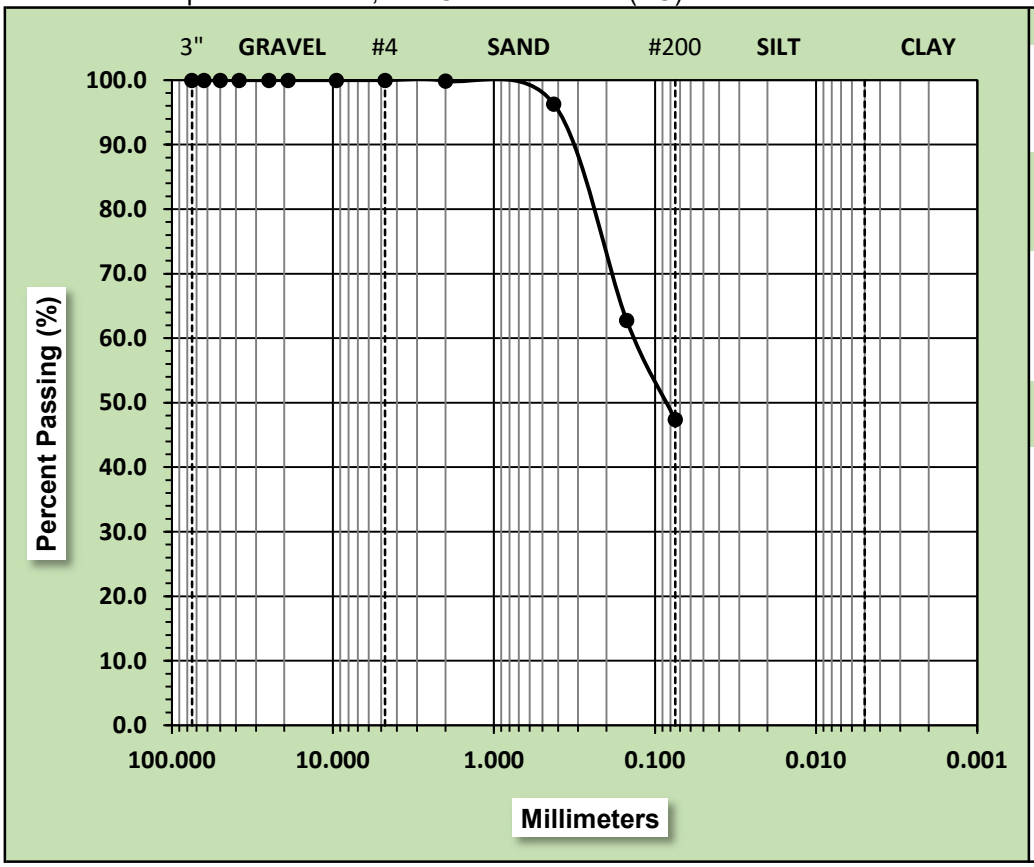
## PROJECT INFORMATION

| | | | |
|---|---|---|---|
| Project #: | 72753 | Report Date: | 6/27/2025 |
| Project Name: | Brunswick Co. HHS & EOC | Tested By: | CAS |
| Project Location: | Bolivia, NC | | |
| Client Name: | Edifice General Contractors | | |

## SAMPLE INFORMATION

| | | | | | |
|---|---|---|---|---|---|
| Location: | B-17 | Sample #: | Bulk | Sample Date: | 6/4/2025 |
| Depth: | 1 to 5 feet | Offset: | N/A | Lab Control #: | 2 |

Material Description: Brown, fine CLAYEY SAND (SC)




| Soil Properties | |
|---|---|
| As-Received Moisture Content | 20.9% |
| Specific Gravity | --- |
| Liquid Limit | 25 |
| Plastic Limit | 14 |
| Plastic Index | 11 |
| Group Symbol | SC |
| %Passing | |
| 3" | |
| 2.5" | |
| 2" | |
| 1.5" | |
| 1" | |
| 3/4" | |
| 3/8" | |
| #4 | 100.0 |
| #10 | 99.9 |
| #40 | 96.3 |
| #100 | 62.8 |
| #200 | 47.4 |

**Maximum Particle Size** **#4** **Gravel** **0.0%** **Sand** **52.6%** **Silt and Clay** **47.4%**

**$C_u$** --- **$C_c$** ---

**Description of Sand & Gravel Particles:** Rounded, Angular, Hard

***Notes:*** 2

***References:*** ASTM D2216 Method A tested on 1/00/00 by CAS
ASTM D422 tested on 1//00/00 by CAS
ASTM D4318 Method A tested on 6/9/25 by CAS

| Chris Smith | | Laboratory Manager | 6/27/25 |
|---|---|---|---|
| *Technical Responsibility* | *Signature* | *Position* | *Date* |

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*Form No. TR-Class*
*Revision No. 1.2*
*Revision Date: 9/18/22*

# Material Classification

*ASTM D2487*

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

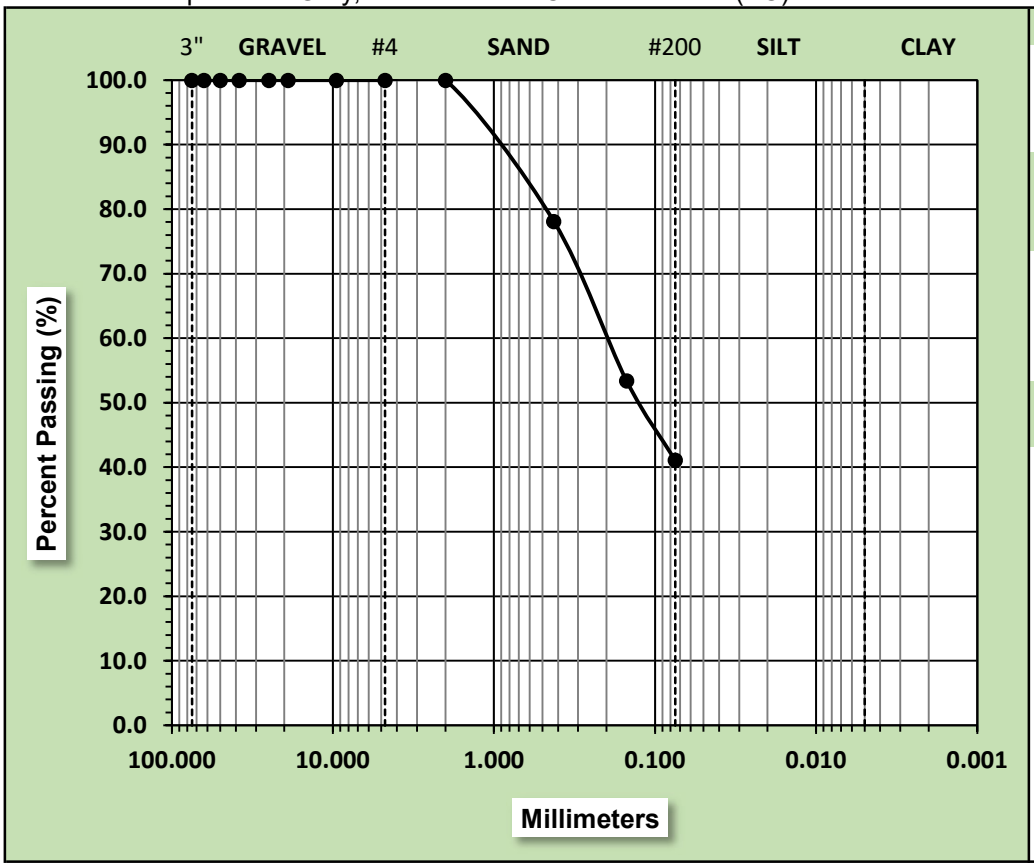
## PROJECT INFORMATION

| | | | |
|---|---|---|---|
| Project #: | 72753 | Report Date: | 6/27/2025 |
| Project Name: | Brunswick Co. HHS & EOC | Tested By: | CAS |
| Project Location: | Bolivia, NC | | |
| Client Name: | Edifice General Contractors | | |

## SAMPLE INFORMATION

| | | | | | |
|---|---|---|---|---|---|
| Location: | B-18 | Sample #: | S-1 | Sample Date: | 6/4/2025 |
| Depth: | 1 to 2.5 feet | Offset: | N/A | Lab Control #: | 11 |

Material Description: Gray,medium to fine CLAYEY SAND (SC)




| Soil Properties | |
|---|---|
| Natural Moisture Content | 20.8% |
| Specific Gravity | --- |
| Liquid Limit | 26 |
| Plastic Limit | 16 |
| Plastic Index | 10 |
| Group Symbol | SC |
| %Passing | |
| 3" | |
| 2.5" | |
| 2" | |
| 1.5" | |
| 1" | |
| 3/4" | |
| 3/8" | |
| #4 | |
| #10 | 100.0 |
| #40 | 78.1 |
| #100 | 53.4 |
| #200 | 41.1 |

**Maximum Particle Size #4 Gravel 0.0% Sand 58.9% Silt and Clay 41.1%**

**$C_u$** --- **$C_c$** ---

**Description of Sand & Gravel Particles:**

***Notes:*** 11

***References:*** ASTM D2216 Method A tested on 1/00/00 by CAS
ASTM D422 tested on 1//00/00 by CAS
ASTM D4318 Method A tested on 6/9/25 by CAS

| Chris Smith | | Laboratory Manager | 6/27/25 |
|---|---|---|---|
| *Technical Responsibility* | *Signature* | *Position* | *Date* |

*Information included in this report relates only to material sampled at the time of testing.*
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*Form No. TR-Compaction*
*Revision No. 1.1*
*Revision Date: 05/18/18*

# MOISTURE-DENSITY RELATIONSHIP REPORT

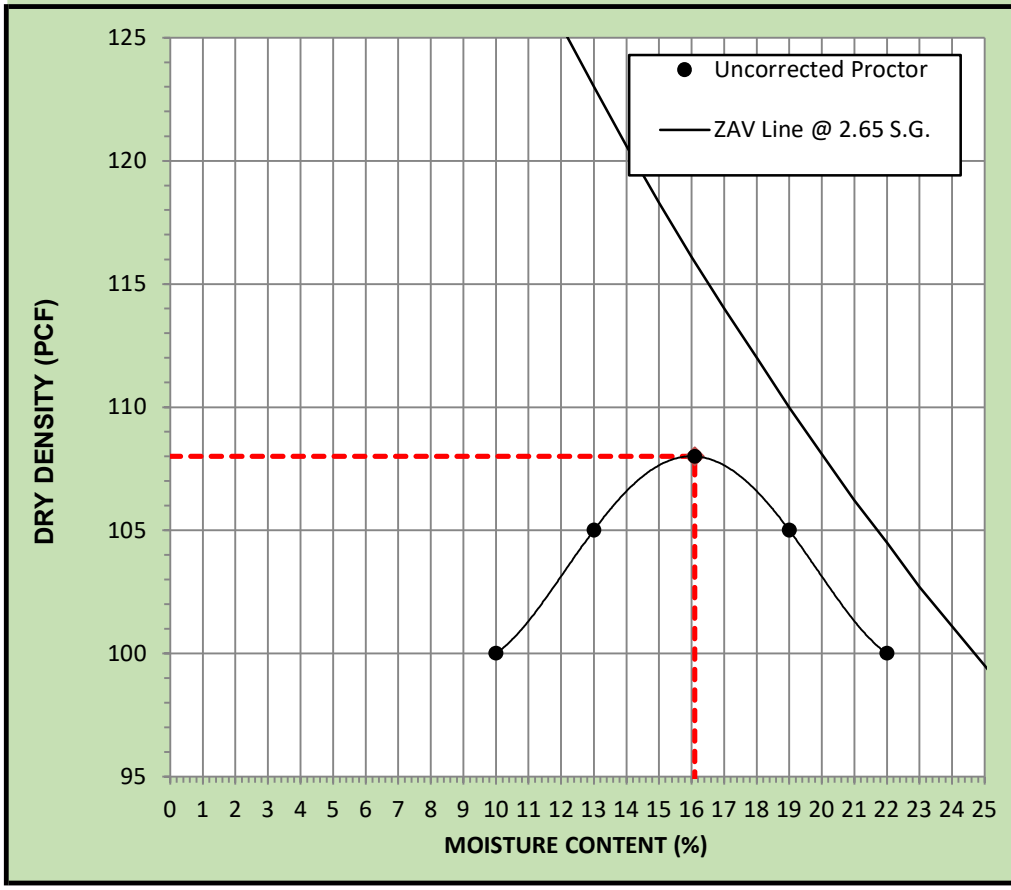
TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

| PROJECT INFORMATION | | | |
|---|---|---|---|
| Project #: | 72753 | Report Date: | 6/27/2025 |
| Project Name: | Brunswick Co. HHS & EOC | Test Date(s): | 6/9/2025 |
| Project Location: | Bolivia, NC | Tested By: | CAS |
| Client Name: | Edifice General Contractors | | |

| SAMPLE INFORMATION | | | | | |
|---|---|---|---|---|---|
| Location: | B-12 | Sample #: | Bulk | Sample Date: | 6/4/2025 |
| Depth: | 1 to 5 feet | Offset: | N/A | Lab Control #: | 1 |
| Material Description: | Tan, fine CLAYEY SAND (SC) | | | | |

| Corrected Maximum Dry Density | 108.0 PCF | Corrected Optimum Moisture Content | 16.1 % |
|---|---|---|---|

**ASTM D698 - Method A**




| Soil Properties | |
|---|---|
| As-Received Moisture Content | 25.2% |
| Assumed Specific Gravity | 2.65 |
| Liquid Limit | 38 |
| Plastic Limit | 16 |
| Plastic Index | 22 |
| %Passing | |
| 1.5" | |
| 3/4" | |
| 3/8" | |
| No. 4 | 100.0 |
| No. 10 | 99.7 |
| No. 40 | 93.4 |
| No. 200 | 39.4 |
| Uncorrected Moisture-Density | |
| MDD (pcf) | 108.0 |
| OMC (%) | 16.1 |
| Assumed Properties of Oversize Fraction | |
| Sp.Gr.(OD) | --- |
| Absorption | --- |

*The Moisture-Density Curve Displayed relates only to material passing a No. 4 sieve.*
*Air-dried material passing a No. 4 sieve was prepared then compacted with a circular, manual rammer.*

***References / Comments / Deviations:***

| Chris Smith | | Laboratory Manager | 6/27/25 |
|---|---|---|---|
| *Technical Responsibility* | *Signature* | *Position* | *Date* |

*Information included in this report relates only to material sampled at the time of testing.*
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# MOISTURE-DENSITY RELATIONSHIP REPORT

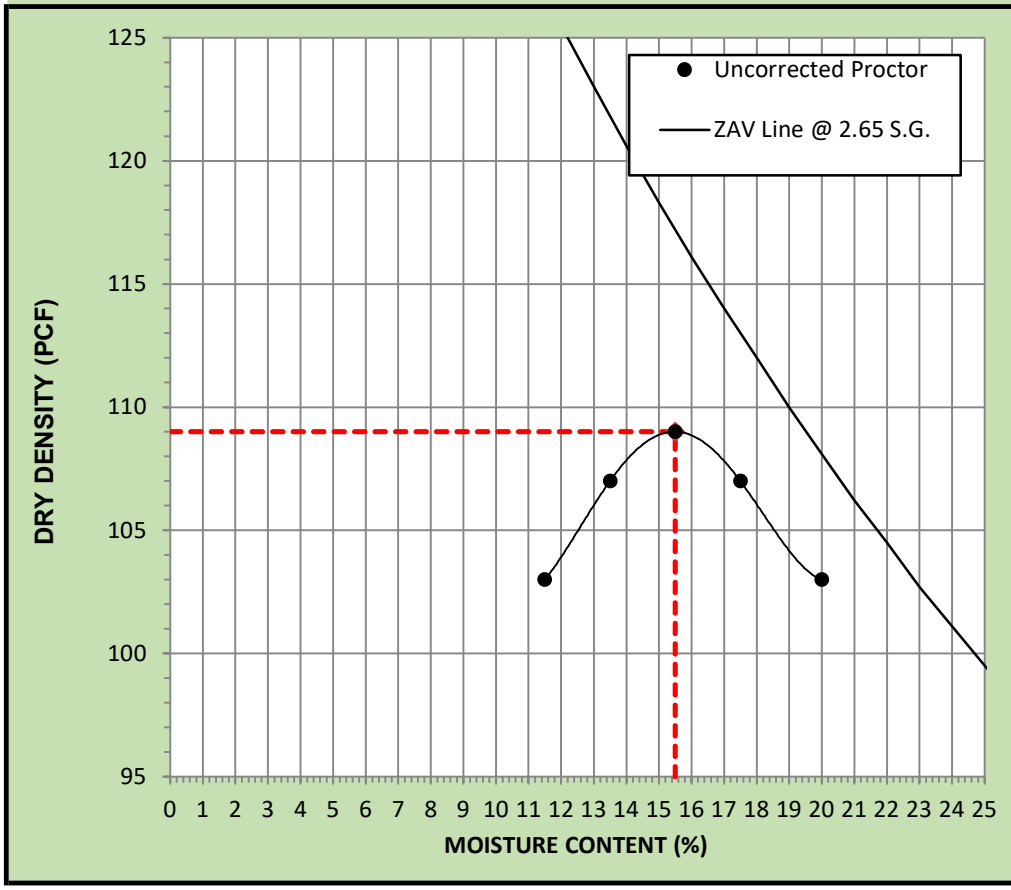
TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

| PROJECT INFORMATION | | | |
|---|---|---|---|
| Project #: | 72753 | Report Date: | 6/27/2025 |
| Project Name: | Brunswick Co. HHS & EOC | Test Date(s): | 6/9/2025 |
| Project Location: | Bolivia, NC | Tested By: | CAS |
| Client Name: | Edifice General Contractors | | |

| SAMPLE INFORMATION | | | | | |
|---|---|---|---|---|---|
| Location: | B-17 | Sample #: | Bulk | Sample Date: | 6/4/2025 |
| Depth: | 1 to 5 feet | Offset: | N/A | Lab Control #: | 2 |
| Material Description: | Brown, fine CLAYEY SAND (SC) | | | | |

**Corrected Maximum Dry Density** **109.0 PCF** **Corrected Optimum Moisture Content** **15.5 %**

**ASTM D698 - Method A**




| Soil Properties | |
|---|---|
| As-Received Moisture Content | 20.9% |
| Assumed Specific Gravity | 2.65 |
| Liquid Limit | 25 |
| Plastic Limit | 14 |
| Plastic Index | 11 |
| %Passing | |
| 1.5" | |
| 3/4" | |
| 3/8" | |
| No. 4 | 100.0 |
| No. 10 | 99.9 |
| No. 40 | 96.3 |
| No. 200 | 47.4 |
| Uncorrected Moisture-Density | |
| MDD (pcf) | 109.0 |
| OMC (%) | 15.5 |
| Assumed Properties of Oversize Fraction | |
| Sp.Gr.(OD) | --- |
| Absorption | --- |

*The Moisture-Density Curve Displayed relates only to material passing a No. 4 sieve.*
*Air-dried material passing a No. 4 sieve was prepared then compacted with a circular, manual rammer.*

***References / Comments / Deviations:***

| Chris Smith | | Laboratory Manager | 6/27/25 |
|---|---|---|---|
| *Technical Responsibility* | *Signature* | *Position* | *Date* |

*Information included in this report relates only to material sampled at the time of testing.*
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Form No. TR-CBR
Revision No. 1
Revision Date: 05/18/18

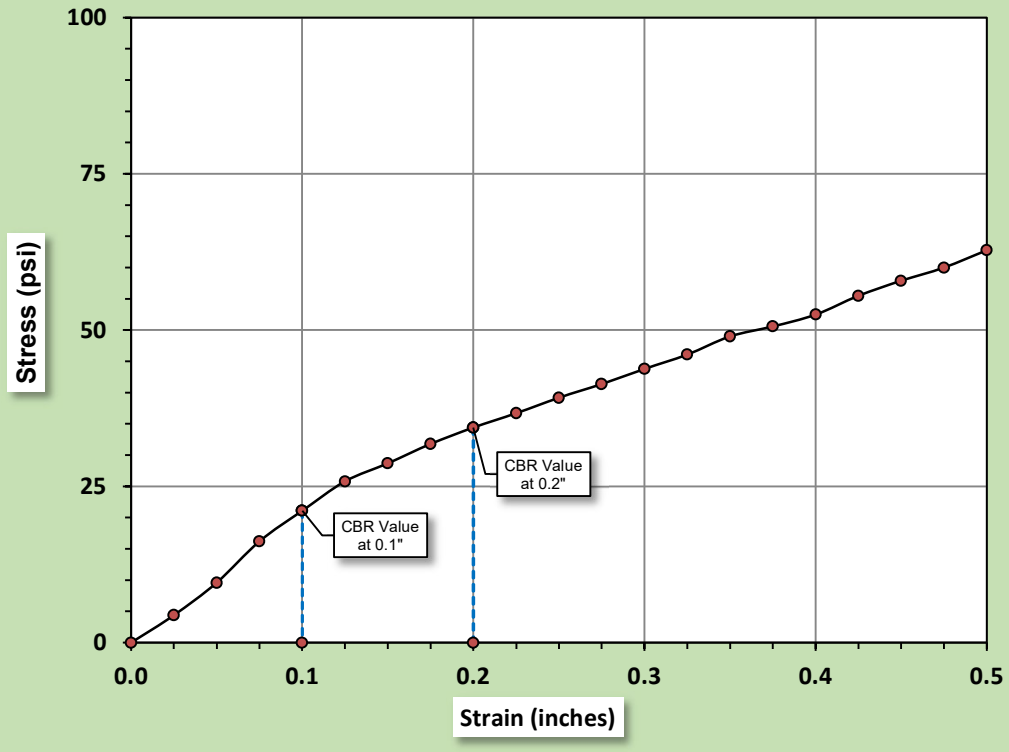
# CBR (California Bearing Ratio) of Laboratory Compacted Soil

*ASTM D1883*

| PROJECT INFORMATION | | | |
|---|---|---|---|
| Project #: | 72753 | Report Date: | 6/27/2025 |
| Project Name: | Brunswick Co. HHS & EOC | Test Date(s): | 6/13/2025 |
| Project Location: | Bolivia, NC | Tested By: | CAS |
| Client Name: | Edifice General Contractors | | |

| SAMPLE INFORMATION | | | | | |
|---|---|---|---|---|---|
| Location: | B-12 | Sample #: | Bulk | Sample Date: | 6/4/2025 |
| Depth: | 1 to 5 feet | Offset: | N/A | Lab Control #: | 1 |
| Material Description: | Tan, fine CLAYEY SAND (SC) | | | | |

| Uncorrected CBR Values | | | | Corrected CBR Values | | | |
|---|---|---|---|---|---|---|---|
| CBR at 0.1 in. | 2.1 | CBR at 0.2 in. | 2.3 | CBR at 0.1 in | --- | CBR at 0.2 in | --- |




| Soil Properties | |
|---|---|
| As-Received Moisture Content | 25.2% |
| Liquid Limit | 38 |
| Plastic Limit | 16 |
| Plastic Index | 22 |

| %Passing | |
|---|---|
| 1.5" | |
| 3/4" | |
| 3/8" | |
| No. 4 | 100.0 |
| No. 10 | 99.7 |
| No. 40 | 93.4 |
| No. 100 | 57.1 |
| No. 200 | 39.4 |

| ASTM D698 - Method A | |
|---|---|
| MDD (pcf) | 108.0 |
| OMC (%) | 16.1 |

| *Before Soaking* | | *After Soaking* | |
|---|---|---|---|
| Compactive Effort (Blows Per Layer) | 56 | Final Dry Density (pcf) | 104.2 |
| Initial Dry Density (pcf) | 106.5 | Average Final Moisture Content | 17.9% |
| Moisture Content of Compacted Specimen | 16.0% | Moisture Content (top 1" after soaking) | 19.8% |
| Percent Compaction | 98.6% | Percent Swell | 3.4% |

Soak Time (hours): 96 Surcharge Weight (lb): 10 Surcharge Stress (psf): 50.9

*ASTM D698 - Method A was performed on grading complying with CBR specification.*

*ASTM D1883 was performed on the entire gradation compacted in a 6" CBR mold.*

% Retained on 3/4" sieve: 0.0

*References / Comments / Deviations:*

| Chris Smith | | Laboratory Manager | 6/27/25 |
|---|---|---|---|
| *Technical Responsibility* | *Signature* | *Position* | *Date* |

*Information included in this report relates only to material sampled at the time of testing.*

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Form No. TR-CBR
Revision No. 1
Revision Date: 05/18/18

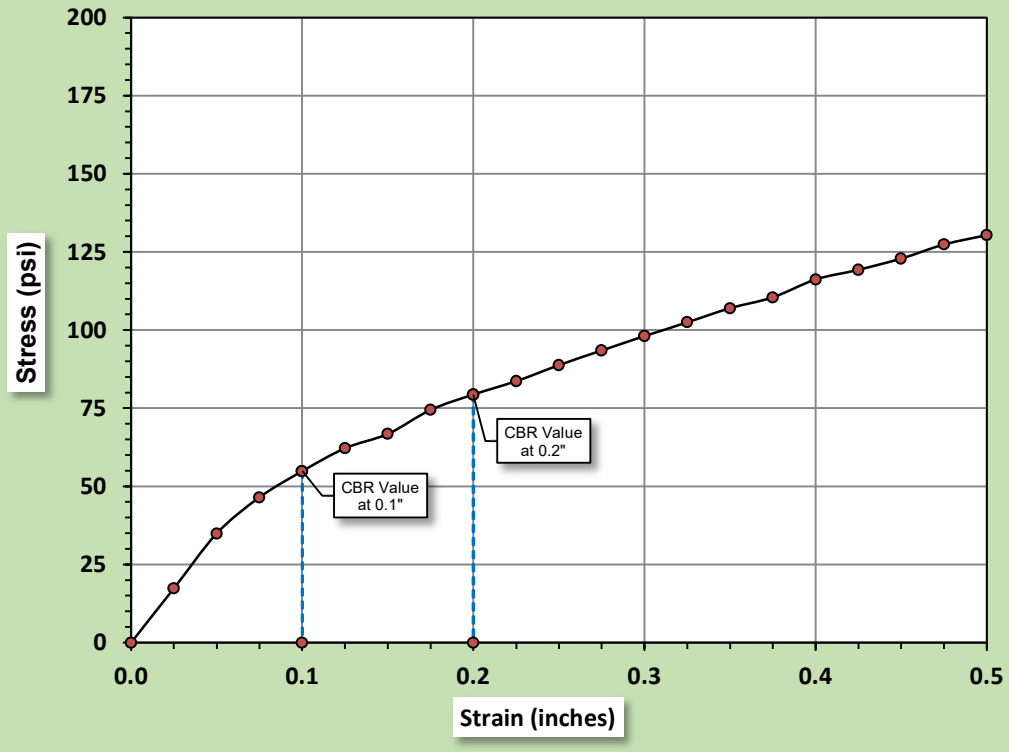
# CBR (California Bearing Ratio) of Laboratory Compacted Soil

*ASTM D1883*

| PROJECT INFORMATION | | | |
|---|---|---|---|
| Project #: | 72753 | Report Date: | 6/27/2025 |
| Project Name: | Brunswick Co. HHS & EOC | Test Date(s): | 6/13/2025 |
| Project Location: | Bolivia, NC | Tested By: | CAS |
| Client Name: | Edifice General Contractors | | |

| SAMPLE INFORMATION | | | | | |
|---|---|---|---|---|---|
| Location: | B-17 | Sample #: | Bulk | Sample Date: | 6/4/2025 |
| Depth: | 1 to 5 feet | Offset: | N/A | Lab Control #: | 2 |
| Material Description: | Brown, fine CLAYEY SAND (SC) | | | | |

| Uncorrected CBR Values | | | | Corrected CBR Values | | | |
|---|---|---|---|---|---|---|---|
| CBR at 0.1 in. | 5.5 | CBR at 0.2 in. | 5.3 | CBR at 0.1 in | --- | CBR at 0.2 in | --- |




| Soil Properties | |
|---|---|
| As-Received Moisture Content | 20.9% |
| Liquid Limit | 25 |
| Plastic Limit | 14 |
| Plastic Index | 11 |

| %Passing | |
|---|---|
| 1.5" | |
| 3/4" | |
| 3/8" | |
| No. 4 | 100.0 |
| No. 10 | 99.9 |
| No. 40 | 96.3 |
| No. 100 | 62.8 |
| No. 200 | 47.4 |

| ASTM D698 - Method A | |
|---|---|
| MDD (pcf) | 109.0 |
| OMC (%) | 15.5 |

| *Before Soaking* | | *After Soaking* | |
|---|---|---|---|
| Compactive Effort (Blows Per Layer) | 56 | Final Dry Density (pcf) | 108.5 |
| Initial Dry Density (pcf) | 109.2 | Average Final Moisture Content | 18.9% |
| Moisture Content of Compacted Specimen | 15.4% | Moisture Content (top 1" after soaking) | 22.4% |
| Percent Compaction | 100.2% | Percent Swell | 1.1% |

Soak Time (hours): 96 Surcharge Weight (lb): 10 Surcharge Stress (psf): 50.9

*ASTM D698 - Method A was performed on grading complying with CBR specification.*

*ASTM D1883 was performed on the entire gradation compacted in a 6" CBR mold.*

% Retained on 3/4" sieve: 0.0

*References / Comments / Deviations:*

| Chris Smith | | Laboratory Manager | 6/27/25 |
|---|---|---|---|
| *Technical Responsibility* | *Signature* | *Position* | *Date* |

*Information included in this report relates only to material sampled at the time of testing.*

*This report shall not be reproduced, except in full, without written approval of Timmons Group.*

August 21, 2025

Timmons Group
521 Uwharrie Court, Suite E
Raleigh, North Carolina 27606

Attention: Jesse Isreal, EI

Reference: **Report of Geophysical Testing**
**Brunswick County HHS & EOC – Seismic Testing**
Bolivia, North Carolina
S&ME Project No. 25060123

Dear Mr. Isreal:

As requested, S&ME, Inc. has prepared this letter to provide seismic site parameters in accordance with the 2024 North Carolina Building Code (NCBC) and ASCE 7-16, which is effective in North Carolina as of July 1, 2025. Our work was performed in general accordance with S&ME Proposal Number 25060123 dated August 5, 2025, and authorized by you on August 12, 2025.

## ♦ Project Information

Project information was provided during a telephone conversation and in email correspondence between Jesse Isreal (Timmons Group) and Jonathan Prevatte (S&ME) on July 30, 2025. Based on the provided information Timmons Group recently completed a geotechnical exploration at the project site for a new Health and Human Services (HHS) and Emergency Operations Center (EOC), located at 3325 Old Ocean Highway in Bolivia, North Carolina.

We were provided a copy of the "*Geotechnical Engineering Report – Brunswick County HHS & EOC*" by Timmons Group, Job No. 72753, dated July 16, 2025, for reference.

We understand that based upon Standard Penetration Test (SPT) data collected during the previous geotechnical exploration the seismic site class was determined to be Site Class E, but was close to meeting the average N-value requirement for Site Class D.

S&ME was requested to provide a proposal to perform Multi-Channel Analysis of Surface Waves (MASW) and Multi-Channel Analysis of Microtremors (MAM) shear wave velocity testing at the site in an attempt to achieve a more favorable seismic site class.

# ♦ Geophysical Services

## Methodology, Field Services, and Data Processing

On August 15, 2025, we completed surface wave seismic surveys to determine the Seismic Site Class at the requested location (SW-1; Figure 1). The Seismic Site Class is based on the average shear wave velocity ($V_s$) to a depth of 100 feet ($V_{s100}$), and analysis of surface waves (Rayleigh waves) can be used to determine shear wave velocities.

Surface waves generated from either an active or passive energy source (e.g., sledgehammer striking a metal plate or background noise, respectively) are recorded at the ground surface along a spread of low-frequency sensors (i.e., geophones). Active sources typically provide relatively higher frequencies (i.e., better resolution at shallower depths) while passive sources generally provide relatively lower frequencies (e.g., greater depth at lower resolution). Seismic measurements are transformed from the time domain into the frequency domain, from which the phase characteristics of the surface waves can be calculated. A dispersion curve (i.e., phase velocity curve vs frequency) is developed and then transformed into a one-dimensional (1D) shear wave velocity profile through an inversion and iterative process in which $V_{s100}$ is calculated.

- We used a combination of the active Multi-Channel Analysis of Surface Waves (MASW) and passive Microtremor Array Measurements (MAM) methods.
- The MASW survey was conducted using a Geometrics seismograph equipped with twenty-four (24) 4.5 Hz vertical geophones at set spacings of 5 feet along linear arrays and a 16-lb sledgehammer as the energy source.
- The MAM survey was conducted using a Geometrics seismograph equipped with eleven (11) 4.5 Hz vertical geophones at a set spacing of 30 feet along an "L"-shaped array, using background noise as the energy source.
- Data analysis was conducted using the Geogiga Technology Corp. Seismic Pro™ software (SURFACE PLUS module).

## Seismic Testing Results

The following summarizes the results of the geophysical testing services:

- Surface wave measurements were obtained to a depth of approximately 195 feet at location SW-1 as shown on Figure 1 attached.

- Based on Chapter 20 and Equation 20.4-1 of ASCE 7-16, the calculated weighted average $V_{s100}$ value is estimated to be **1,162 feet per second** (ft/s) at SW-1. This is greater than the minimum of 600 ft/s that is required by Table 20.3-1 of ASCE 7-16 for consideration of Site Class D parameters but is less than the minimum of 1,200 ft/s that is required by Table 20.3-1 of ASCE 7-16 for consideration of Site Class C parameters.

### Seismic Design Coefficients

Section 20.3.2 of ASCE 7-16 specifies that Site Class E is also appropriate where there is more than 10 ft. of soft clay in the soil profile having the following characteristics:

- Undrained shear strength ($S_u$) of less than 500 pounds per square foot (psf),
- Water content (w%) of greater than or equal to 40 percent by weight, *and*
- Plasticity Index (PI) of greater than 20 percent.

Based upon our review of the geotechnical data provided, including the laboratory test results attached to the provided geotechnical report, it does not appear that these soil conditions are widely present at the site. Therefore, based upon the seismic test results it appears that structures built within the applicable survey area may be designed using a Seismic Site Class of D. The spectral accelerations and site coefficients provided below in Table 1 apply to the site under this conclusion.

**Table-1: Seismic Design Coefficients**

| Criteria | Site Class | $S_S$ | $S_1$ | $S_{DS}$ | $S_{D1}$ | $PGA_M$ |
|---|---|---|---|---|---|---|
| 2024 NCBC/ASCE 7-16 | D | 0.181 | 0.076 | 0.193 | 0.122 | 0.148g |

$PGA_M$ = Site-modified peak ground acceleration.

## ♦ Geophysical Limitations

Regardless of the thoroughness of a geophysical survey, there is always a possibility that actual conditions may not match the interpretations. The results should be considered accurate only to the degree implied by the methods used and the method's limitations and data coverage. Accordingly, the possibility exists that not all features at a project site will be located due to either subsurface soil conditions or the occurrence of features outside the lateral limits and below the depth of penetration of the methods used. The geophysical methods used for this survey also have inherent limitations. Site activity (e.g., heavy vehicle traffic, etc.) can cause noise/interference in the data sets. Depth restrictions are also associated with the MASW/MAM methods and associated energy sources.

## ♦ Qualifications of Letter

This letter has been prepared in accordance with generally accepted geotechnical engineering practice for specific application to this project. The conclusions and recommendations contained in this letter are based upon applicable standards of our practice in this geographic area at the time this letter was prepared. No other representation or warranty either express or implied, is made.

We relied on project information provided to us by the client to develop our conclusions and recommendations. If project information described in this letter is not accurate, or if it changes during project development, we should be notified of the changes so that we can modify our recommendations based on this additional information if necessary.

Our conclusions and recommendations are based on limited data from a geophysical testing program. Some variations may not become evident until construction. If conditions are encountered which appear different than those described in our letter, we should be notified.

Unless specifically noted otherwise, our geophysical testing program did not include an assessment of regulatory compliance, environmental conditions or pollutants or presence of any biological materials (mold, fungi, bacteria). If there is a concern about these items, other studies should be performed. S&ME can provide a proposal and perform these services if requested.

## ♦ Closing

S&ME appreciates this opportunity to work with you as your geotechnical engineering consultant on this project. Please contact us at (803) 561-9024 if you have questions or need additional information regarding this letter.

Sincerely,

**S&ME, Inc.**

Jonathan M. Prevatte
Associate Project Manager

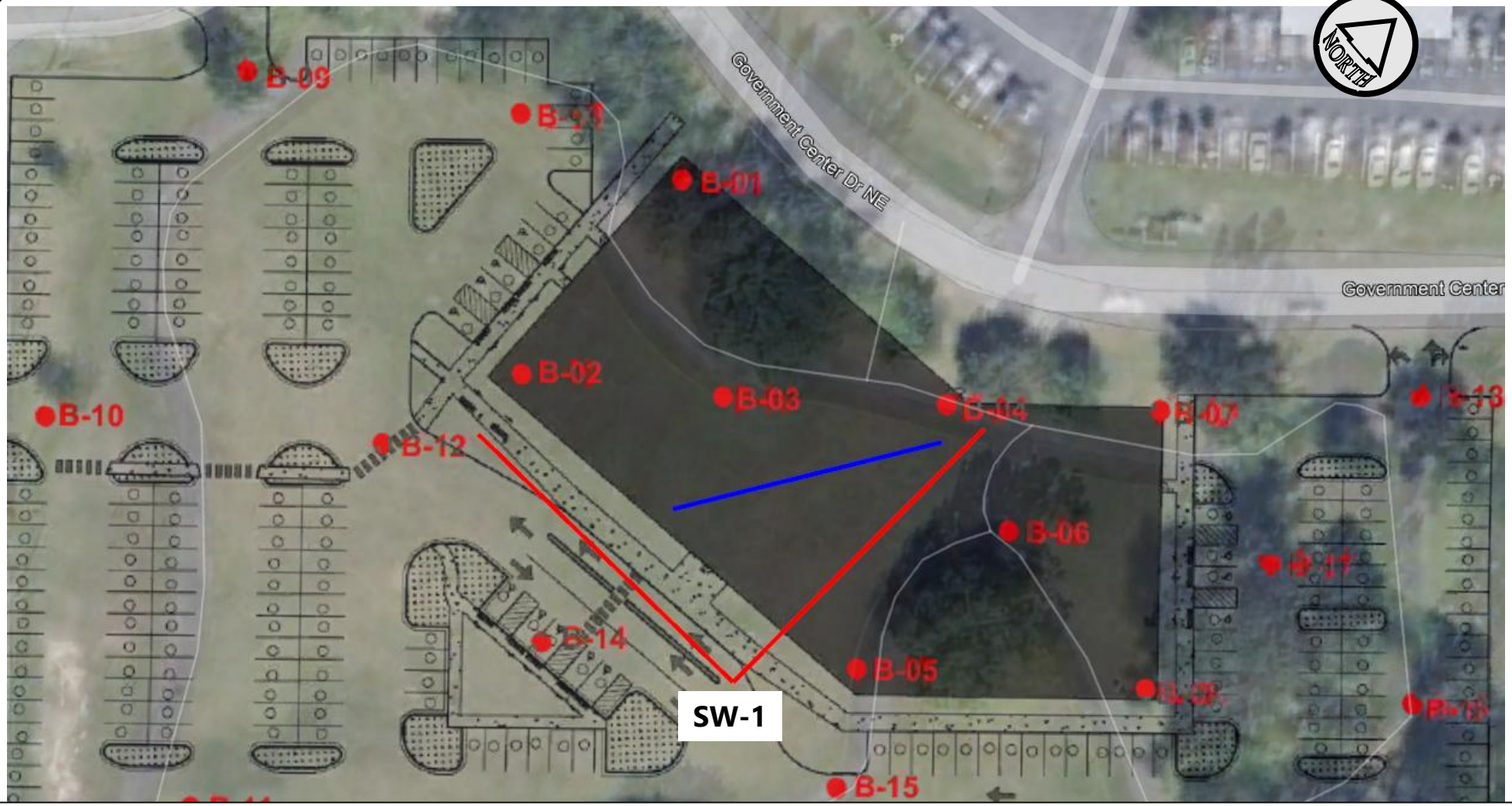
NORTH CAROLINA PROFESSIONAL SEAL 055983 ENGINEER RON FOREST JR
8/21/2025

Ronald P. Forest, Jr., P.E.
Senior Geotechnical Engineer
NC Registration No. 055983

NC PE Firm License No. F-0176

Attachments: Figure 1 - Test Location Sketch
Shear Wave Velocity Profile SW-1

# Attachments




**LEGEND**

= **Approximate MASW Test Location**

= **Approximate MAM Test Location**

***Overlay provided by Timmons Group. Boring locations shown performed by others.**

| | | | |
|---|---|---|---|
| | **Test Location Sketch** | SCALE: NOT TO SCALE | FIGURE NO. 1 |
| | Brunswick County HHS & EOC _ Seismic Testing<br>Bolivia, North Carolina | DATE: 8/19/25<br>PROJECT NUMBER 25060123 | |

**Shear Wave Velocity Profile SW-1**
**Brunswick County HHS & EOC - Seismic Testing**
**Bolivia, North Carolina**
**S&ME Project: 25060123**