

City of Brookhaven  
Community Development and Public Works  
2665 Buford Highway, Atlanta, Georgia 30324

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## PROJECT MANUAL

HLG STUDIO PROJECT No. 22.036.01

DATE: MAY 1, 2023

REISSUED FOR BIDDING AND PERMIT

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Reissued for Bidding and Permit

OWNER: City of Brookhaven  
 43622 Peachtree Road  
 Brookhaven, Georgia 30319

July 14, 2023

*Specifications are identified by the individual disciplines in accordance with the following legend and list. Signatures and seals indicate professional responsibility for those sections.*

Legend	Discipline	Consultant	Design Professional
AR	Architecture/ Interior Design	HLG Studios	Roger T. Godwin AIA
SE	Structural Engineering	Wallace Design Collective	Eric D. Blackmore, PE
MPFPE	Mechanical/ Plumbing/ Fire Protection Engineering	AHA Engineers	Jesse W. Foley, PE
EE	Electrical Engineering	AHA Engineers	Onofre L. Mayuga
EL	Elevator Consulting	Lerch Bates	Cooper Corley
CE	Civil Engineering	Flippo Civil Design	Paul T. Flippo, PE

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## SECTION 010100 - SUMMARY OF WORK

### PART 1 - GENERAL:

#### 1. WORK COVERED BY CONTRACT DOCUMENTS

The work includes all elements and systems described on the drawings and in the specifications contained in the project manual.

- B.. The Contractor shall lay out the work with appropriately qualified personnel from the information shown on the drawings.

#### 2. RELATED REQUIREMENTS

- A. I. Bidding Conditions provided by the Owner.
- B. II. Contractual Conditions provided by the Owner

#### 3. CONTRACT WORK

The Construction base bid shall generally include, but not be limited to the following work:

Construction of a new two-story classroom building as shown on the drawings.

#### 4. CONTRACT TIME

All work shall be substantially complete as stated in the Contract between the Owner and the Construction Manager.

#### 5. WORK BY OTHERS

- A. Work on the project which will be executed prior to the start of work on this contract, and which is excluded from this contract, as follows:

- 1. None identified at this time.

#### 6. CONTRACTOR'S USE OF PREMISES

- A. Coordinate use of premises under direction of Architect/Engineer. Locate construction staging area as shown on the site plan.
- B. Assume full responsibility for the protection and safekeeping of Products under this Contract, stored on site.
- C. Move any stored Products, under Contractor's control, which interfere with operation of the Owner or any separate Contractor.
- D. Protect all existing site vegetation and improvements not specifically noted to be demolished.

#### 7. OWNER OCCUPANCY

- A. Contractor shall at all times conduct his operations as to insure the safety of and least inconvenience to the students and staff of the school.
- B. Owner may take beneficial occupancy of any portion of the new building so agreed and arranged between Owner, Contractor and Architect/Engineer.



8. OWNER - FURNISHED EQUIPMENT PRODUCTS – When identified elsewhere in these documents

Owner furnished equipment including installation by the Owner's vendor, or products may be planned for this contract and shall be provided to the Contractor upon 60 days written notice. Owner furnished items are as indicated on the drawings. Installation of Owner furnished equipment shall be by the Owner's installer. The Contractor and their trade contractors shall be responsible for making final plumbing, electrical and similar miscellaneous connections to all Owner furnished equipment, in compliance with the requirements of these documents and applicable codes and standards.

9. RIGHT OF ACCESS

The Contractor agrees that representatives of the Owner and Architect/Engineer will have access to the work wherever it is in preparation or progress and that the Contractor will provide facilities for such access.

10. SAFETY AND HEALTH REGULATIONS FOR CONSTRUCTION

The Contractor shall be solely responsible for all applicable obligations prescribed as employer obligations under any and all governmental regulations.

11. PROTECTION OF EXISTING GROUNDS

- A. Turfs, irrigation systems, shrubbery, etc. shall be protected from any and all damage by construction vehicles or work activities. The Contractor shall be responsible for restoring same to equal or better conditions.
- B. Trees are a valuable natural resource and shall be protected to at least their drip lines with wood fencing acceptable to the Architect/Engineer. Construction vehicles and activities shall in no case, except as specifically shown on the Contract Documents, violate the drip lines of existing trees.
- C. The Contractor's fenced staging and construction areas may or may not include existing trees and shrubs; these shall receive protection. The entire staging and construction area shall be re-sodded as required.
- D. In an effort to document existing grounds conditions, the Contractor shall provide a VHS video tape prior to his commencing any on site Construction Activities. Such video tape shall be delivered to the Architect/Engineer for review with the Owner at the project completion in order to evaluate and direct the Contractor as to restoration required.
- E. Coordinate with Section 01760.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

**END OF SECTION 01010.**

**SECTION 01040 - COORDINATION****PART 1 - GENERAL:**

## 1. WORK INCLUDED

- A. Contractor shall supervise and direct the work competently and efficiently, devoting such attention thereto and applying such skills as may be necessary to perform the work in accordance with the Contract Documents.
- B. Contractor shall be solely responsible for all means, methods, techniques, sequences and procedures of construction, and for providing adequate safety precautions and coordinating all portions of the work under the Contract Documents.
- C. Contractor shall be responsible to see that the finished work complies accurately with the Contract Documents.
- D. Contractor shall be responsible for all project coordination.

## 2. RELATED REQUIREMENTS

- A. Section 01010 - Summary of Work
- B. Section 012500 Substitution Procedures
- C. Section 01700 - Contract Closeout

## 3. DESCRIPTION

- A. Coordinate scheduling, submittals, and work of the various sections of specifications to assure efficient and orderly sequence of installation of construction elements, with provisions for accommodating items to be installed later.
  - 1. Maintain reports and records at job site:
    - a. Daily log of progress of work and other pertinent data. Maintain log accessible to Owner, Architect/Engineer and his representative.
    - b. Assemble documentation for handling of any claims or disputes which may arise.
  - 2. Inspections and Testing:
    - a. Inspect the work to assure that it is performed in accordance with the requirements of the Contract Documents.
    - b. Arrange with the Architect/Engineer and/or owner' representative as applicable for special inspections or testing required by Section 01410 or other specification sections.
    - c. Reject work which does not conform to requirements of the Contract Documents.
- B. Coordinate sequence of work to insure proposed completion dates are met.
  - 1. Construction Schedule:

- a. Prepare detailed schedule of Contractor's operations and for all subcontractors on the project.
  - b. Monitor schedules as work progresses.
    1. Identify potential variances between scheduled and probable completion date.
    2. Recommend to Architect/Engineer any adjustments in schedule to meet required completion date.
    3. Provide monthly summary reports of each monitoring.
  - c. Observe work to monitor compliance with schedule.
    1. Verify that labor and equipment are adequate to meet and maintain the schedule for the work.
    2. Verify that product deliveries are adequate to meet and maintain the schedule for the work.
    3. Report any non-compliance to Architect/Engineer, with recommendations for remedy.
    4. Verify that adequate services are provided to comply with requirements for work and climatic conditions.
    5. Verify proper maintenance and operation of temporary facilities.
    6. Administer traffic and parking controls for construction workers. Construction traffic shall not interfere with surrounding traffic movement.
2. Coordination of Subcontractors:
- a. Coordinate work of all subcontractors and relationship between them.
  - b. Establish on-site lines of authority and communication. Schedule and conduct progress meetings among Owner and Architect/Engineer representatives and subcontractors.
  - c. Ensure that specified cleaning is done during progress of the work and at completion of contract.

#### 4. MEETINGS

In addition to progress meeting specified in Section 01200, hold coordination meetings and pre-installation conferences with personnel and subcontractors to assure coordination of work. Contractor shall record and prepare meeting notes and distribute same to all attendees.

## 5. COORDINATION OF SUBMITTALS

- A. Schedule and coordinate submittals specified in Section 01340.
  - Administer processing of shop drawings, product data, and samples.
- B. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
  - 1. Coordinate Testing Laboratory Services:
    - a. Notify laboratory of test schedule.
    - b. Verify that required personnel are present.
    - c. Verify that specified tests are made as scheduled.
    - d. Verify compliance of the test results with specified criteria. Determine need for retesting and submit recommendations to Architect/Engineer. Administer and pay for required retesting.
  - 2. Coordinate with Sub-contractors as required:
    - a. Provide temporary utilities (electric, water) required by the Subcontractors in the performance of their work.
    - b. Provide designated location where the Subcontractors may place construction debris for removal by the Contractor.
- C. Coordinate requests for changes to assure compatibility of space, of operating elements, and effect on work of other sections.
  - 1. Recommend necessary of desirable changes to Architect/Engineer.
  - 2. Review subcontractor's requests for changes and substitutions. Submit recommendations to Architect/Engineer.
  - 3. Process Change Orders in accord with General Conditions and Change Order Procedures.

## 6. COORDINATION OF SPACE

- A. Coordinate use of Project space and sequence of installation of subcontractor work which is indicated diagrammatically on Drawings. Follow routings shown for pipes, ducts, and conduits as closely as practicable, with due allowance for available physical space; make runs parallel with lines of building. Utilize space efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- B. In finished areas, except as otherwise shown, conceal pipes, ducts, and wiring in the construction. Coordinate locations of fixtures and outlets with finish elements.

## 7. INTERPRETATION OF CONTRACT DOCUMENTS

- A. Consult with Architect/Engineer to obtain interpretation or clarifications for any portions of the contract documents which are unclear or ambiguous. Transmit all requests for interpretation in writing.
- B. Assist in the answering of any questions which may arise.
- C. Transmit written interpretations to Sub Contractors, Suppliers and Others who's work may be affected by the clarification.
- D. Interpretations shall be based on the Architect/Engineers review of the Contract Documents. In case of conflicting data, assumption shall be made that the item of greater quality, cost of quantity was bid.

## 8. START-UP

- A. Direct the check-out of utilities, operational systems, and equipment.
- B. Assist in initial start-up and testing.
- C. Record dates of the start of the operations of systems and equipment.
- D. Submit to Architect/Engineer written notice of the beginning of warranty period for equipment put into service.

## 9. COORDINATION OF CONTRACT CLOSEOUT

- A. Substantial Completion:
  - 1. Coordinate completion and cleanup of work of separate sections in preparation for Substantial Completion.
  - 2. Upon determination of Substantial Completion of work or portion thereof, prepare for the Architect/Engineer a list of incomplete or unsatisfactory items.
- B. Final Completion:
  - 1. Upon determination that work is at final completion:
    - a. Submit written notice to Architect/Engineer that the work is ready for final inspection.
    - b. Secure and transmit to Architect/Engineer required closeout submittals.
  - 2. Turn over to Architect/Engineer.
    - a. Operations and maintenance data.
    - b. Spare parts and maintenance materials.

- c. Warranties and other data as required for these specifications.
  - d. Owner file copies of all submittals, changes, etc.
- C. After Owner occupancy of premises, coordinate access to site by various sections for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.
- D. Assemble and coordinate closeout submittals specified.

PART 2 - PRODUCTS:

Not used.

PART 3 - EXECUTION:

Not used.

END OF SECTION 01040.

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**SECTION 01 05 00 - FIELD ENGINEERING****PART 1 - GENERAL:****1. REQUIREMENTS INCLUDED**

- A. Provide and pay for field engineering services required for project.
  - 1. Survey work required for execution of Project.
  - 2. Civil, structural or other professional engineering services specified, or required to execute Contractor's construction schedule.

**2. RELATED REQUIREMENTS**

- A. Section 01 01 00 - "Summary of Work"

**3. QUALIFICATIONS OF SURVEYOR OR ENGINEER**

- A. Qualified Registered Engineer or Registered Land Surveyor registered in the state of Florida, acceptable to Contractor, Owner and Architect/Engineer.
- B. Registered professional Engineer of the discipline required for the specific service on the Project, licensed in the state of Florida.

**4. SURVEY REFERENCED POINTS**

- A. Existing basic horizontal and vertical control points for the Project are those designated on the drawings.
- B. Locate and protect control points prior to starting site work, and preserve all permanent reference points during construction.
  - 1. Make no change or relocations without prior written notice to Architect/Engineer and Owner.
  - 2. Report to Architect/Engineer when any reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations.
  - 3. Require surveyor to replace Project Control Points which may be lost or destroyed.
    - a. Establish replacement based on original survey control.

**5. PROJECT SURVEY REQUIREMENTS**

- A. Establish a minimum of two permanent benchmarks on site, referenced to data established by survey control points.
  - Record the benchmark locations with horizontal and vertical data on Project Record Documents.
- B. Establish lines and levels, location and layout, by instrumentation and similar appropriate means:
  - 1. Site Improvements:
    - a. Stakes for grading, fill and topsoil placement.
    - b. Utility slopes and invert elevations.
  - 2. Batter boards for structures.
  - 3. Building foundation, column locations and floor levels.
  - 4. Controlling lines and levels required for mechanical and electrical trades.
- C. Verify building dimensions, layout, location on site, and finish floor elevations. Notify Architect/Engineer of any discrepancies in the dimensioning on the drawings.
- D. On a monthly basis, verify layouts by same methods.



**6. RECORDS**

- A. Maintain a complete, accurate log of all control and survey work as it progresses.
- B. On completion of foundation walls and major site improvements, prepare a certified survey showing all dimensions, locations, angles and elevation of construction. Provide three (3) copies and one reproducible of certified survey to Architect/Engineer for distribution.

**7. SUBMITTALS**

- A. Submit name and address of Surveyor and professional engineer to Architect/Engineer.
- B. On request of Architect/Engineer, submit documentation to verify accuracy of field engineering work.
- C. Submit Certificate signed by registered engineer or surveyor certifying that elevations and locations of improvements are in conformance, or nonconformance with Contract Documents.
- D. Submit six signed and sealed tie-in-surveys upon completion of the ground floor slab. Such survey shall indicate elevations and tie dimensions to existing structures.

**PART 2 - PRODUCTS:**

Not used.

**PART 3 - EXECUTION:**

Not used.

**END OF SECTION 01 05 00**

**SECTION 01 21 01 - PROCEDURES AND PERFORMANCE****PART 1 - PROCEDURES**

1. Observation: The Architect and his Consulting Engineers may review all the work including Architectural, Civil, Structural, Plumbing, Electrical and Mechanical on this project.
2. Tests: Required tests on the project will be Soil Density Tests, concrete cylinder and slump tests and other testing that may be specified on other sections of these Contract Documents or on the drawings, and others as may be deemed appropriated by the Architect/Engineer and Owner. Refer to structural drawings and specifications for specific requirements.

**PART 2 - PERFORMANCE**

1. Measurements and Dimensions: Before ordering materials or doing work which is dependent for proper size, or installation upon coordination with building conditions, the Contractor shall verify all dimensions by taking measurements at the building and shall be responsible for the correctness of same. No consideration will be given any claim based on the difference between the actual dimensions and those indicated on the drawings. Any discrepancies between the drawings and/or the specifications and the existing conditions shall be referred to the Architect for adjustment before any work affected thereby is begun.

**PART 3 - EXECUTION**

Not used.

**END OF SECTION 01 21 01**

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## SECTION 012500 - SUBSTITUTION PROCEDURES

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Requirements:
  - 1. Section 01 60 00 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

## 1.2 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

## 1.3 ACTION SUBMITTALS

- A. Substitution Requests: Submit one electronic copy of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles. The following documents shall be required for the Architects review at minimum. Failure to include any item listed shall be grounds for rejection.
  - 1. Substitution Request Form: Use CSI Form 13.1A.
  - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
    - a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
    - b. Coordination 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 substitution 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 and 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 substitution 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 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.

#### 1.4 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.

### PART 2 - PRODUCTS

#### 2.1 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:
    - a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
    - b. Requested substitution will not adversely affect Contractor's construction schedule.
    - c. Requested substitution has received necessary approvals of authorities having jurisdiction, including Florida Product Approval number if applicable.
    - d. Requested substitution is compatible with other portions of the Work.
    - e. Requested substitution has been coordinated with other portions of the Work.
    - f. Requested substitution provides specified warranty.
    - g. If requested substitution involves more than one contractor, the contractor shall certify in writing that the 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

PART 3 - EXECUTION (Not Used)

CSI FORM 13.1A follows in section 012500 Appendix 'A'.

END OF SECTION 012500

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# SUBSTITUTION REQUEST

(After the Bidding/Negotiating Phase)

Project: \_\_\_\_\_ Substitution Request Number: \_\_\_\_\_  
 \_\_\_\_\_  
 From: \_\_\_\_\_  
 To: \_\_\_\_\_ Date: \_\_\_\_\_  
 \_\_\_\_\_  
 A/E Project Number: \_\_\_\_\_  
 Re: \_\_\_\_\_ Contract For: \_\_\_\_\_

Specification Title: \_\_\_\_\_ Description: \_\_\_\_\_  
 Section: \_\_\_\_\_ Page: \_\_\_\_\_ Article/Paragraph: \_\_\_\_\_

Proposed Substitution: \_\_\_\_\_  
 Manufacturer: \_\_\_\_\_ Address: \_\_\_\_\_ Phone: \_\_\_\_\_  
 Trade Name: \_\_\_\_\_ Model No.: \_\_\_\_\_  
 Installer: \_\_\_\_\_ Address: \_\_\_\_\_ Phone: \_\_\_\_\_

History:  New product  1-4 years old  5-10 years old  More than 10 years old

Differences between proposed substitution and specified product: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

Point-by-point comparative data attached — REQUIRED BY A/E

Reason for not providing specified item: \_\_\_\_\_  
 \_\_\_\_\_

Similar Installation:  
 Project: \_\_\_\_\_ Architect: \_\_\_\_\_  
 Address: \_\_\_\_\_ Owner: \_\_\_\_\_  
 \_\_\_\_\_ Date Installed: \_\_\_\_\_

Proposed substitution affects other parts of Work:  No  Yes; explain \_\_\_\_\_  
 \_\_\_\_\_

Savings to Owner for accepting substitution: \_\_\_\_\_ (\$ \_\_\_\_\_).

Proposed substitution changes Contract Time:  No  Yes [Add] [Deduct] \_\_\_\_\_ days.

Supporting Data Attached:  Drawings  Product Data  Samples  Tests  Reports  \_\_\_\_\_



# SUBSTITUTION REQUEST

(After the Bidding/Negotiating Phase — Continued)

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The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
  - Same warranty will be furnished for proposed substitution as for specified product.
  - Same maintenance service and source of replacement parts, as applicable, is available.
  - Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
  - Cost data as stated above is complete. Claims for additional costs related to accepted substitution which may subsequently become apparent are to be waived.
  - Proposed substitution does not affect dimensions and functional clearances.
  - Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution.
  - Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.
- 

Submitted by: \_\_\_\_\_

Signed by: \_\_\_\_\_

Firm: \_\_\_\_\_

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

\_\_\_\_\_

Telephone: \_\_\_\_\_

Attachments:

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## A/E's REVIEW AND RECOMMENDATION

- Approve Substitution - Make submittals in accordance with Specification Section 01 33 00 Submittal Procedures.
- Approve Substitution as noted - Make submittals in accordance with Specification Section 01 33 00 Submittal Procedures.
- Reject Substitution - Use specified materials.
- Substitution Request received too late - Use specified materials.

Signed by: \_\_\_\_\_ Date: \_\_\_\_\_

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## OWNER'S REVIEW AND ACTION

- Substitution approved - Make submittals in accordance with Specification Section 01 33 00 Submittal Procedures. Prepare Change Order.
- Substitution approved as noted - Make submittals in accordance with Specification Section 01 33 00 Submittal Procedures. Prepare Change Order.
- Substitution rejected - Use specified materials.

Signed by: \_\_\_\_\_ Date: \_\_\_\_\_

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Additional Comments:     Contractor     Subcontractor     Supplier     Manufacturer     A/E

## SECTION 012900 - PAYMENT PROCEDURES

## 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 necessary to prepare and process Applications for Payment.
- B. Related Requirements:
  - 1. Section 012100 "Allowances" for procedural requirements governing the handling and processing of allowances.
  - 2. Section 012200 "Unit Prices" for administrative requirements governing the use of unit prices.
  - 3. Section 012600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
  - 4. Section 013200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

## 1.3 DEFINITIONS

- A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

## 1.4 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
  - 1. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.
  - 2. Submit the schedule of values to Architect at earliest possible date, but no later than **seven** days before the date scheduled for submittal of initial Applications for Payment.
  - 3. Subschedules for Phased Work: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values coordinated with each phase of payment.
  - 4. Subschedules for Separate Elements of Work: Where the Contractor's construction schedule defines separate elements of the Work, provide subschedules showing values coordinated with each element.
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
  - 1. Identification: Include the following Project identification on the schedule of values:
    - a. Project name and location.
    - b. Owner's name.
    - c. Owner's Project number.
    - d. Name of Architect.

- e. Architect's Project number.
  - f. Contractor's name and address.
  - g. Date of submittal.
2. Arrange schedule of values consistent with format of **AIA Document G703**.
  3. Arrange the schedule of values in tabular form, with separate columns to indicate the following for each item listed:
    - a. Related Specification Section or division.
    - b. Description of the Work.
    - c. Name of subcontractor.
    - d. Name of manufacturer or fabricator.
    - e. Name of supplier.
    - f. Change Orders (numbers) that affect value.
    - g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent. Round dollar amounts to whole dollars, with total equal to Contract Sum.
      - 1) Labor.
      - 2) Materials.
      - 3) Equipment.
  4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of **five** percent of the Contract Sum.
  5. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
    - a. Differentiate between items stored on-site and items stored off-site.
  6. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
  7. Purchase Contracts: Provide a separate line item in the schedule of values for each Purchase contract. Show line-item value of Purchase contract. Indicate Owner payments or deposits, if any, and balance to be paid by Contractor.
  8. Temporary Facilities: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
  9. Closeout Costs. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling [**five**] <Insert number> percent of the Contract Sum and subcontract amount.
  10. Schedule of Values Revisions: Revise the schedule of values when Change Orders or Construction Change Directives result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Construction Change Directive.

#### 1.5 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments, as certified by Architect and paid for by Owner.
- B. Payment Application Times: The date for each progress payment is indicated in the Owner/Contractor Agreement. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.

1. Submit draft copy of Application for Payment **seven** days prior to due date for review by Architect.
- C. Application for Payment Forms: Use **AIA Document G702 and AIA Document G703** as form for Applications for Payment.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. **Architect** will return incomplete applications without action.
1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
  2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
  3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
  4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.
- E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment for stored materials.
  2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
  3. Provide summary documentation for stored materials indicating the following:
    - a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
    - b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
    - c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.
- F. Transmittal: Submit **three** signed and notarized original copies of each Application for Payment to **Architect** by a method ensuring receipt **within 24 hours**. One copy shall include waivers of lien and similar attachments if required.
1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from **entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment, sub-subcontractors, and suppliers for construction period covered by the previous application**].
1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
  2. When an application shows completion of an item, submit conditional final or full waivers.
  3. Owner reserves the right to designate which entities involved in the Work must submit waivers.

4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
  5. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.
- H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
  2. Schedule of values.
  3. Contractor's construction schedule (preliminary if not final).
- I. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
    - a. Complete administrative actions, submittals, and Work preceding this application, as described in Section 017700 "Closeout Procedures."
  2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- J. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
  2. Certification of completion of final punch list items.
  3. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
  4. Updated final statement, accounting for final changes to the Contract Sum.
  5. AIA Document G706.
  6. AIA Document G706A.
  7. AIA Document G707.
  8. Evidence that claims have been settled.
  9. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
  10. Final liquidated damages settlement statement.
  11. Proof that taxes, fees, and similar obligations are paid.
  12. Waivers and releases.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

## SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
  - 1. Coordination drawings.
  - 2. Requests for Information (RFIs).
  - 3. Project meetings.
- B. Related Requirements:
  - 1. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.

## 1.2 DEFINITIONS

- A. RFI: Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

## 1.3 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. Use CSI Form 1.5A. Include the following information in tabular form:
  - 1. Name, address, and telephone number 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.

## 1.4 GENERAL COORDINATION PROCEDURES

- A. Coordination: The General Contractor shall 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 activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
1. 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.

## 1.5 COORDINATION DRAWINGS

- A. Coordination Drawings, The General Contractor shall prepare coordination drawings according to requirements in individual Sections, where installation is not completely shown 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. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
    - b. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- B. 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.
  2. Plenum Space: Indicate sub-framing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings.
  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. Review: Architect will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility.

## 1.6 REQUESTS FOR INFORMATION (RFIs)

- A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
1. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.
  2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
  3. Maintain an RFI log for review at every project meeting. Include date submitted and returned and brief description of subject matter.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
1. Project name.
  2. Project number.
  3. Date.
  4. Name of Sub-contractor.
  5. Name of Architect and General Contractor.
  6. RFI number, numbered sequentially.
  7. RFI subject.
  8. Specification Section number and title and related paragraphs, as appropriate.
  9. Drawing number and detail references, as appropriate.
  10. Field dimensions and conditions, as appropriate.
  11. Contractor's suggested resolution. If Contractor's solution(s) impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
  12. Contractor's signature.
  13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
  14. Offer potential solutions for consideration.
- C. RFI Forms: AIA Document G716 or Software-generated form with substantially the same content as indicated above, acceptable to Architect.
- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day
1. The following RFIs will be returned without action:
    - a. Requests for approval of submittals.
    - b. Requests for approval of substitutions.
    - c. Requests for coordination information already indicated in the Contract Documents.
    - d. Requests for adjustments in the Contract Time or the Contract Sum.
    - e. Requests for interpretation of Architect's actions on submittals.
    - f. 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 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 012600 "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 10 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. Include the following:
1. Project name.
  2. Name and address of Contractor.
  3. Name and address of Architect and General Contractor.
  4. RFI number including RFIs that were dropped and not submitted.
  5. RFI description.
  6. Date the RFI was submitted.
  7. Date Architect's response was received.
- 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. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.

#### 1.7 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated. Meetings shall be scheduled at two week intervals.
1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
  2. Agenda: The contractor shall prepare the meeting agenda. Distribute the agenda to all invited attendees at least two days prior to meeting.
  3. Minutes: The contractor shall be responsible for conducting meeting and recording significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.
- B. Pre-construction Conference: Owner and Architect will schedule and conduct a pre-construction 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, Commissioning Authority, 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. Tentative construction schedule.
    - b. Phasing.
    - c. Critical work sequencing and long-lead items.
    - d. Designation of key personnel and their duties.
    - e. Procedures for processing field decisions and Change Orders.
    - f. Procedures for RFIs.
    - g. Procedures for testing and inspecting.
    - h. Procedures for processing Applications for Payment.
    - i. Distribution of the Contract Documents.
    - j. Submittal procedures.

- k. Preparation of record documents.
  - l. Use of the premises and existing building.
  - m. Work restrictions.
  - n. Working hours.
  - o. Owner's occupancy requirements.
  - p. Responsibility for temporary facilities and controls.
  - q. Procedures for moisture and mold control.
  - r. Procedures for disruptions and shutdowns.
  - s. Construction waste management and recycling.
  - t. Parking availability.
  - u. Office, work, and storage areas.
  - v. Equipment deliveries and priorities.
  - w. First aid.
  - x. Security.
  - y. Progress cleaning.
3. Pre-Construction Meeting Minutes: The Architect and Owner will conduct the pre-construction meeting and will record and distribute minutes.
- C. Pre-installation Conferences: The contractor shall conduct a pre-installation conference at Project site before each construction activity that requires coordination with other construction.
- 1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect, and Owner 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. Review of mockups.
    - i. Possible conflicts.
    - j. Compatibility problems.
    - k. Time schedules.
    - l. Weather limitations.
    - m. Manufacturer's written instructions.
    - n. Warranty requirements.
    - o. Compatibility of materials.
    - p. Acceptability of substrates.
    - q. Temporary facilities and controls.
    - r. Space and access limitations.
    - s. Regulations of authorities having jurisdiction.
    - t. Testing and inspecting requirements.
    - u. Installation procedures.
    - v. Coordination with other work.
    - w. Required performance results.
    - x. Protection of adjacent work.
    - y. Protection of construction and personnel.

3. The contractor shall 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.

D. Progress Meetings: Conduct progress meetings at monthly intervals.

1. Attendees: In addition to representatives of Owner, General Contractor 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.
2. 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) Status of submittals.
    - 4) Deliveries.
    - 5) Off-site fabrication.
    - 6) Access.
    - 7) Site utilization.
    - 8) Temporary facilities and controls.
    - 9) Progress cleaning.
    - 10) Quality and work standards.
    - 11) Status of correction of deficient items.
    - 12) Field observations.
    - 13) Status of RFIs.
    - 14) Status of proposal requests.
    - 15) Pending changes.
    - 16) Status of Change Orders.
    - 17) Pending claims and disputes.
    - 18) Documentation of information for payment requests.
3. Minutes: The contractor shall be responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
  - a. Schedule Updating: The contractor shall revise the 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

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## SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

### 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. Contractor's Construction Schedule.
  2. Construction schedule updating reports.
  3. Daily construction reports.
  4. Site condition 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. 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 when activities can be performed and the critical path of Project.
- C. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- D. Event: The starting or ending point of an activity.
- E. 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.

### 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 Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.
- C. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
- D. Construction Schedule Updating Reports: Submit with Applications for Payment.
- E. Daily Construction Reports: Submit at **monthly** intervals.
- F. Site Condition Reports: Submit at time of discovery of differing conditions.

#### 1.4 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.

#### 1.5 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.
- B. Time Frame: Extend schedule from date established for **the Notice to Proceed** to date of **final completion**. **Clearly note the Date of Substantial Completion on the schedule.**
  - 1. Contract completion date shall 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. Procurement Activities: Include procurement process activities for the following long lead 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.
    - a. Mechanical, Electrical Plumbing, Roofing.
  - 2. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
  - 3. Startup and Testing Time: Include no fewer than **15** days for startup and testing.

4. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
  5. 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. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
- 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 .
- F. 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.
- G. 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.
- H. 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.
- I. Distribution: Distribute copies of approved schedule to Architect and 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.



## 1.6 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 to Proceed**.
- 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.

## 1.7 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. Stoppages, delays, shortages, and losses.
  - 11. Meter readings and similar recordings.
  - 12. Emergency procedures.
  - 13. Orders and requests of authorities having jurisdiction.
  - 14. Change Orders received and implemented.
  - 15. Equipment or system tests and startups.
  - 16. Partial completions and occupancies.
  - 17. Substantial Completions authorized.
- B. 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013200

## SECTION 013233 - PHOTOGRAPHIC DOCUMENTATION

## 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 the following:
1. Preconstruction photographs.
  2. Concealed Work photographs.
  3. Periodic construction photographs.
  4. Final Completion construction photographs.
  5. Preconstruction video recordings.
  6. Periodic construction video recordings.
  7. Construction webcam.
- B. Related Requirements:
1. Section 017700 "Closeout Procedures" for submitting photographic documentation as Project Record Documents at Project closeout.
  2. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.
  3. Section 024119 "Selective Demolition" for photographic documentation before selective demolition operations commence.

## 1.3 INFORMATIONAL SUBMITTALS

- A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each **photograph and video recording**. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.
- B. Digital Photographs: Submit image files within **three** days of taking photographs.
1. Submit photos **on CD-ROM or thumb-drive**. Include copy of key plan indicating each photograph's location and direction.
  2. Identification: Provide the following information with each image description **in file metadata tag**:
    - a. Name of Project.
    - b. Name and contact information for photographer.
    - c. Name of Architect **and Construction Manager**.
    - d. Name of Contractor.
    - e. Date photograph was taken.
    - f. Description of location, vantage point, and direction.
    - g. Unique sequential identifier keyed to accompanying key plan.
- C. Video Recordings: Submit video recordings within **seven** days of recording.

1. Submit video recordings **on CD-ROM or thumb drive**. Include copy of key plan indicating each video's location and direction.
2. Identification: With each submittal, provide the following information **in file metadata tag**:
  - a. Name of Project.
  - b. Name and address of photographer.
  - c. Name of Architect **and Construction Manager**.
  - d. Name of Contractor.
  - e. Date video recording was recorded.
  - f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
3. Transcript: Prepared on **8-1/2-by-11-inch (215-by-280-mm)** paper, punched and bound in three-ring binders. Provide label on front and spine. Include a cover sheet with label information. Include name of Project and date of video recording on each page.

#### 1.4 QUALITY ASSURANCE

- A. Photographer Qualifications: An individual who has been regularly engaged as a professional photographer of construction projects for not less than three years.

#### 1.5 FORMATS AND MEDIA

- A. Digital Photographs: Provide color images in JPG format, produced by a digital camera with minimum sensor size of **12** megapixels, and at an image resolution of not less than **3200 by 2400** pixels, **and with vibration-reduction technology**. Use flash in low light levels or backlit conditions.
- B. Digital Video Recordings: Provide high-resolution, digital video in MPEG format, produced by a digital camera with minimum sensor resolution of [**12** megapixels and capable of recording in full high-definition mode **with vibration-reduction technology**. Provide supplemental lighting in low light levels or backlit conditions.
- C. Digital Images: Submit digital media as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
- D. Metadata: Record accurate date and time from camera.
- E. File Names: Name media files with **date, Project area** and sequential numbering suffix.

#### 1.6 CONSTRUCTION PHOTOGRAPHS

- A. Photographer: Engage a qualified photographer to take construction photographs.
- B. General: Take photographs with maximum depth of field and in focus.
  1. Maintain key plan with each set of construction photographs that identifies each photographic location.
- C. Preconstruction Photographs: Before commencement of the Work, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by **Architect**.

1. Flag **excavation areas** and **construction limits** before taking construction photographs.
  2. Take **20** photographs to show existing conditions adjacent to property before starting the Work.
  3. Take **20** photographs of existing buildings either on or adjoining property, to accurately record physical conditions at start of construction.
  4. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.
- D. Concealed Work Photographs: Before proceeding with installing work that will conceal other work, take photographs sufficient in number, with annotated descriptions, to record nature and location of concealed Work, including, but not limited to, the following:
1. Underground utilities.
  2. Underslab services.
  3. Piping.
  4. Electrical conduit.
  5. Waterproofing and weather-resistant barriers.
- E. Periodic Construction Photographs: Take **50** photographs **weekly coinciding with the cutoff date associated with each Application for Payment**. Select vantage points to show status of construction and progress since last photographs were taken.
- F. Final Completion Construction Photographs: Take **20** photographs after date of Substantial Completion for submission as Project Record Documents. **Architect**] will inform photographer of desired vantage points.

#### 1.7 CONSTRUCTION VIDEO RECORDINGS

- A. Video Recording Photographer: Engage a qualified videographer to record construction video recordings.
- B. Narration: Describe scenes on video recording by **audio narration by microphone while or dubbing audio narration off-site after** video recording is recorded. Include description of items being viewed, recent events, and planned activities. At each change in location, describe vantage point, location, direction (by compass point), and elevation or story of construction.
1. Confirm date and time at beginning and end of recording.
  2. Begin each video recording with name of Project, Contractor's name, videographer's name, and Project location.
- C. Transcript: Provide a typewritten transcript of the narration. Display images and running time captured from video recording opposite the corresponding narration segment.
- D. Preconstruction Video Recording: Before starting **excavation, demolition, construction**, record video recording of Project site and surrounding properties from different vantage points, as directed by **Architect**
1. Flag **excavation areas, construction limits** before recording construction video recordings.
  2. Show existing conditions adjacent to Project site before starting the Work.
  3. Show existing buildings either on or adjoining Project site to accurately record physical conditions at the start of **excavation, demolition, construction**.
  4. Show protection efforts by Contractor.
- E. Periodic Construction Video Recordings: Record video recording **monthly coinciding with the cutoff date associated with each Application for Payment**. Select vantage points to show status of

construction and progress since last video recordings were recorded. Minimum recording time shall be **30** minutes(s).

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013233

**SECTION 01 33 00 - SUBMITTAL PROCEDURES**

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.
- B. Related Sections:
  - 1. Division 01 Section "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
  - 2. Division 01 Section "Operation and Maintenance Data" for submitting operation and maintenance manuals.
  - 3. Owner' Non-Technical Specification or Division 01 Section "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
  - 4. Non Technical specifications Section C-11.

## 1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action.
- 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.

## 1.3 ACTION SUBMITTALS

- A. Submittal Schedule: Within thirty days of Notice to Proceed, submit a schedule 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 modifications to submittals noted by the Architect and additional time for handling and reviewing submittals required by those corrections.

## 1.4 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Digital Data Files: Electronic copies of CAD Drawings of the Contract Drawings, floor plans and elevations only, will be provided upon request by Architect for Contractor's use in preparing submittals.
  - 1. Architect will furnish Contractor one set of digital data drawing files of the Contract Drawings upon request by Contractor for use in preparing Shop Drawings.
    - a. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
    - b. Contractor shall execute a data licensing agreement in the form of AIA Document C106, Digital Data Licensing Agreement.

- 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. Coordinate transmittal of different types of submittals for related parts of the Work 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.
- D. Identification and Information: Place a permanent label or title block on each paper copy submittal item for identification.
1. Indicate name of firm or entity that prepared each submittal on label or title block.
  2. Provide a space approximately 150 by 200 mm (6 by 8 inches) on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
  3. Include the following information for processing and recording action taken:
    - a. Project name.
    - b. Date.
    - c. Name of Architect.
    - d. Name of Construction Manager.
    - e. Name of Contractor.
    - f. Name of subcontractor.
    - g. Name of supplier.
    - h. Name of manufacturer.
    - i. Submittal number or other unique identifier, including revision identifier.
      - 1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 061000.01.A).
    - j. Number and title of appropriate Specification Section.
    - k. Drawing number and detail references, as appropriate.
    - l. Location(s) where product is to be installed, as appropriate.
    - m. Other necessary identification.
- E. Identification and Information: Identify and incorporate information in each electronic submittal file as follows:
1. Assemble complete submittal package into a single indexed file with links enabling navigation to each item.

2. Name file with submittal number or other unique identifier, including revision identifier.
  - a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-061000.01.A).
3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.
4. Include the following information on an inserted cover sheet:
  - a. Project name.
  - b. Date.
  - c. Name and address of Architect.
  - d. Name of Construction Manager.
  - e. Name of Contractor.
  - f. Name of firm or entity that prepared submittal.
  - g. Name of subcontractor.
  - h. Name of supplier.
  - i. Name of manufacturer.
  - j. Number and title of appropriate Specification Section.
  - k. Drawing number and detail references, as appropriate.
  - l. Location(s) where product is to be installed, as appropriate.
  - m. Related physical samples submitted directly.
  - n. Other necessary identification.
- F. Options: Identify options requiring selection by the Architect.
- G. Deviations: Identify deviations from the Contract Documents on submittals.
- H. Additional Paper Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
  1. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Architect.
- I. Transmittal: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will discard submittals received from sources other than Contractor.
  1. Transmittal Form: Use AIA Document G810.
  2. On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.
- J. 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.
- K. 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.



- L. Use for Construction: Use only final submittals that are marked with approval notation from Architect's action stamp.

## PART 2 - PRODUCTS

### 2.1 SUBMITTAL PROCEDURES

#### A. General Submittal Procedure Requirements:

1. Action Submittals: Submit three paper copies of each submittal, unless otherwise indicated. Architect will return two copies.
2. Informational Submittals: Submit two paper copies of each submittal, unless otherwise indicated. Architect will not return copies.
3. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Division 01 Section "Closeout Procedures."
4. Certificates and Certifications Submittals: Provide 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.
  - a. Provide a digital signature with digital certificate on electronically-submitted certificates and certifications where indicated.
  - b. Provide a notarized statement on original paper copy certificates and certifications where indicated.
5. Test and Inspection Reports Submittals: Comply with requirements specified in Division 01 Section "Quality Requirements."

#### B. 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 not suitable 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 showing 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 or concurrent with Samples.

6. Submit Product Data in the following format:
  - a. Three paper copies of Product Data, unless otherwise indicated. Architect will return two copies.
  
- C. 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 upon 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.
  2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 215 by 280 mm (8-1/2 by 11 inches) but no larger than 600 by 900 mm (24 by 36 inches).
  3. Submit Shop Drawings in the following format:
    - a. Two opaque (bond) copies of each submittal. Architect will return one copy.
  
- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
  1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
  2. Identification: Attach label on unexposed side of Samples that includes the following:
    - a. Generic description of Sample.
    - b. Product name and name of manufacturer.
    - c. Sample source.
    - d. Number and title of applicable Specification Section.
  3. 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.
  4. 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.

5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
  - a. Number of Samples: Submit two sets of Samples. Architect will retain one Sample sets; remainder will be returned.
    - 1) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- E. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."
- F. Application for Payment: Comply with requirements specified in Division 01 Section "Payment Procedures."
- G. Schedule of Values: Comply with requirements specified in Division 01 Section "Payment Procedures."
- H. 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. Use CSI Form 1.5A.
  1. Submit subcontract list in the following format:
    - a. Number of Copies: Two paper copies of subcontractor list, unless otherwise indicated. Architect will return one copy.
- I. Coordination Drawings: Comply with requirements specified in Division 01 Section "Project Management and Coordination."
- J. 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.
- K. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on American Welding Society (AWS) forms. Include names of firms and personnel certified.
- L. 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.
- M. 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.
- N. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

- O. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- P. 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.
- Q. Product Test Reports: Submit written reports indicating 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.
- R. 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.
- S. Schedule of Tests and Inspections: Comply with requirements specified in Division 01 Section "Quality Requirements."
- T. Field Test Reports: Submit 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.
- U. Maintenance Data: Comply with requirements specified in Division 01 Section "Operation and Maintenance Data."
- V. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

## 2.2 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
  - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit three 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.

**PART 3 - EXECUTION****3.1 CONTRACTOR'S REVIEW**

- A. Action 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. Project Closeout and Maintenance/Material Submittals: Refer to requirements in Division 01 Section "Closeout Procedures."
- C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, 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.

**3.2 ARCHITECT'S ACTION**

- A. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.
- B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.
- C. 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.
- D. Incomplete submittals are not acceptable, will be considered nonresponsive, and will be returned without review.
- E. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

**END OF SECTION 01 33 00**

**SECTION 01 33 30 – STRUCTURAL SUBMITTAL PROCEDURES****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Structural submittal schedule requirements.
  - 2. Supplemental administrative and procedural requirements for structural submittals.
- B. Related Requirements:
  - 1. Section 01 33 00 – Submittal Procedures.

**1.2 DEFINITIONS**

- A. Action Submittals: Written and graphic information and physical samples that require responsive action of the Design Professional. 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 responsive action of the Design Professional. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual specification sections as "Informational Submittals."

**1.3 STRUCTURAL SUBMITTAL SCHEDULE**

- A. Structural Submittal Schedule: Submit to the Design Professional a list of structural 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 the Design Professional and additional time for handling and reviewing submittals required by those corrections.
  - 1. Coordinate structural submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
  - 2. Final Structural Submittal Schedule: Submit concurrently with the first complete submittal of the Contractor's construction schedule.
    - a. Submit revised structural submittal schedule as required to reflect changes in current status and time for submittals.
  - 3. Format: Arrange the following information in a tabular format:
    - a. Scheduled date for first submittal.
    - b. Specification section number and title.
    - c. Submittal Category: Action; Informational.
    - d. Name of subcontractor.
    - e. Description of Work covered.
    - f. Schedule date for Design Professional's final release.
- B. Any submittal schedule required by Section 01 33 00 – Submittal Procedures and meeting the requirements listed above satisfies this requirement.

**1.4 SUBMITTAL FORMATS**

- A. Submittal Information: Include a transmittal letter with the following information in each submittal:
  - 1. Project name.
  - 2. Date.
  - 3. Name of Contractor.

4. Name of firm or entity that prepared submittal.
  5. Names of subcontractor, manufacturer, and supplier.
  6. Unique submittal number, including revision identifier.
  7. Category and type of submittal.
  8. Submittal purpose and description.
  9. Number and title of specification section, with paragraph number and generic name for each of multiple items.
  10. Drawing number and detail references, as appropriate.
  11. Indication of full or partial submittal.
  12. Location(s) where product is to be installed, as appropriate.
  13. Other necessary identification.
  14. Remarks.
- B. 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 the Design Professional on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.
- C. Submittal Document Format: Provide submittals with the format specified in Section 01 33 00 – Submittal Procedures.

#### 1.5 SUBMITTAL PROCEDURES

- A. Prepare and submit submittals required by individual specification sections. Types of submittals are indicated in individual specification sections.
1. Divide large submittals (greater than 250 pages or sheets) into packages not to exceed 250 pages or sheets.
  2. Prepare and transmit submittals in accordance with Section 01 33 00 – Submittal Procedures.
- 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 action submittals and informational submittals required by the same specification section as separate packages under separate transmittals.
  3. 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. The Design Professional 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 structural submittal review, including time for resubmittals, as follows. Time for review shall commence on the Structural Design Professional'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 14 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. The Design Professional 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 14 days for review of each resubmittal.
  4. Size Limit: The maximum of 250 pages or sheets will be reviewed in a 14 day period unless written authorization is provided by the Design Professional to the Contractor.

- 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 the Structural Design Professional'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 "REVIEWED WITH NO EXCEPTIONS" or "REVIEWED WITH EXCEPTIONS NOTED" from the Structural Design Professional's action stamp.

## 1.6 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. Submit Product Data before Shop Drawings, and before or concurrently with Samples.
- B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
  - 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
    - a. Identification of products.
    - b. Schedules.
    - c. Compliance with specified standards.
    - d. Notation of coordination requirements.
    - e. Notation of dimensions established by field measurement.
    - f. Relationship and attachment to adjoining construction clearly indicated.
    - g. Seal and signature of professional engineer if specified.
- C. Samples: Submit Samples for review of type, color, pattern, and texture for a check of these characteristics with other materials.
  - 1. Transmit Samples that contain multiple, related components, such as accessories together in one submittal package.
  - 2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
    - a. Project name and submittal number.
    - b. Generic description of Sample.
    - c. Product name and name of manufacturer.
    - d. Sample source.
    - e. Number and title of applicable specification section.
    - f. Specification paragraph number and generic name of each item.



3. 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.
  4. 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.
  5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
- D. 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.
- E. 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 on AWS forms. Include names of firms and personnel certified.
- F. 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.

#### 1.7 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 the Design Professional.
- B. Delegated Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit a 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.

#### 1.8 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 the Design Professional.
- B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.
  1. THE STRUCTURAL DESIGN PROFESSIONAL WILL NOT REVIEW SUBMITTALS RECEIVED FROM CONTRACTOR THAT DO NOT HAVE CONTRACTOR'S REVIEW AND APPROVAL.
  2. By approving and submitting product data, shop drawings, or samples, the Contractor represents all field measurements, field construction criteria, materials, member sizes, catalogue numbers, and similar criteria has been verified.
  3. By approving and submitting product data, shop drawings, or samples, the Contractor represents shop drawings have been checked and coordinated with the requirements of the Project and the Contract Documents.
- C. The Contractor is responsible to furnish equipment, materials, and labor for the Project which meets the requirements of the codes and authorities quoted, as well as the Contract Documents.

## 1.9 STRUCTURAL DESIGN PROFESSIONAL'S REVIEW

### A. Scope of Structural Review:

1. Action Submittals: Submittal reviewed for the limited purpose of checking the general arrangement and conformance of the structural information in the submittal with the design concept expressed in the Contract Documents. Design Professional's review is not conducted for the purpose of determining the accuracy or completeness of other details, such as dimensions, quantities, nor the approval of an assembly in which the item functions.
2. Informational Submittals: Submittal reviewed for the limited purpose of checking the general conformance of the structural information in the submittal with the requirements expressed in the Contract Documents. Design Professional's review is not conducted for the purpose of determining the accuracy or completeness of other details, such as dimensions, quantities, nor the approval of an assembly in which the item functions.
3. Delegated Design Submittals: Submittal reviewed for the use of specified design criteria and to verify the design and drawings are prepared by a registered engineer in the project jurisdiction. Design Professional's review is not conducted for the purpose of determining the accuracy or completeness of other details, such as dimensions, quantities, nor the approval of an assembly in which the item functions.

### B. Action Submittals: The Structural Design Professional will review each submittal, indicate corrections or revisions required, and return.

1. The Structural Design Professional will stamp each submittal (or otherwise indicate) with an action stamp to indicate action, as follows:
2. "APPROVED": Final unrestricted release; Submittal reviewed as indicated above in Scope of Structural Review with no exceptions taken. Work covered by the submittal may proceed provided it complies with the requirements of the Contract Documents.
3. "APPROVED AS NOTED": Final-but-restricted-release; Submittal reviewed as indicated above in Scope of Structural Review with certain exceptions noted. Work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and it complies with the requirements of the Contract Documents. The Design Professional reserves the right to require submission of corrected submittal for records.
4. "REVISE AS NOTED AND RESUBMIT": Submittal reviewed as indicated above in Scope of Structural Review and contains significant deviations from the Contract Documents warranting review after correction. Limited, noncomprehensive corrections or notations will be made. Do not proceed with the Work covered by the submittal in any aspect. Do not use or allow others to use these submittals. Revise submittal and resubmit submittal.
5. "REJECTED – RESUBMIT AS SPECIFIED": Submittal reviewed as indicated above in Scope of Structural Review and is fundamentally not in compliance. Reason for rejection will be noted. No other corrections or notations will be made. Do not proceed with the Work covered by the submittal in any aspect. Do not use or allow others to use these submittals. Discard submittal and prepare a new submittal.
6. "RETAINED FOR RECORDS ONLY": Submittal not reviewed. Submittal retained for record by the Design Professional.

### C. Informational Submittals: The Structural Design Professional will review each submittal and will not return it or will return it if it does not comply with requirements.

### D. Delegated Design Submittals: The Structural Design Professional will review each submittal, indicate corrections or revisions required, and return.

1. The Structural Design Professional will stamp each submittal (or otherwise indicate) with an action stamp to indicate action, as follows:
  - a. "APPROVED": Final unrestricted release; Submittal reviewed as indicated above in Scope of Structural Review with no exceptions taken. Work covered by the submittal may proceed provided it complies with the requirements of the Contract Documents.

- b. “APPROVED AS NOTED”: Final-but-restricted-release; Submittal reviewed as indicated above in Scope of Structural Review with certain exceptions noted. Work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and it complies with the requirements of the Contract Documents. The Design Professional reserves the right to require submission of corrected submittal for records.
  - c. “REVISE AS NOTED AND RESUBMIT”: Submittal reviewed as indicated above in Scope of Structural Review and contains significant deviations from the Contract Documents warranting review after correction. Do not proceed with the Work covered by the submittal in any aspect. Do not use or allow others to use these submittals. Revise submittal and resubmit submittal.
  - d. “REJECTED – RESUBMIT AS SPECIFIED”: Submittal reviewed as indicated above in Scope of Structural Review and is fundamentally not in compliance. Reason for rejection will be noted No other corrections or notations will be made. Do not proceed with the Work covered by the submittal in any aspect. Do not use or allow others to use these submittals. Discard submittal and prepare a new submittal.
  - e. “RETAINED FOR RECORDS ONLY”: Submittal not reviewed. Submittal retained for record by the Design Professional.
- E. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from the Design Professional.
- F. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- G. The Structural Design Professional will return without review submittals received from sources other than Contractor via the Architectural Design Professional. The Structural Design Professional will not accept submittals directly from manufacturers or subcontractors.
- H. Submittals not required by the Contract Documents will be returned or discarded by the Structural Design Professional without action.
- I. Design Professional’s review of submittals does not relieve the Contractor of responsibility for any deviation from the requirements of the Contract Documents unless the Contractor has directed specific attention to the deviation at the time of submission and the Design Professional has given written approval for the specific deviation.
- J. Design Professional’s review of submittals does not relieve the Contractor of responsibility for errors or omissions contained in the submittals
- K. Design Professional’s review of submittals shall not be construed as authorizing any change in the Contract Sum or Contract Time.

## PART 2 - PRODUCTS

NOT USED

## PART 3 - EXECUTION

NOT USED

## END OF SECTION 01 33 30

**SECTION 01 33 30 – STRUCTURAL SUBMITTAL PROCEDURES****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Structural submittal schedule requirements.
  - 2. Supplemental administrative and procedural requirements for structural submittals.
- B. Related Requirements:
  - 1. Section 01 33 00 – Submittal Procedures.

**1.2 DEFINITIONS**

- A. Action Submittals: Written and graphic information and physical samples that require responsive action of the Design Professional. 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 responsive action of the Design Professional. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual specification sections as "Informational Submittals."

**1.3 STRUCTURAL SUBMITTAL SCHEDULE**

- A. Structural Submittal Schedule: Submit to the Design Professional a list of structural 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 the Design Professional and additional time for handling and reviewing submittals required by those corrections.
  - 1. Coordinate structural submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
  - 2. Final Structural Submittal Schedule: Submit concurrently with the first complete submittal of the Contractor's construction schedule.
    - a. Submit revised structural submittal schedule as required to reflect changes in current status and time for submittals.
  - 3. Format: Arrange the following information in a tabular format:
    - a. Scheduled date for first submittal.
    - b. Specification section number and title.
    - c. Submittal Category: Action; Informational.
    - d. Name of subcontractor.
    - e. Description of Work covered.
    - f. Schedule date for Design Professional's final release.
- B. Any submittal schedule required by Section 01 33 00 – Submittal Procedures and meeting the requirements listed above satisfies this requirement.

**1.4 SUBMITTAL FORMATS**

- A. Submittal Information: Include a transmittal letter with the following information in each submittal:
  - 1. Project name.
  - 2. Date.
  - 3. Name of Contractor.

4. Name of firm or entity that prepared submittal.
  5. Names of subcontractor, manufacturer, and supplier.
  6. Unique submittal number, including revision identifier.
  7. Category and type of submittal.
  8. Submittal purpose and description.
  9. Number and title of specification section, with paragraph number and generic name for each of multiple items.
  10. Drawing number and detail references, as appropriate.
  11. Indication of full or partial submittal.
  12. Location(s) where product is to be installed, as appropriate.
  13. Other necessary identification.
  14. Remarks.
- B. 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 the Design Professional on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.
- C. Submittal Document Format: Provide submittals with the format specified in Section 01 33 00 – Submittal Procedures.

#### 1.5 SUBMITTAL PROCEDURES

- A. Prepare and submit submittals required by individual specification sections. Types of submittals are indicated in individual specification sections.
1. Divide large submittals (greater than 250 pages or sheets) into packages not to exceed 250 pages or sheets.
  2. Prepare and transmit submittals in accordance with Section 01 33 00 – Submittal Procedures.
- 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 action submittals and informational submittals required by the same specification section as separate packages under separate transmittals.
  3. 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. The Design Professional 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 structural submittal review, including time for resubmittals, as follows. Time for review shall commence on the Structural Design Professional'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 14 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. The Design Professional 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 14 days for review of each resubmittal.
  4. Size Limit: The maximum of 250 pages or sheets will be reviewed in a 14 day period unless written authorization is provided by the Design Professional to the Contractor.

- 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 the Structural Design Professional'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 "REVIEWED WITH NO EXCEPTIONS" or "REVIEWED WITH EXCEPTIONS NOTED" from the Structural Design Professional's action stamp.

## 1.6 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. Submit Product Data before Shop Drawings, and before or concurrently with Samples.
- B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
  - 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
    - a. Identification of products.
    - b. Schedules.
    - c. Compliance with specified standards.
    - d. Notation of coordination requirements.
    - e. Notation of dimensions established by field measurement.
    - f. Relationship and attachment to adjoining construction clearly indicated.
    - g. Seal and signature of professional engineer if specified.
- C. Samples: Submit Samples for review of type, color, pattern, and texture for a check of these characteristics with other materials.
  - 1. Transmit Samples that contain multiple, related components, such as accessories together in one submittal package.
  - 2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
    - a. Project name and submittal number.
    - b. Generic description of Sample.
    - c. Product name and name of manufacturer.
    - d. Sample source.
    - e. Number and title of applicable specification section.
    - f. Specification paragraph number and generic name of each item.

3. 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.
  4. 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.
  5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
- D. 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.
- E. 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 on AWS forms. Include names of firms and personnel certified.
- F. 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.

#### 1.7 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 the Design Professional.
- B. Delegated Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit a 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.

#### 1.8 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 the Design Professional.
- B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.
  1. THE STRUCTURAL DESIGN PROFESSIONAL WILL NOT REVIEW SUBMITTALS RECEIVED FROM CONTRACTOR THAT DO NOT HAVE CONTRACTOR'S REVIEW AND APPROVAL.
  2. By approving and submitting product data, shop drawings, or samples, the Contractor represents all field measurements, field construction criteria, materials, member sizes, catalogue numbers, and similar criteria has been verified.
  3. By approving and submitting product data, shop drawings, or samples, the Contractor represents shop drawings have been checked and coordinated with the requirements of the Project and the Contract Documents.
- C. The Contractor is responsible to furnish equipment, materials, and labor for the Project which meets the requirements of the codes and authorities quoted, as well as the Contract Documents.

## 1.9 STRUCTURAL DESIGN PROFESSIONAL'S REVIEW

- A. Scope of Structural Review:
1. Action Submittals: Submittal reviewed for the limited purpose of checking the general arrangement and conformance of the structural information in the submittal with the design concept expressed in the Contract Documents. Design Professional's review is not conducted for the purpose of determining the accuracy or completeness of other details, such as dimensions, quantities, nor the approval of an assembly in which the item functions.
  2. Informational Submittals: Submittal reviewed for the limited purpose of checking the general conformance of the structural information in the submittal with the requirements expressed in the Contract Documents. Design Professional's review is not conducted for the purpose of determining the accuracy or completeness of other details, such as dimensions, quantities, nor the approval of an assembly in which the item functions.
  3. Delegated Design Submittals: Submittal reviewed for the use of specified design criteria and to verify the design and drawings are prepared by a registered engineer in the project jurisdiction. Design Professional's review is not conducted for the purpose of determining the accuracy or completeness of other details, such as dimensions, quantities, nor the approval of an assembly in which the item functions.
- B. Action Submittals: The Structural Design Professional will review each submittal, indicate corrections or revisions required, and return.
1. The Structural Design Professional will stamp each submittal (or otherwise indicate) with an action stamp to indicate action, as follows:
  2. "APPROVED": Final unrestricted release; Submittal reviewed as indicated above in Scope of Structural Review with no exceptions taken. Work covered by the submittal may proceed provided it complies with the requirements of the Contract Documents.
  3. "APPROVED AS NOTED": Final-but-restricted-release; Submittal reviewed as indicated above in Scope of Structural Review with certain exceptions noted. Work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and it complies with the requirements of the Contract Documents. The Design Professional reserves the right to require submission of corrected submittal for records.
  4. "REVISE AS NOTED AND RESUBMIT": Submittal reviewed as indicated above in Scope of Structural Review and contains significant deviations from the Contract Documents warranting review after correction. Limited, noncomprehensive corrections or notations will be made. Do not proceed with the Work covered by the submittal in any aspect. Do not use or allow others to use these submittals. Revise submittal and resubmit submittal.
  5. "REJECTED – RESUBMIT AS SPECIFIED": Submittal reviewed as indicated above in Scope of Structural Review and is fundamentally not in compliance. Reason for rejection will be noted. No other corrections or notations will be made. Do not proceed with the Work covered by the submittal in any aspect. Do not use or allow others to use these submittals. Discard submittal and prepare a new submittal.
  6. "RETAINED FOR RECORDS ONLY": Submittal not reviewed. Submittal retained for record by the Design Professional.
- C. Informational Submittals: The Structural Design Professional will review each submittal and will not return it or will return it if it does not comply with requirements.
- D. Delegated Design Submittals: The Structural Design Professional will review each submittal, indicate corrections or revisions required, and return.
1. The Structural Design Professional will stamp each submittal (or otherwise indicate) with an action stamp to indicate action, as follows:
    - a. "APPROVED": Final unrestricted release; Submittal reviewed as indicated above in Scope of Structural Review with no exceptions taken. Work covered by the submittal may proceed provided it complies with the requirements of the Contract Documents.

- b. “APPROVED AS NOTED”: Final-but-restricted-release; Submittal reviewed as indicated above in Scope of Structural Review with certain exceptions noted. Work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and it complies with the requirements of the Contract Documents. The Design Professional reserves the right to require submission of corrected submittal for records.
  - c. “REVISE AS NOTED AND RESUBMIT”: Submittal reviewed as indicated above in Scope of Structural Review and contains significant deviations from the Contract Documents warranting review after correction. Do not proceed with the Work covered by the submittal in any aspect. Do not use or allow others to use these submittals. Revise submittal and resubmit submittal.
  - d. “REJECTED – RESUBMIT AS SPECIFIED”: Submittal reviewed as indicated above in Scope of Structural Review and is fundamentally not in compliance. Reason for rejection will be noted No other corrections or notations will be made. Do not proceed with the Work covered by the submittal in any aspect. Do not use or allow others to use these submittals. Discard submittal and prepare a new submittal.
  - e. “RETAINED FOR RECORDS ONLY”: Submittal not reviewed. Submittal retained for record by the Design Professional.
- E. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from the Design Professional.
  - F. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
  - G. The Structural Design Professional will return without review submittals received from sources other than Contractor via the Architectural Design Professional. The Structural Design Professional will not accept submittals directly from manufacturers or subcontractors.
  - H. Submittals not required by the Contract Documents will be returned or discarded by the Structural Design Professional without action.
  - I. Design Professional’s review of submittals does not relieve the Contractor of responsibility for any deviation from the requirements of the Contract Documents unless the Contractor has directed specific attention to the deviation at the time of submission and the Design Professional has given written approval for the specific deviation.
  - J. Design Professional’s review of submittals does not relieve the Contractor of responsibility for errors or omissions contained in the submittals
  - K. Design Professional’s review of submittals shall not be construed as authorizing any change in the Contract Sum or Contract Time.

## PART 2 - PRODUCTS

NOT USED

## PART 3 - EXECUTION

NOT USED

## END OF SECTION 01 33 30

## SECTION 014000 - QUALITY REQUIREMENTS

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
  - 1. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
  - 2. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

## 1.2 DEFINITIONS

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

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

### 1.3 DELEGATED DESIGN SERVICES

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

### 1.4 CONFLICTING REQUIREMENTS

- A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Architect regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Architect for clarification before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified is the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements,

indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:
1. Seismic-force-resisting system, designated seismic system, or component listed in the Statement of Special Inspections.
  2. Main wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.
- B. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- C. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.

## 1.6 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
1. Date of issue.
  2. Project title and number.
  3. Name, address, telephone number, and email address of testing agency.
  4. Dates and locations of samples and tests or inspections.
  5. Names of individuals making tests and inspections.
  6. Description of the Work and test and inspection method.
  7. Identification of product and Specification Section.
  8. Complete test or inspection data.
  9. Test and inspection results and an interpretation of test results.
  10. Record of temperature and weather conditions at time of sample taking and testing and inspection.
  11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
  12. Name and signature of laboratory inspector.
  13. Recommendations on retesting and reinspecting.
- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
1. Statement on condition of substrates and their acceptability for installation of product.
  2. Statement that products at Project site comply with requirements.
  3. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
  4. Results of operational and other tests and a statement of whether observed performance complies with requirements.
  5. Other required items indicated in individual Specification Sections.

- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Statement that equipment complies with requirements.
  2. Results of operational and other tests and a statement of whether observed performance complies with requirements.
  3. Other required items indicated in individual Specification Sections.

## 1.7 QUALITY ASSURANCE

- A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.
- F. Specialists: Certain Specification Sections require that specific construction activities be performed by entities who are recognized experts in those operations. Specialists will satisfy qualification requirements indicated and engage in the activities indicated.
1. Requirements of authorities having jurisdiction supersede requirements for specialists.
- G. Testing and Inspecting Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented according to **ASTM E329**; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
- H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect, demonstrate, repair, and perform service on installations of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

- J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
1. Contractor responsibilities include the following:
    - a. Provide test specimens representative of proposed products and construction.
    - b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
    - c. When testing is complete, remove test specimens and test assemblies,; do not reuse products on Project.
  2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
- K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
1. Build mockups of size indicated.
  2. Build mockups in location indicated or, if not indicated, as directed by Architect.
  3. Notify Architect **seven** days in advance of dates and times when mockups will be constructed.
  4. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed to perform same tasks during the construction at Project.
  5. Demonstrate the proposed range of aesthetic effects and workmanship.
  6. Obtain Architect's approval of mockups before starting corresponding work, fabrication, or construction.
    - a. Allow **seven** days for initial review and each re-review of each mockup.
  7. Promptly correct unsatisfactory conditions noted by Architect's preliminary review, to the satisfaction of the Architect, before completion of final mockup.
  8. Approval of mockups by the Architect does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  9. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
  10. Demolish and remove mockups when directed unless otherwise indicated.
- L. Specialty Mockups: See Section 014339 "Mockups" for additional construction requirements for **integrated exterior mockups and room mockups**.

## 1.8 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspection they are engaged to perform.
  2. Costs for retesting and reinspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to Contractor, **and the Contract Sum will be adjusted by Change Order**.



- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.
1. Engage a qualified testing agency to perform quality-control services.
    - a. Contractor will not employ same entity engaged by Owner, unless agreed to in writing by Owner.
  2. Notify testing agencies at least **24** hours in advance of time when Work that requires testing or inspection will be performed.
  3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
  4. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
  5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- D. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
  2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
  3. Conduct and interpret tests and inspections and state in each report whether tested and inspected Work complies with or deviates from requirements.
  4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
  5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
  6. Do not perform duties of Contractor.
- E. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."
- F. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- G. Contractor's Associated Requirements and Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
  2. Incidental labor and facilities necessary to facilitate tests and inspections.

3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Preliminary design mix proposed for use for material mixes that require control by testing agency.
6. Security and protection for samples and for testing and inspection equipment at Project site.

H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

## 1.9 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Owner will engage a qualified **testing agency** and **special inspector** to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner[, **as indicated in the Statement of Special Inspections attached to this Section**], and as follows:

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.
2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected Work.

## PART 2 - PRODUCTS (Not Used)

## PART 3 - EXECUTION

### 3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Architect.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's **and authorities' having jurisdiction** reference during normal working hours.

1. Submit log at Project closeout as part of Project Record Documents.

## 3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspection, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
  - 1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000i

## SECTION 014200 - REFERENCES

## PART 1 - GENERAL

## 1.1 DEFINITIONS

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

## 1.2 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

### 1.3 ABBREVIATIONS AND ACRONYMS

- A. Project Specific and Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."
- B.
  1. BDS– Bay District Schools.
- C. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list.
  1. AABC - Associated Air Balance Council; [www.aabc.com](http://www.aabc.com).
  2. AAMA - American Architectural Manufacturers Association; [www.aamanet.org](http://www.aamanet.org).
  3. AAPFCO - Association of American Plant Food Control Officials; [www.aapfco.org](http://www.aapfco.org).
  4. AASHTO - American Association of State Highway and Transportation Officials; [www.transportation.org](http://www.transportation.org).
  5. AATCC - American Association of Textile Chemists and Colorists; [www.aatcc.org](http://www.aatcc.org).
  6. ABMA - American Bearing Manufacturers Association; [www.americanbearings.org](http://www.americanbearings.org).
  7. ACI - American Concrete Institute; (Formerly: ACI International); [www.concrete.org](http://www.concrete.org).
  8. ACPA - American Concrete Pipe Association; [www.concrete-pipe.org](http://www.concrete-pipe.org).
  9. AEIC - Association of Edison Illuminating Companies, Inc. (The); [www.aeic.org](http://www.aeic.org).
  10. AF&PA - American Forest & Paper Association; [www.afandpa.org](http://www.afandpa.org).
  11. AGA - American Gas Association; [www.aga.org](http://www.aga.org).
  12. AHAM - Association of Home Appliance Manufacturers; [www.aham.org](http://www.aham.org).
  13. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); [www.ahrinet.org](http://www.ahrinet.org).
  14. AI - Asphalt Institute; [www.asphaltinstitute.org](http://www.asphaltinstitute.org).
  15. AIA - American Institute of Architects (The); [www.aia.org](http://www.aia.org).
  16. AISC - American Institute of Steel Construction; [www.aisc.org](http://www.aisc.org).
  17. AISI - American Iron and Steel Institute; [www.steel.org](http://www.steel.org).
  18. AITC - American Institute of Timber Construction; [www.aitc-glulam.org](http://www.aitc-glulam.org).
  19. AMCA - Air Movement and Control Association International, Inc.; [www.amca.org](http://www.amca.org).
  20. ANSI - American National Standards Institute; [www.ansi.org](http://www.ansi.org).
  21. AOSA - Association of Official Seed Analysts, Inc.; [www.aosaseed.com](http://www.aosaseed.com).
  22. APA - APA - The Engineered Wood Association; [www.apawood.org](http://www.apawood.org).
  23. APA - Architectural Precast Association; [www.archprecast.org](http://www.archprecast.org).
  24. API - American Petroleum Institute; [www.api.org](http://www.api.org).
  25. ARI - Air-Conditioning & Refrigeration Institute; (See AHRI).
  26. ARI - American Refrigeration Institute; (See AHRI).
  27. ARMA - Asphalt Roofing Manufacturers Association; [www.asphaltroofing.org](http://www.asphaltroofing.org).
  28. ASCE - American Society of Civil Engineers; [www.asce.org](http://www.asce.org).
  29. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (See ASCE).
  30. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; [www.ashrae.org](http://www.ashrae.org).
  31. ASME - ASME International; (American Society of Mechanical Engineers); [www.asme.org](http://www.asme.org).
  32. ASSE - American Society of Safety Engineers (The); [www.asse.org](http://www.asse.org).
  33. ASSE - American Society of Sanitary Engineering; [www.asse-plumbing.org](http://www.asse-plumbing.org).
  34. ASTM - ASTM International; (American Society for Testing and Materials International); [www.astm.org](http://www.astm.org).
  35. ATIS - Alliance for Telecommunications Industry Solutions; [www.atis.org](http://www.atis.org).
  36. AWEA - American Wind Energy Association; [www.awea.org](http://www.awea.org).
  37. AWI - Architectural Woodwork Institute; [www.awinet.org](http://www.awinet.org).

38. AWMAC - Architectural Woodwork Manufacturers Association of Canada; [www.awmac.com](http://www.awmac.com).
39. AWPA - American Wood Protection Association; (Formerly: American Wood-Preservers' Association); [www.awpa.com](http://www.awpa.com).
40. AWS - American Welding Society; [www.aws.org](http://www.aws.org).
41. AWWA - American Water Works Association; [www.awwa.org](http://www.awwa.org).
42. BHMA - Builders Hardware Manufacturers Association; [www.buildershardware.com](http://www.buildershardware.com).
43. BIA - Brick Industry Association (The); [www.gobrick.com](http://www.gobrick.com).
44. BICSI - BICSI, Inc.; [www.bicsi.org](http://www.bicsi.org).
45. BIFMA - BIFMA International; (Business and Institutional Furniture Manufacturer's Association); [www.bifma.com](http://www.bifma.com).
46. BISSC - Baking Industry Sanitation Standards Committee; [www.bissc.org](http://www.bissc.org).
47. BWF - Badminton World Federation; (Formerly: International Badminton Federation); [www.bwfbadminton.org](http://www.bwfbadminton.org).
48. CDA - Copper Development Association; [www.copper.org](http://www.copper.org).
49. CEA - Canadian Electricity Association; [www.electricity.ca](http://www.electricity.ca).
50. CEAA - Consumer Electronics Association; [www.ce.org](http://www.ce.org).
51. CFFA - Chemical Fabrics & Film Association, Inc.; [www.chemicalfabricsandfilm.com](http://www.chemicalfabricsandfilm.com).
52. CFSEI - Cold-Formed Steel Engineers Institute; [www.cfsei.org](http://www.cfsei.org).
53. CGA - Compressed Gas Association; [www.cganet.com](http://www.cganet.com).
54. CIMA - Cellulose Insulation Manufacturers Association; [www.cellulose.org](http://www.cellulose.org).
55. CISCA - Ceilings & Interior Systems Construction Association; [www.cisca.org](http://www.cisca.org).
56. CISPI - Cast Iron Soil Pipe Institute; [www.cispi.org](http://www.cispi.org).
57. CLFMI - Chain Link Fence Manufacturers Institute; [www.chainlinkinfo.org](http://www.chainlinkinfo.org).
58. CPA - Composite Panel Association; [www.pbmdf.com](http://www.pbmdf.com).
59. CRI - Carpet and Rug Institute (The); [www.carpet-rug.org](http://www.carpet-rug.org).
60. CRRC - Cool Roof Rating Council; [www.coolroofs.org](http://www.coolroofs.org).
61. CRSI - Concrete Reinforcing Steel Institute; [www.crsi.org](http://www.crsi.org).
62. CSA - Canadian Standards Association; [www.csa.ca](http://www.csa.ca).
63. CSA - CSA International; (Formerly: IAS - International Approval Services); [www.csa-international.org](http://www.csa-international.org).
64. CSI - Construction Specifications Institute (The); [www.csinet.org](http://www.csinet.org).
65. CSSB - Cedar Shake & Shingle Bureau; [www.cedarbureau.org](http://www.cedarbureau.org).
66. CTI - Cooling Technology Institute; (Formerly: Cooling Tower Institute); [www.cti.org](http://www.cti.org).
67. CWC - Composite Wood Council; (See CPA).
68. DASMA - Door and Access Systems Manufacturers Association; [www.dasma.com](http://www.dasma.com).
69. DHI - Door and Hardware Institute; [www.dhi.org](http://www.dhi.org).
70. ECA - Electronic Components Association; (See ECIA).
71. ECAMA - Electronic Components Assemblies & Materials Association; (See ECIA).
72. ECIA - Electronic Components Industry Association; [www.eciaonline.org](http://www.eciaonline.org).
73. EIA - Electronic Industries Alliance; (See TIA).
74. EIMA - EIFS Industry Members Association; [www.eima.com](http://www.eima.com).
75. EJMA - Expansion Joint Manufacturers Association, Inc.; [www.ejma.org](http://www.ejma.org).
76. ESD - ESD Association; (Electrostatic Discharge Association); [www.esda.org](http://www.esda.org).
77. ESTA - Entertainment Services and Technology Association; (See PLASA).
78. EVO - Efficiency Valuation Organization; [www.evo-world.org](http://www.evo-world.org).
79. FIBA - Federation Internationale de Basketball; (The International Basketball Federation); [www.fiba.com](http://www.fiba.com).
80. FIVB - Federation Internationale de Volleyball; (The International Volleyball Federation); [www.fivb.org](http://www.fivb.org).
81. FM Approvals - FM Approvals LLC; [www.fmglobal.com](http://www.fmglobal.com).
82. FM Global - FM Global; (Formerly: FMG - FM Global); [www.fmglobal.com](http://www.fmglobal.com).
83. FRSA - Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc.; [www.floridarroof.com](http://www.floridarroof.com).
84. FSA - Fluid Sealing Association; [www.fluidsealing.com](http://www.fluidsealing.com).
85. FSC - Forest Stewardship Council U.S.; [www.fscus.org](http://www.fscus.org).
86. GA - Gypsum Association; [www.gypsum.org](http://www.gypsum.org).

87. GANA - Glass Association of North America; [www.glasswebsite.com](http://www.glasswebsite.com).
88. GS - Green Seal; [www.greenseal.org](http://www.greenseal.org).
89. HI - Hydraulic Institute; [www.pumps.org](http://www.pumps.org).
90. HI/GAMA - Hydronics Institute/Gas Appliance Manufacturers Association; (See AHRI).
91. HMMA - Hollow Metal Manufacturers Association; (See NAAMM).
92. HPVA - Hardwood Plywood & Veneer Association; [www.hpva.org](http://www.hpva.org).
93. HPW - H. P. White Laboratory, Inc.; [www.hpwhite.com](http://www.hpwhite.com).
94. IAPSC - International Association of Professional Security Consultants; [www.iapsc.org](http://www.iapsc.org).
95. IAS - International Accreditation Service; [www.iasonline.org](http://www.iasonline.org).
96. IAS - International Approval Services; (See CSA).
97. ICBO - International Conference of Building Officials; (See ICC).
98. ICC - International Code Council; [www.iccsafe.org](http://www.iccsafe.org).
99. ICEA - Insulated Cable Engineers Association, Inc.; [www.icea.net](http://www.icea.net).
100. ICPA - International Cast Polymer Alliance; [www.icpa-hq.org](http://www.icpa-hq.org).
101. ICRI - International Concrete Repair Institute, Inc.; [www.icri.org](http://www.icri.org).
102. IEC - International Electrotechnical Commission; [www.iec.ch](http://www.iec.ch).
103. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); [www.ieee.org](http://www.ieee.org).
104. IES - Illuminating Engineering Society; (Formerly: Illuminating Engineering Society of North America); [www.ies.org](http://www.ies.org).
105. IESNA - Illuminating Engineering Society of North America; (See IES).
106. IEST - Institute of Environmental Sciences and Technology; [www.iest.org](http://www.iest.org).
107. IGMA - Insulating Glass Manufacturers Alliance; [www.igmaonline.org](http://www.igmaonline.org).
108. IGSHPA - International Ground Source Heat Pump Association; [www.igshpa.okstate.edu](http://www.igshpa.okstate.edu).
109. ILI - Indiana Limestone Institute of America, Inc.; [www.iliai.com](http://www.iliai.com).
110. Intertek - Intertek Group; (Formerly: ETL SEMCO; Intertek Testing Service NA); [www.intertek.com](http://www.intertek.com).
111. ISA - International Society of Automation (The); (Formerly: Instrumentation, Systems, and Automation Society); [www.isa.org](http://www.isa.org).
112. ISAS - Instrumentation, Systems, and Automation Society (The); (See ISA).
113. ISFA - International Surface Fabricators Association; (Formerly: International Solid Surface Fabricators Association); [www.isfanow.org](http://www.isfanow.org).
114. ISO - International Organization for Standardization; [www.iso.org](http://www.iso.org).
115. ISSFA - International Solid Surface Fabricators Association; (See ISFA).
116. ITU - International Telecommunication Union; [www.itu.int/home](http://www.itu.int/home).
117. KCMA - Kitchen Cabinet Manufacturers Association; [www.kcma.org](http://www.kcma.org).
118. LMA - Laminating Materials Association; (See CPA).
119. LPI - Lightning Protection Institute; [www.lightning.org](http://www.lightning.org).
120. MBMA - Metal Building Manufacturers Association; [www.mbma.com](http://www.mbma.com).
121. MCA - Metal Construction Association; [www.metalconstruction.org](http://www.metalconstruction.org).
122. MFMA - Maple Flooring Manufacturers Association, Inc.; [www.maplefloor.org](http://www.maplefloor.org).
123. MFMA - Metal Framing Manufacturers Association, Inc.; [www.metalframingmfg.org](http://www.metalframingmfg.org).
124. MHIA - Material Handling Industry of America; [www.mhia.org](http://www.mhia.org).
125. MIA - Marble Institute of America; [www.marble-institute.com](http://www.marble-institute.com).
126. MMPA - Moulding & Millwork Producers Association; (Formerly: Wood Moulding & Millwork Producers Association); [www.wmmpa.com](http://www.wmmpa.com).
127. MPI - Master Painters Institute; [www.paintinfo.com](http://www.paintinfo.com).
128. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry Inc.; [www.mss-hq.org](http://www.mss-hq.org).
129. NAAMM - National Association of Architectural Metal Manufacturers; [www.naamm.org](http://www.naamm.org).
130. NACE - NACE International; (National Association of Corrosion Engineers International); [www.nace.org](http://www.nace.org).
131. NADCA - National Air Duct Cleaners Association; [www.nadca.com](http://www.nadca.com).
132. NAIMA - North American Insulation Manufacturers Association; [www.naima.org](http://www.naima.org).
133. NBGQA - National Building Granite Quarries Association, Inc.; [www.nbgqa.com](http://www.nbgqa.com).
134. NCAA - National Collegiate Athletic Association (The); [www.ncaa.org](http://www.ncaa.org).
135. NCMA - National Concrete Masonry Association; [www.ncma.org](http://www.ncma.org).

136. NEBB - National Environmental Balancing Bureau; [www.nebb.org](http://www.nebb.org).
137. NECA - National Electrical Contractors Association; [www.necanet.org](http://www.necanet.org).
138. NeLMA - Northeastern Lumber Manufacturers Association; [www.nelma.org](http://www.nelma.org).
139. NEMA - National Electrical Manufacturers Association; [www.nema.org](http://www.nema.org).
140. NETA - InterNational Electrical Testing Association; [www.netaworld.org](http://www.netaworld.org).
141. NFHS - National Federation of State High School Associations; [www.nfhs.org](http://www.nfhs.org).
142. NFPA - NFPA; (National Fire Protection Association); [www.nfpa.org](http://www.nfpa.org).
143. NFPA - NFPA International; (See NFPA).
144. NFRC - National Fenestration Rating Council; [www.nfrc.org](http://www.nfrc.org).
145. NHLA - National Hardwood Lumber Association; [www.nhla.com](http://www.nhla.com).
146. NLGA - National Lumber Grades Authority; [www.nlga.org](http://www.nlga.org).
147. NOFMA - National Oak Flooring Manufacturers Association; (See NWFMA).
148. NOMMA - National Ornamental & Miscellaneous Metals Association; [www.nomma.org](http://www.nomma.org).
149. NRCA - National Roofing Contractors Association; [www.nrca.net](http://www.nrca.net).
150. NRMCA - National Ready Mixed Concrete Association; [www.nrmca.org](http://www.nrmca.org).
151. NSF - NSF International; (National Sanitation Foundation International); [www.nsf.org](http://www.nsf.org).
152. NSPE - National Society of Professional Engineers; [www.nspe.org](http://www.nspe.org).
153. NSSGA - National Stone, Sand & Gravel Association; [www.nssga.org](http://www.nssga.org).
154. NTMA - National Terrazzo & Mosaic Association, Inc. (The); [www.ntma.com](http://www.ntma.com).
155. NWFMA - National Wood Flooring Association; [www.nwfa.org](http://www.nwfa.org).
156. PCI - Precast/Prestressed Concrete Institute; [www.pci.org](http://www.pci.org).
157. PDI - Plumbing & Drainage Institute; [www.pdionline.org](http://www.pdionline.org).
158. PLASA - PLASA; (Formerly: ESTA - Entertainment Services and Technology Association); [www.plasa.org](http://www.plasa.org).
159. RCSC - Research Council on Structural Connections; [www.boltcouncil.org](http://www.boltcouncil.org).
160. RFCI - Resilient Floor Covering Institute; [www.rfci.com](http://www.rfci.com).
161. RIS - Redwood Inspection Service; [www.redwoodinspection.com](http://www.redwoodinspection.com).
162. SAE - SAE International; (Society of Automotive Engineers); [www.sae.org](http://www.sae.org).
163. SCTE - Society of Cable Telecommunications Engineers; [www.scte.org](http://www.scte.org).
164. SDI - Steel Deck Institute; [www.sdi.org](http://www.sdi.org).
165. SDI - Steel Door Institute; [www.steeldoor.org](http://www.steeldoor.org).
166. SEFA - Scientific Equipment and Furniture Association; [www.sefalabs.com](http://www.sefalabs.com).
167. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (See ASCE).
168. SIA - Security Industry Association; [www.siaonline.org](http://www.siaonline.org).
169. SJI - Steel Joist Institute; [www.steeljoist.org](http://www.steeljoist.org).
170. SMA - Screen Manufacturers Association; [www.smainfo.org](http://www.smainfo.org).
171. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; [www.smacna.org](http://www.smacna.org).
172. SMPTE - Society of Motion Picture and Television Engineers; [www.smpte.org](http://www.smpte.org).
173. SPFA - Spray Polyurethane Foam Alliance; [www.sprayfoam.org](http://www.sprayfoam.org).
174. SPIB - Southern Pine Inspection Bureau; [www.spib.org](http://www.spib.org).
175. SPRI - Single Ply Roofing Industry; [www.spri.org](http://www.spri.org).
176. SRCC - Solar Rating and Certification Corporation; [www.solar-rating.org](http://www.solar-rating.org).
177. SSINA - Specialty Steel Industry of North America; [www.ssina.com](http://www.ssina.com).
178. SSPC - SSPC: The Society for Protective Coatings; [www.sspc.org](http://www.sspc.org).
179. STI - Steel Tank Institute; [www.steeltank.com](http://www.steeltank.com).
180. SWI - Steel Window Institute; [www.steelwindows.com](http://www.steelwindows.com).
181. SWPA - Submersible Wastewater Pump Association; [www.swpa.org](http://www.swpa.org).
182. TCA - Tilt-Up Concrete Association; [www.tilt-up.org](http://www.tilt-up.org).
183. TCNA - Tile Council of North America, Inc.; (Formerly: Tile Council of America); [www.tileusa.com](http://www.tileusa.com).
184. TEMA - Tubular Exchanger Manufacturers Association, Inc.; [www.tema.org](http://www.tema.org).
185. TIA - Telecommunications Industry Association; (Formerly: TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance); [www.tiaonline.org](http://www.tiaonline.org).
186. TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance; (See TIA).
187. TMS - The Masonry Society; [www.masonrysociety.org](http://www.masonrysociety.org).



188. TPI - Truss Plate Institute; [www.tpinst.org](http://www.tpinst.org).
  189. TPI - Turfgrass Producers International; [www.turfgrassod.org](http://www.turfgrassod.org).
  190. TRI - Tile Roofing Institute; (Formerly: National Tile Roofing Manufacturing Association); [www.tilerroofing.org](http://www.tilerroofing.org).
  191. UBC - Uniform Building Code; (See ICC).
  192. UL - Underwriters Laboratories Inc.; [www.ul.com](http://www.ul.com).
  193. UNI - Uni-Bell PVC Pipe Association; [www.uni-bell.org](http://www.uni-bell.org).
  194. USAV - USA Volleyball; [www.usavolleyball.org](http://www.usavolleyball.org).
  195. USGBC - U.S. Green Building Council; [www.usgbc.org](http://www.usgbc.org).
  196. USITT - United States Institute for Theatre Technology, Inc.; [www.usitt.org](http://www.usitt.org).
  197. WASTEC - Waste Equipment Technology Association; [www.wastec.org](http://www.wastec.org).
  198. WCLIB - West Coast Lumber Inspection Bureau; [www.wclib.org](http://www.wclib.org).
  199. WCMA - Window Covering Manufacturers Association; [www.wcmanet.org](http://www.wcmanet.org).
  200. WDMA - Window & Door Manufacturers Association; [www.wdma.com](http://www.wdma.com).
  201. WI - Woodwork Institute; (Formerly: WIC - Woodwork Institute of California); [www.wicnet.org](http://www.wicnet.org).
  202. WMMPA - Wood Moulding & Millwork Producers Association; (See MMPA).
  203. WSRCA - Western States Roofing Contractors Association; [www.wsrca.com](http://www.wsrca.com).
  204. WPA - Western Wood Products Association; [www.wwpa.org](http://www.wwpa.org).
- D. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list.
1. DIN - Deutsches Institut für Normung e.V.; [www.din.de](http://www.din.de).
  2. IAPMO - International Association of Plumbing and Mechanical Officials; [www.iapmo.org](http://www.iapmo.org).
  3. ICC - International Code Council; [www.iccsafe.org](http://www.iccsafe.org).
  4. ICC-ES - ICC Evaluation Service, LLC; [www.icc-es.org](http://www.icc-es.org).
- E. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list.
1. COE - Army Corps of Engineers; [www.usace.army.mil](http://www.usace.army.mil).
  2. CPSC - Consumer Product Safety Commission; [www.cpsc.gov](http://www.cpsc.gov).
  3. DOC - Department of Commerce; National Institute of Standards and Technology; [www.nist.gov](http://www.nist.gov).
  4. DOD - Department of Defense; <http://dodssp.daps.dla.mil>.
  5. DOE - Department of Energy; [www.energy.gov](http://www.energy.gov).
  6. EPA - Environmental Protection Agency; [www.epa.gov](http://www.epa.gov).
  7. FAA - Federal Aviation Administration; [www.faa.gov](http://www.faa.gov).
  8. FG - Federal Government Publications; [www.gpo.gov](http://www.gpo.gov).
  9. GSA - General Services Administration; [www.gsa.gov](http://www.gsa.gov).
  10. HUD - Department of Housing and Urban Development; [www.hud.gov](http://www.hud.gov).
  11. LBL - Lawrence Berkeley National Laboratory; Environmental Energy Technologies Division; <http://eetd.lbl.gov>.
  12. OSHA - Occupational Safety & Health Administration; [www.osha.gov](http://www.osha.gov).
  13. SD - Department of State; [www.state.gov](http://www.state.gov).
  14. TRB - Transportation Research Board; National Cooperative Highway Research Program; [www.trb.org](http://www.trb.org).
  15. USDA - Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; [www.ars.usda.gov](http://www.ars.usda.gov).
  16. USDA - Department of Agriculture; Rural Utilities Service; [www.usda.gov](http://www.usda.gov).
  17. USDJ - Department of Justice; Office of Justice Programs; National Institute of Justice; [www.ojp.usdoj.gov](http://www.ojp.usdoj.gov).
  18. USP - U.S. Pharmacopeia; [www.usp.org](http://www.usp.org).
  19. USPS - United States Postal Service; [www.usps.com](http://www.usps.com).

- F. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list.
1. CFR - Code of Federal Regulations; Available from Government Printing Office; [www.gpo.gov/fdsys](http://www.gpo.gov/fdsys).
  2. DOD - Department of Defense; Military Specifications and Standards; Available from Department of Defense Single Stock Point; <http://dodssp.daps.dla.mil>.
  3. DSCC - Defense Supply Center Columbus; (See FS).
  4. FED-STD - Federal Standard; (See FS).
  5. FS - Federal Specification; Available from Department of Defense Single Stock Point; <http://dodssp.daps.dla.mil>.
    - a. Available from Defense Standardization Program; [www.dsp.dla.mil](http://www.dsp.dla.mil).
    - b. Available from General Services Administration; [www.gsa.gov](http://www.gsa.gov).
    - c. Available from National Institute of Building Sciences/Whole Building Design Guide; [www.wbdg.org/ccb](http://www.wbdg.org/ccb).
  6. MILSPEC - Military Specification and Standards; (See DOD).
  7. USAB - United States Access Board; [www.access-board.gov](http://www.access-board.gov).
  8. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (See USAB).
- G. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list.
1. CBHF; State of California; Department of Consumer Affairs; Bureau of Electronic Appliance and Repair, Home Furnishings and Thermal Insulation; [www.bearhfti.ca.gov](http://www.bearhfti.ca.gov).
  2. CCR; California Code of Regulations; Office of Administrative Law; California Title 24 Energy Code; [www.calregs.com](http://www.calregs.com).
  3. CDHS; California Department of Health Services; (See CDPH).
  4. CDPH; California Department of Public Health; Indoor Air Quality Program; [www.cal-iaq.org](http://www.cal-iaq.org).
  5. CPUC; California Public Utilities Commission; [www.cpuc.ca.gov](http://www.cpuc.ca.gov).
  6. SCAQMD; South Coast Air Quality Management District; [www.aqmd.gov](http://www.aqmd.gov).
  7. TFS; Texas Forest Service; Forest Resource Development and Sustainable Forestry; <http://txforests-service.tamu.edu>.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

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## SECTION 014339 - MOCKUPS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
1. Room mockups.

#### 1.2 DEFINITIONS

- A. Integrated Exterior Mockups: Mockups of the exterior envelope constructed on-site as **freestanding temporary built elements** and/or **part of permanent construction**, consisting of multiple products, assemblies, and subassemblies.
- B. Room Mockups: Mockups of typical interior spaces complete with wall, floor, and ceiling finishes; doors; windows; millwork; casework; specialties; furnishings and equipment; and lighting as indicated.

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **Project site**.
1. Meet with **Construction Manager**, and Architect, testing and inspecting agency representative, and installers of major systems whose Work is included in **integrated exterior and room** mockups.
  2. Review coordination of equipment and furnishings provided by the Owner for room mockups.
  3. Review locations and extent of mockups.
  4. Review testing procedures to be performed on mockups.
  5. Review and finalize schedule for mockups, and verify availability of materials, personnel, equipment, and facilities needed to complete mockups **and testing** and maintain schedule for the Work.

#### 1.4 ACTION SUBMITTALS

- A. Shop Drawings: For **room** mockups.
- B. Delegated Design Submittal: For temporary structural supports for mockups not attached to building structure, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Room Mockup Coordination Drawings: **Details** drawn to scale and coordinated with each other, using input from installers of the items involved:

## 1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified in accordance with ASTM E699 for testing indicated and acceptable to Architect.

- B. Build mockups to do the following:

1. Verify selections made under Sample submittals.
2. Demonstrate aesthetic effects.
3. Demonstrate the qualities of products and workmanship.
4. Demonstrate acceptable coordination between components and systems.
5. Perform preconstruction testing, such as window air- and water-leakage testing.

- C. Fabrication: Before fabricating or installing portions of the Work requiring mockups, build mockups for each form of construction and finish required. Use materials and installation methods as required for the Work.

1. Build mockups of size indicated.
2. Build mockups in location indicated or, if not indicated, as directed by Architect.
3. Employ supervisory personnel who will oversee mockup construction. Employ workers who will be employed to perform same tasks during the construction at Project.
4. Demonstrate the proposed range of aesthetic effects and workmanship.
5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
6. Demolish and remove mockups when directed by Architect unless otherwise indicated.

- D. Notifications:

1. Notify Architect **seven** days in advance of the dates and times when mockups will be constructed.
2. Notify Architect **14** days in advance of the dates and times when mockups will be tested.
3. Allow **seven** days for initial review and each re-review of each mockup.

- E. Approval: Obtain Architect's approval of mockups before starting fabrication or construction of corresponding Work.

1. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

## 1.7 COORDINATION

- A. Coordinate schedule for construction of mockups, so construction, testing, and review of mockups do not impact Project schedule.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design support structure for free-standing mockups.
- B. Structural Performance:
  - 1. Wind Loads: As indicated on Drawings.
- C. Mockup Testing Performance Requirements: Perform tests using design pressures and performance criteria indicated for assemblies and products that are specified in other Sections and incorporated into **integrated exterior** mockups.

### 2.2 ROOM MOCKUPS

- A. Build room mockups **according to approved mockup Shop Drawings** and **as indicated on Drawings** to evaluate constructability, demonstrate the coordination of trades and sequencing of Work, and to demonstrate aesthetic requirements. Include each visible finish, component, and equipment item within room mockups; include operable lighting.
- B. Provide room mockups of the following rooms:
  - a. Typical Office
- C. The Work of room mockups includes, but is not limited to, the following:
  - 1. Millwork and casework.
  - 2. Doors and frames., to include base and cove profiles
  - 3. Access doors and frames.
  - 4. Metal framing.
  - 5. Gypsum board.
  - 6. Acoustical ceilings.
  - 7. Painting.
  - 8. Registers and grilles.
  - 9. Wiring devices.
  - 10. Lighting.
  - 11. Finish Flooring, all types.

## PART 3 - EXECUTION

- 3.1 Construct mockup in accordance with other sections of this spec and as detailed on the drawings.

END OF SECTION 014339

**SECTION 01 45 25 – STRUCTURAL AND SPECIAL INSPECTION/TESTING AGENCY SERVICES****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Administrative and procedural requirements for structural inspections and tests related to quality assurance and quality control.
  - 2. Administrative and procedural requirements for special inspections and tests related to quality assurance and quality control.
- B. Special inspection and testing services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
  - 1. Specific quality-assurance and quality-control requirements for individual work results are specified in their respective specification sections. Requirements in individual Sections may also cover production of standard products.
  - 2. Specified inspections, tests, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
- C. Related Requirements:
  - 1. Section 01 33 00 – Submittal Procedures.
  - 2. Section 01 33 30 – Structural Submittal Procedures.
  - 3. Section 01 40 00 – Quality Requirements.

**1.2 REFERENCE STANDARDS**

- A. American Council of Independent Laboratories (ACIL):
  - 1. National Cooperation for Laboratory Accreditation (NACLA)
- B. ASTM International (ASTM):
  - 1. ASTM E329 – Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.
- C. National Institute of Standards and Technology (NIST):
  - 1. National Voluntary Laboratory Accreditation Program (NVLAP).

**1.3 DEFINITIONS**

- A. Special Inspection: Inspection of construction requiring the expertise of an approved special inspector in order to ensure compliance with the building code and the approved Construction Documents.
  - 1. Continuous Special Inspection: Special Inspection by the Special Inspector who is present continuously when and where the work to be inspected is being performed.
  - 2. Periodic Special Inspection: Special Inspection by the Special Inspector who is intermittently present where the work to be inspected has been or is being performed.
- B. Special Inspector: A qualified person employed or retained by an approved Inspection/Testing Agency having the competence necessary to inspect a particular type of construction requiring Special Inspection.



#### 1.4 INFORMATIONAL SUBMITTALS

- A. Special Inspection/Testing Agency Qualifications: Documentation of the qualifications for the Special Inspection/Testing Agency and for each Special Inspector assigned to the Project.
1. Identify names and qualifications of each technician, inspector, or engineer working on the Project.
  2. Identify what tests and inspections each technician, inspector, or engineer is responsible for conducting.
- B. Contractor's Statement of Responsibility: Signed and dated "Contractor's Statement of Responsibility" for each contractor responsible for the construction or fabrication of main windforce-resisting system, seismic force-resisting system, designated seismic system, or wind/seismic resisting component listed in the "Statement of Special Inspections" (including where applicable "Special Inspections for Wind Resistance" and "Special Inspections for Seismic Resistance"). Include the following minimum information:
1. Project name.
  2. Contractor's/Subcontractor's name and address.
  3. Contractor's/Subcontractor's license number.
  4. Description of building system and components covered.
- C. Fabricator's Certificate of Compliance: Signed and dated "Fabricator's Certificate of Compliance" for each approved fabricator that is exempt from Special Inspection of shop fabrication and implementation procedures. Include the following minimum information:
1. Project name.
  2. Fabricator's name and address.
  3. Certification or approval agency and certification number.
  4. Date of last audit or approval.
  5. Description of the fabricated structural members and assemblies covered.
- D. Special Inspection Daily Reports: Written, signed Special Inspection Daily Reports. Include the following minimum information:
1. Project name and location.
  2. Name of Special Inspection/Testing Agency and Special Inspector conducting the service.
  3. Date and time of service.
  4. Description of services, inspections, and tests made including whether coverage was continuous or periodic and location where applicable.
  5. Any deficiencies or discrepancies in the test or inspection.
  6. Any deficiencies or discrepancies corrected.
- E. Special Inspection Interim Reports: Written, signed special inspection interim reports at the frequency specified in the "Statement of Special Inspections." Include the following minimum information:
1. Project name and location.
  2. Report number
  3. Name of Special Inspection/Testing Agency and Special Inspector conducting the service.
  4. Date and time of service.
  5. Description of services, inspections, and tests made including whether coverage was continuous or periodic and location where applicable.
  6. Any deficiencies or discrepancies in the test or inspection.
  7. Any deficiencies or discrepancies corrected since the last interim report.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Final Report of Special Inspections: Submit a signed Final Report of Special Inspections. Include the following minimum information:
1. Project Name and Location.
  2. Name of Special Inspection/Testing Agency.
  3. Name and signature of the Special Inspection/Testing Agency representative completing the report.

4. Any prior Interim Special Inspection Reports considered to be integral to the Final Report.
5. A list of deficiencies or discrepancies corrected since the final Interim Special Inspection Report.

## 1.6 SPECIAL INSPECTION DOCUMENTS

- A. Statement of Special Inspections: Prepared by the Design Professional and identifying the following information:
  1. Project name and location.
  2. Registered Design Professional in Responsible Charge
  3. Frequency of interim report submittals.
  4. If Special Inspections for Wind Resistance are required.
  5. If Special Inspections for Seismic Resistance are required.
- B. Special Inspections for Wind Resistance: Prepared by the Design Professional and identifying the following information:
  1. Description of main windforce-resisting systems subject to special inspections for wind resistance.
  2. Description of wind force-resisting components subject to special inspections for wind resistance.
- C. Special Inspections for Seismic Resistance: Prepared by the Design Professional and identifying the following information:
  1. Description of seismic force-resisting system subject to special inspection and testing for seismic resistance.
  2. Description of designated seismic systems subject to special inspection and testing for seismic resistance.
  3. Description of additional seismic systems and components requiring special inspection.
  4. Description of additional seismic systems and components requiring testing.
- D. Schedule of Special Inspection Services: Prepared by the Design Professional identifying the following items:
  1. Materials, systems, components, and work required to have special inspections or tests.
  2. Type and extent of each special inspection
  3. Type and extent of each test.
  4. Identification if each special inspection will be continuous or periodic.
  5. Agent responsible for the test or inspection

## 1.7 STRUCTURAL INSPECTION/TESTING REQUIREMENT SUMMARY

- A. Specific structural Inspection/Testing requirements are given in the following specification sections:
  1. Division 03:
    - a. Section 03 10 00 – Concrete Forming and Accessories.
    - b. Section 03 20 00 – Concrete Reinforcing.
    - c. Section 03 30 00 – Cast-in-Place Concrete.
  2. Division 04:
    - a. Section 04 16 01 – Structural Post-Installed Masonry Anchoring.
  3. Division 05:
    - a. Section 05 12 00 – Structural Steel Framing.
  4. Division 31:
    - a. Section 31 23 01 – Excavation and Fill for Structures.

## 1.8 QUALITY ASSURANCE

- A. Structural Inspection/Testing Agency Qualifications: An NVLAP accredited, an NACLA accredited, or an independent agency with the experience and capability to conduct inspection and testing indicated as documented in accordance with ASTM E329, and with additional qualifications specified; and where required by the Authority Having Jurisdiction (AHJ), that is acceptable to that AHJ.

- B. Special Inspector Qualifications: Individual Special Inspectors of the Special Inspection/Testing Agencies with competence and relevant experience or training for the tests and inspections to which they are assigned. Experience or training shall be considered to be relevant where the documented experience or training is related in complexity to the same type of special inspection or testing activities for projects of similar complexity and material qualities. These qualifications are in addition to qualifications specified in other sections of the Building Code and any applicable amendments.

## 1.9 QUALITY CONTROL

- A. Owner Responsibilities: The Owner will engage a qualified Special Inspection/Testing Agency to perform the required Special Inspections.
1. Owner will furnish Contractor with names, addresses, and telephone numbers of the Special Inspection/Testing Agencies engaged and a description of types of testing and inspection they are engaged to perform.
  2. Owner will transmit the qualifications of the selected Special Inspection/Testing Agency and Special Inspectors to the Registered Design Professional in Responsible Charge for review and comment.
- B. Contractor Responsibilities:
1. Cooperate with Special Inspection/Testing Agencies and their personnel performing required tests and inspections.
  2. Provide reasonable auxiliary services as requested by the Special Inspection/Testing Agencies and their personnel.
  3. Notify agency sufficiently in advance of operations to permit assignment of personnel.
  4. Provide access to the Work.
  5. Provide incidental labor and facilities necessary to facilitate tests and inspections.
  6. Provide adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
  7. Provide facilities for storage and field curing of test samples.
  8. Provide preliminary design mix proposed for use for material mixes that require control by testing agency.
  9. Provide mill test reports when requested.
  10. Provide security and protection for samples and for testing and inspection equipment at Project site.
  11. Provide a copy of the Contract Documents to the Special Inspection/Testing Agencies.
  12. Submit Fabricator's Certificate of Compliance for structural, load-bearing or lateral load-resisting members or assemblies fabricated on the premises of an approved fabricator.
  13. Submit Certificate of compliance for the seismic qualification of nonstructural components, supports, and attachments identified in the Statement of Special Inspections and the Schedule of Special Inspections.
  14. Submit Certificates of compliance for designated seismic systems identified in the Statement of Special Inspections.
  15. Costs for retesting and reinspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to Contractor.
  16. Costs for any additional inspection/testing required for the Contractor's convenience are the Contractor's responsibility.
- C. Special Inspection/Testing Agency Responsibilities:
1. Verify that manufacturer maintains detailed fabrication and quality-control procedures, and reviewing the completeness and adequacy of those procedures to perform the Work.
  2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
  3. Notify the Design Professional in Responsible Charge and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.

4. Submit a certified written Special Inspection Daily Reports of each test, inspection, and similar quality-control service to the Registered Design Professional in Responsible Charge with copy to Contractor and to authorities having jurisdiction.
  5. Submit certified written Special Inspection Interim Reports at the frequency specified in the "Statement of Special Inspections" to the Registered Design Professional in Responsible Charge with copy to Contractor and to authorities having jurisdiction.
  6. Submit a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies to the Registered Design Professional in Responsible Charge with copy to Contractor and to authorities having jurisdiction.
  7. Maintain a log of discrepancies in tests and inspections. Periodically update this log with corrective actions and Inspection/Testing of those corrective actions.
  8. Interpret tests and inspections. State in each report whether tested and inspected Work complies with or deviates from the Contract Documents.
  9. Leave copies of special inspector field notes with the Contractor prior to leaving the construction site. Field notes shall include the following information:
    - a. Name of the Inspection/Testing Agency's representative.
    - b. Message given to the Contractor
    - c. Date and time of message.
    - d. Name of the Contractor's representative informed.
    - e. Type and location of work or materials tested/inspected.
    - f. Determination if the work or materials complied with the Contract Documents.
  10. Comply with Contractor's site access requirements and procedures.
  11. Retesting and reinspecting corrected Work.
  12. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
  13. Do not perform duties of Contractor.
- D. Options: If the Special Inspection/Testing Agency is located sufficiently far from the Project that travel expenses will be a consideration, or if the amount of sampling performed is minor, and by mutual agreement of the Design Professional in Responsible Charge and the Contractor, the Contractor may be requested to take samples and forward them to the Special Inspection/Testing Agency for testing and inspection.

## PART 2 - PRODUCTS

NOT USED

## PART 3 - EXECUTION

### 3.1 REPAIR AND PROTECTION

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

## END OF SECTION 01 45 25

### STATEMENT OF SPECIAL INSPECTIONS

**PROJECT:** Brookhaven PD Building Renovation

**LOCATION:** 2665 Buford Highway NE, Brookhaven, Georgia 30324

**PERMIT APPLICANT:** \_\_\_\_\_

**PERMIT APPLICANT'S ADDRESS:** \_\_\_\_\_

**ARCHITECT OF RECORD:** Roger Godwin, RA (HLGstudio)

**STRUCTURAL ENGINEER OF RECORD:** Eric D. Blackmore, PE, SE (Wallace Design Collective)

**MECHANICAL ENGINEER OF RECORD:** Jesse W. Foley, PE (AHA Consulting Engineers)

**ELECTRICAL ENGINEER OF RECORD:** Onogre L. Mayuga, PE (AHA Consulting Engineers)

**REGISTERED DESIGN PROFESSIONAL IN RESPONSIBLE CHARGE:** Roger Godwin, RA

This *Statement of Special Inspections* is submitted in accordance with Section 1704.3 of the 2018 International Building Code. It includes a *Schedule of Special Inspection Services* applicable to the above-referenced Project as well as the identity of the individuals, agencies, or firms intended to be retained for conducting these inspections. If applicable, it includes *Special Inspections for Wind Resistance* and/or *Special Inspections for Seismic Resistance*.

Are *Special Inspections for Wind Resistance* included in the *Statement of Special Inspections*? NO  
Are *Special Inspections for Seismic Resistance* included in the *Statement of Special Inspections*? YES

The Special Inspector(s) shall keep records of all inspections and shall furnish interim inspection reports to the Building Official and to the Registered Design Professional in Responsible Charge at a frequency agreed upon by the Design Professional and the Building Official prior to the start of work. Discrepancies shall be brought to the immediate attention of the Contractor for correction. If the discrepancies are not corrected, the discrepancies shall be brought to the attention of the Building Official and the Registered Design Professional in Responsible Charge prior to completion of that phase of work. A *Final Report of Special Inspections* documenting required special inspections and corrections of any discrepancies noted in the inspections shall be submitted to the Building Official and the Registered Design Professional in Responsible Charge at the conclusion of the project.

Frequency of interim report submittals to the Registered Design Professional in Responsible Charge:

Weekly       Bi-Weekly       Monthly       Other; specify: \_\_\_\_\_

Frequency of interim report submittals to the Building Official:

Monthly       Bi-Monthly       Upon Completion       Other; specify: \_\_\_\_\_

The Special Inspection Program does not relieve the Contractor of the responsibility to comply with the Contract Documents. Jobsite safety and means and methods of construction are solely the responsibility of the Contractor.

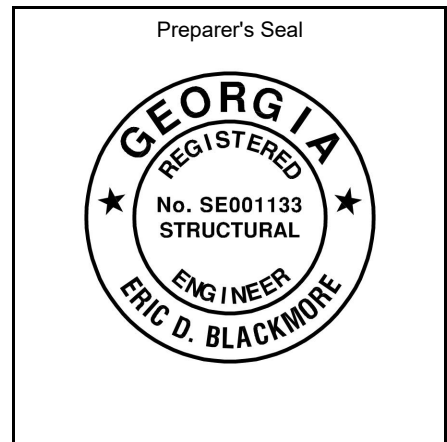
Statement of Special Inspections Prepared by:

Eric D. Blackmore  
Type or print name  
*Eric D. Blackmore*      14 July 2023  
Signature      Date

Building Officials Acceptance:

\_\_\_\_\_  
Signature      Date

Permit Number: \_\_\_\_\_



## **SPECIAL INSPECTIONS FOR WIND RESISTANCE**

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See the *Schedule of Special Inspections* for inspection and testing requirements

**Allowable Stress Design Wind Speed:** **V<sub>asd</sub> = 83 m.p.h.**

**Wind Exposure Category:** **Category B**

**Special Inspection for Wind Resistance Required:** **NO**

(Required in Wind Exposure Category B, where the Allowable Stress Design Wind Speed (V<sub>asd</sub>) is 120 miles-per-hour or greater. Required in Wind Exposure Category C or D, where the Allowable Stress Design Wind Speed (V<sub>asd</sub>) is 110 miles-per-hour or greater.)

**Description of structural wood and cold-formed steel light-frame construction, main windforce-resisting system subject to special inspections for wind resistance:**

(Required for systems noted in IBC Section 1705.11.1 and 1705.11.2.)

None

**Description of wind force-resisting components subject to special inspections for wind resistance:**

(Required for systems and components noted in IBC Section 1705.11.3.)

None

**Statement of Responsibility:**

Each contractor responsible for the construction or fabrication of a system or component described above must submit a *Contractor's Statement of Responsibility*.

## SPECIAL INSPECTIONS FOR SEISMIC RESISTANCE

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See the *Schedule of Special Inspections* for inspection and testing requirements

**Seismic Design Category:** SDC C

**Special Inspection for Seismic Resistance Required:** YES

**Description of seismic force-resisting system subject to special inspection and testing for seismic resistance:**

(Required for systems noted in IBC Section 1705.12.1, 1705.12.2, and 1705.12.3. Special inspections for seismic resistance of structural steel, where required, shall be in accordance with AISC 341.)

None

**Description of designated seismic systems subject to special inspection and testing for seismic resistance:**

(Required for architectural, electrical, and mechanical systems and their components that require design in accordance with ASCE 7, Chapter 13, have a component importance factor ( $I_p$ ) greater than one and are in Seismic Design Category C, D, E, or F.)

None

**Description of additional seismic systems and components requiring special inspections:**

(Required for systems noted in IBC Section 1705.12.5, 1705.12.6, 1705.12.7, and 1705.12.8.)

1. Anchorage of electrical equipment for emergency and standby power systems
2. Verify installation clearances of mechanical and electrical, including duct work, piping systems, and their structural supports meet one of the following: a) minimum clearances per Section 13.2.3 of ASCE/SEI 7, or b) nominal minimum clearance of 3 inches between sprinkler system drops and springs and sprinkler supports do not support other systems.

**Description of additional seismic systems and components requiring testing:**

(Required for systems and components noted in IBC Section 1705.12.13.)

Certificate of Compliance for Canopy System

**Statement of Responsibility:**

Each contractor responsible for the construction or fabrication of a system or component described above must submit a *Contractor's Statement of Responsibility*.

SCHEDULE OF SPECIAL INSPECTION SERVICES					
PROJECT	Brookhaven PD Building Renovation				
MATERIAL / ACTIVITY	SERVICE	APPLICABLE TO THIS PROJECT			
		Y/N	EXTENT	AGENT*	DATE COMPLETED
<b>1705.1.1 Special Cases</b>					
(work unusual in nature, including but not limited to alternative materials and systems, unusual design applications, materials, and systems with special manufacturer's requirements – add additional rows as needed)	Submittal Review, Shop (3) and/or Field Inspection				
1. Inspection of anchors post-installed in solid grouted masonry: Per research reports including verification of anchor type, anchor dimensions, hole dimensions, hole cleaning procedures, anchor spacing, edge distances, masonry unit, grout, masonry compressive strength, anchor embedment, and tightening torque.	Field Inspection	Y	Periodic or as required by the research report issued by an approved source	1	
2. Aggregate Pier Inspection:					
a. Before installation: Review of the aggregate pier designer's use of soil parameters as presented in the project soils report.	Submittal Review	N	Each Submittal		
b. During installation: Verification of aggregate properties, type and number of lifts of aggregate, hole size and depth, top elevations of the pier elements, and applied energy.	Field Inspection	N	Periodic or as required by the research report issued by an approved source		
c. After installation: Review of the results of qualitative tests on production aggregate pier elements such as modulus load testing, uplift pull-out testing, and dynamic cone penetration tests for compliance with the design specifications.	Review of Field Testing	N	Periodic		
3. Fall Arrest System Inspection:					
a. Prior to testing, visual inspection of welded and bolted connections of manufacturer hardware to support structure.	Field Inspection	N	Periodic		
b. Prior to testing, verification of support elements and bracing elements installed in accordance with Structural Documents.	Field Inspection	N	Periodic		
c. System testing and commissioning: Observation of testing procedures in accordance with the manufacturer's testing protocol. Record testing apparatus used, verify calibration of load measuring devices, record maximum test load attained and deflection of top of each anchor at maximum test load (relative to a fixed point).	Observation of Field Testing	N	Continuous		



SCHEDULE OF SPECIAL INSPECTION SERVICES					
PROJECT	Brookhaven PD Building Renovation				
MATERIAL / ACTIVITY	SERVICE	APPLICABLE TO THIS PROJECT			
		Y/N	EXTENT	AGENT*	DATE COMPLETED
<b>1705.2.1 Structural Steel Construction</b>					
1. Fabricator and erector documents (verify reports and certificates as listed in AISC 360, Section N3.2 for compliance with construction documents).	Submittal Review	Y	Each Submittal	1	
2. Material verification of structural steel.	Shop (3) and Field Inspection	Y	Periodic	1	
3. Structural steel welding:					
a. Inspection tasks prior to welding (Observe or perform for each welded joint or member, the QA tasks listed in AISC 360, Table N5.4-1).	Shop (3) and Field Inspection	Y	Observe or Perform as noted (4)	1	
b. Inspection tasks during welding (Observe or perform for each welded joint or member the QA tasks listed in AISC 360, Table N5.4-2).	Shop (3) and Field Inspection	Y	Observe (4)	1	
c. Inspection tasks after welding (Observe or perform for each welded joint or member the QA tasks listed in AISC 360, Table N5.4-3).	Shop (3) and Field Inspection	Y	Observe or Perform as noted (4)	1	
d. Nondestructive testing (NDT) of welded joints: ( <i>see commentary</i> )					
1) Complete penetration groove welds 5/16" or greater in Risk Category III or IV.	Shop (3) or Field Ultrasonic Testing – 100% of welds	N	Periodic		
2) Complete penetration groove welds 5/16" or greater in Risk Category II.	Shop (3) or Field Ultrasonic Testing – 10% of welds minimum	Y	Periodic	1	
3) Welded joints subject to fatigue when required by AISC 360, Appendix 3, Table A-3.1.	Shop (3) or Field Radiographic or Ultrasonic Testing	N	Periodic		
4) Fabricator's NDT reports when fabricator performs NDT.	Verify Reports	Y	Each Submittal (5)	1	
4. Structural steel bolting:	Shop (3) or Field Inspection				
a. Inspection tasks prior to bolting (Observe or perform tasks for each bolted connection in accordance with QA tasks listed in AISC 360, Table N5.6-1).		Y	Observe or Perform as noted (4)	1	
b. Inspection tasks during bolting (Observe the QA tasks listed in AISC 360, Table N5.6-2).		Y	Observe (4)	1	
1) Pre-tensioned and slip-critical joints:					
a) Turn-of-nut with match-marks.		Y	Periodic	1	
b) Direct tension indicator.		Y	Periodic	1	
c) Twist-off type tension control bolt.		Y	Periodic	1	
d) Turn-of-nut without match-marks.		N	Continuous		
e) Calibrated wrench.		N	Continuous		
2) Snug-tight joints.		Y	Periodic	1	

<b>SCHEDULE OF SPECIAL INSPECTION SERVICES</b>					
<b>PROJECT</b>	<b>Brookhaven PD Building Renovation</b>				
<b>MATERIAL / ACTIVITY</b>	<b>SERVICE</b>	<b>APPLICABLE TO THIS PROJECT</b>			
		<b>Y/N</b>	<b>EXTENT</b>	<b>AGENT*</b>	<b>DATE COMPLETED</b>
c. Inspection tasks after bolting (Perform tasks for each bolted connection in accordance with QA tasks listed in AISC 360, Table N5.6-3).		Y	Perform (4)	1	
5. Visual inspection of exposed cut surfaces of galvanized structural steel main members and exposed corners of the rectangular HSS for cracks subsequent to galvanizing.	Shop (3) or Field Inspection	Y	Periodic	1	
6. Embedded items (Verify diameter, grade, type, length, embedment. See 1705.3 for anchors).	Field Inspection	Y	Periodic	1	
7. Verify member locations, braces, stiffeners, and application of joint details at each connection comply with construction documents.	Field Inspection	Y	Periodic	1	
<b>1705.2.2 Cold-Formed Steel Deck</b>					
1. Manufacturer documents (Verify reports and certificates as listed in SDI QA/QC, Section 2, Paragraphs 2.1 and 2.2 for compliance with construction documents).	Submittal Review	N	Each Submittal		
2. Material verification of steel deck, mechanical fasteners, and welding materials.	Shop (3) and Field Inspection	N	Periodic		
3. Cold-formed steel deck placement:	Shop (3) and Field Inspection				
a. Inspection tasks prior to deck placement (Perform the QA tasks listed in SDI QA/QC, Appendix 1, Table 1.2).		N	Perform (4)		
b. Inspection tasks after deck placement (Perform the QA tasks listed in SDI QA/QC, Appendix 1, Table 1.2).		N	Perform (4)		
4. Cold-formed steel deck welding:	Shop (3) and Field Inspection				
a. Inspection tasks prior to welding (Observe the QA tasks listed in SDI QA/QC, Appendix 1, Table 1.3).		N	Observe (4)		
b. Inspection tasks during welding (Observe the QA tasks listed in SDI QA/QC, Appendix 1, Table 1.4).		N	Observe (4)		
c. Inspection tasks after welding (Observe the QA tasks listed in SDI QA/QC, Appendix 1, Table 1.5).		N	Perform (4)		
5. Cold-formed deck mechanical fastening:	Shop (3) and Field Inspection				
a. Inspection tasks prior to mechanical fastening (Observe the QA tasks listed in SDI QA/QC, Appendix 1, Table 1.6).		N	Observe (4)		
b. Inspection tasks during mechanical fastening (Observe the QA tasks listed in SDI QA/QC, Appendix 1, Table 1.7).		N	Observe (4)		

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c. Inspection tasks after mechanical fastening (Observe the QA tasks listed in SDI QA/QC, Appendix 1, Table 1.8).		N	Perform (4)		
<b>1705.2.3 Open-Web Steel Joists and Joist Girders</b>					
1. Installation of open-web steel joists and joist girders:					
a. End connections – welded or bolted.	Per SJI CJ or SJI 100	N	Periodic		
b. Bridging – horizontal or diagonal:					
1) Standard bridging.	Per SJI CJ or SJI 100	N	Periodic		
2) Bridging that differs from the specifications listed in SJI CJ or SJI 100.		N	Periodic		
<b>1705.2.4 Cold-Formed Steel Trusses Spanning 60-feet or Greater</b>					
1. Verify temporary and permanent restraint/bracing are installed in accordance with the approved truss submittal package.	Field Inspection	N	Periodic		

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<b>1705.3 Concrete Construction</b>					
1. Inspection and placement verification of reinforcing steel and prestressing tendons	Shop (3) and Field Inspection	Y	Periodic	1	
2. Reinforcing bar welding:					
a. Verification of weldability of bars other than ASTM A706.		N	Periodic		
b. Inspection of single-pass fillet welds 5/16-inch or less in size.		N	Periodic		
c. Inspection of all other welds.		N	Continuous		
3. Inspection of anchors cast in concrete.	Shop (3) and Field Inspection	Y	Periodic	1	

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4. Inspection of anchors post-installed in hardened concrete members per research reports, or if no specific requirements are provided, requirements shall be provided by the registered design professional and approved by the building official, including verification of anchor type, anchor dimensions, hole dimensions, hole cleaning procedures, anchor spacing, edge distances, concrete minimum thickness, anchor embedment, and tightening torque.	Field Inspection		Periodic or as required by the research report issued by an approved source		
a. Adhesive anchors installed in horizontal or upward-inclined orientation that resists sustained tension loads.		Y	Continuous	1	
b. Mechanical and adhesive anchors not defined in 4.a.		Y	Periodic	1	
5. Verify use of approved design mix.	Shop (3) and Field Inspection	Y	Periodic	1	
6. Prior to placement, fresh concrete sampling, perform slump and air content tests, determine temperature of concrete, and perform any other tests as specified in construction documents.	Shop (3) and Field Inspection	Y	Continuous	1	
7. Inspection of concrete and shotcrete placement for proper application techniques.	Shop (3) and Field Inspection	Y	Continuous	1	
8. Verify maintenance of specified curing temperature and techniques.	Shop (3) and Field Inspection	Y	Periodic	1	
9. Inspection of prestressed concrete:	Shop (3) and Field Inspection				
a. Application of prestressing force.		N	Continuous		
b. Grouting of bonded prestressing tendons.		N	Continuous		
10. Inspect erection of precast concrete members.		N	Periodic		
11. Verification of in-situ concrete strength prior to stressing of tendons in post-tensioned concrete and prior to removal of shores and forms from beams and structural slabs.	Review Field Testing and Laboratory Reports	N	Periodic		
12. Inspection of formwork for shape, lines, locations, and dimensions.	Field Inspection	Y	Periodic	1	
13. Concrete strength testing and verification of compliance with construction documents.	Field Testing and Review of Laboratory Reports	Y	Periodic	1	

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<b>1705.4 Masonry Construction</b>					
<b>(A) Level 1, 2, and 3 Quality Assurance</b>					
1. Prior to construction, verification of compliance of submittals.	Submittal Review	Y	Each Submittal	1	
<b>(B) Level 2 and 3 Quality Assurance:</b>					
1. Prior to construction, verification of $f'_m$ and $f'_{AAC}$ except where specifically required by the code.	Testing by Unit Strength Method or Prism Test Method	N	Periodic		
2. During construction, verification of slump flow and visual stability index (VSI) when self-consolidating grout is delivered to the project site.	Field Testing	N	Periodic		
3. Verify the following comply prior to the start of masonry construction:					
a. Proportions of the site-prepared mortar.	Field Inspection	N	Periodic		
b. Grade and size of prestressing tendons and anchorages.	Field Inspection	N	Periodic		
c. Grade, type, and size of reinforcement, anchor bolts, prestressing tendons, and prestressing anchorages.	Field Inspection	N	Periodic		
d. Prestressing technique.	Field Inspection	N	Periodic		
e. Properties of thin-bed mortar for AAC masonry.  <i>(Level 2: Continuous for first 5000 SF and periodic after)</i>	Field Inspection	N	Level 2: Continuous*		
		N	Level 3: Continuous		
f. Sample panel construction.	Field Inspection	N	Level 2: Periodic		
		N	Level 3: Continuous		
4. Verify the following comply prior to grouting:					
a. Grout space.	Field Inspection	N	Level 2: Periodic		
		N	Level 3: Continuous		
b. Placement of prestressing tendons and anchorages.	Field Inspection	N	Periodic		
c. Placement of reinforcement, connectors, and anchor bolts.	Field Inspection	N	Level 2: Periodic		
		N	Level 3: Continuous		
d. Proportions of site-prepared grout and prestressing grout for bonded tendons.	Field Inspection	N	Periodic		
5. Verify compliance of the following during construction:					
a. Materials and procedures with the approved submittal.	Field Inspection	N	Periodic		
b. Placement of masonry units and mortar joint construction.	Field Inspection	N	Periodic		
c. Size and location of structural members.	Field Inspection	N	Periodic		

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<b>(B) Level 2 and 3 Quality Assurance (Continued):</b>					
d. Type, size, anchor location, and other details of anchorage of masonry to structural members, frames, or other construction.	Field Inspection	N	Level 2: Periodic		
		N	Level 3: Continuous		
e. Welding of reinforcement.	Field Inspection	N	Continuous		
f. Preparation, construction, and protection of masonry during cold weather (temperature below 40°F) or hot weather (temperature above 90°F).	Field Inspection	N	Periodic		
g. Application and measurement of prestressing force.	Field Testing	N	Continuous		
h. Placement of grout and prestressing grout for bonded tendons is in compliance.	Field Inspection	N	Continuous		
i. Placement of AAC masonry units and construction of thin-bed mortar joints.  <i>(Level 2: Continuous for first 5000 SF and periodic after)</i>	Field Inspection	N	Level 2: Continuous*		
		N	Level 3: Continuous		
j. Observe preparation of grout specimens, mortar specimens, and/or prisms.	Field Inspection	N	Level 2: Periodic		
		N	Level 3: Continuous		
<b>(C) Level 3 Quality Assurance:</b>					
1. During construction, verification of $f_m$ and $f_{AAC}$ for every 5000 SF.	Testing by Unit Strength Method or Prism Test Method	N	Periodic		
2. During construction, verification of proportions of materials as delivered to the project site for premixed or preblended mortar, prestressing grout, and grout other than self-consolidating grout.	Field Inspection	N	Periodic		

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<b>1705.5 Wood Construction</b>					
1. For prefabricated wood structural elements, inspection of the fabrication process and assemblies in accordance with Section 1704.2.5.	In-Plant Review (3)	N	Periodic		
2. For high-load diaphragms, verify grade and thickness of structural panel sheathing agree with approved building plans.	Field Inspection	N	Periodic		
3. For high-load diaphragms, verify nominal size of framing members at adjoining panel edges, nail or staple diameter and length, number of fastener lines, and that spacing between fasteners in each line and at edge margins agree with approved building plans.	Field Inspection	N	Periodic		
4. Metal-plate-connected wood trusses:					
a. For trusses with heights greater than or equal to 60-inches: verify permanent individual truss member restraint/bracing has been installed in accordance with the approved truss submittal package.	Field Inspection	N	Periodic		
b. For trusses spanning 60-feet or greater: verify temporary and permanent restraint/bracing are installed in accordance with the approved truss submittal package.	Field Inspection	N	Periodic		

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<b>1705.6 Soils</b>					
1. Verify materials below shallow foundations are adequate to achieve the design bearing capacity.	Field Inspection	Y	Periodic	1	
2. Verify excavations are extended to proper depth and have reached proper material	Field Inspection	Y	Periodic	1	
3. Perform classification and testing of compacted fill materials	Field Inspection	Y	Periodic	1	
4. Verify use of proper materials, densities, and lift thicknesses during placement and compaction of controlled fill	Field Inspection	Y	Continuous	1	

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5. Prior to placement of controlled fill, inspect subgrade and verify that site has been prepared properly.	Field Inspection	Y	Periodic	1	
<b>1705.7 Driven Deep Foundations</b>					
1. Verify element materials, sizes, and lengths comply with requirements	Field Inspection	N	Continuous		
2. Determine capacities of test elements and conduct additional load tests as required.	Field Inspection	N	Continuous		
3. Inspect driving operations and maintain complete and accurate records for each element	Field Inspection	N	Continuous		
4. Verify placement locations and plumbness, confirm type and size of hammer, record number of blows per foot of penetration, determine required penetrations to achieve design capacity, record tip and butt elevations, and document any damage to foundation elements.	Field Inspection	N	Continuous		
5. For steel elements, perform additional inspections per Section 1705.2.	See IBC Section 1705.2	N	See IBC Section 1705.2		
6. For concrete elements and concrete-filled elements, perform tests and additional inspections per Section 1705.3.	See IBC Section 1705.3	N	See IBC Section 1705.3		
7. For specialty elements, perform additional inspections as determined by the registered design professional in responsible charge.	Field Inspection	N	In Accordance with Construction Documents		
<b>1705.8 Cast-in-Place Deep Foundations</b>					
1. Inspect drilling operations and maintain complete and accurate records for each element.	Field Inspection	N	Continuous		
2. Verify placement locations and plumbness, confirm element diameters, bell diameters (if applicable), lengths, embedment into bedrock (if applicable), and adequate end-bearing strata capacity. Record concrete or grout volumes.	Field Inspection	N	Continuous		
3. For concrete elements, perform tests and additional inspections per Section 1705.3.	See IBC Section 1705.3	N	See IBC Section 1705.3		
<b>1705.9 Helical Pile Foundations</b>					
1. Verify installation equipment, pile dimensions, tip elevations, final depth, final installation torque, and other installation data as required by construction documents.	Field Inspection	N	Continuous		



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<b>1705.10 Fabricated Items</b>					
1. List of fabricated items requiring special inspection during fabrication:	Shop Inspection		As noted in each applicable shop activity		
a. None					
2. List of fabricated items to be fabricated on the premises of a fabricator approved to perform such work without special inspection (including name of approved agency providing periodic audit)					
a. None					

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<b>1705.11.1 Structural Wood Special Inspections for Wind Resistance</b>					
1. Inspection of field gluing operations of elements of the main windforce-resisting system.	Field Inspection	N	Continuous		
2. Inspection of nailing, bolting, anchoring, and other fastening of components within the main windforce-resisting system, including wood shear walls, wood diaphragms, drag struts, braces, and hold-downs.	Shop (3) and Field Inspection	N	Periodic		
<b>1705.11.2 Cold-Formed Steel Special Inspections for Wind Resistance</b>					
1. Inspection during welding operations of elements of the main windforce-resisting system.	Shop (3) and Field Inspection	N	Periodic		
2. Inspection of screw attachment, bolting, anchoring, and other fastening of components within the main windforce-resisting system, including shear walls, braces, diaphragms, collectors (drag struts), and hold-downs.	Shop (3) and Field Inspection	N	Periodic		
<b>1705.11.3 Wind-Resisting Components</b>					
1. Roof covering, roof deck, and roof framing connections.	Shop (3) and Field Inspection	N	Periodic		
2. Exterior wall covering and wall connections to roof and floor diaphragms.	Shop (3) and Field Inspection	N	Periodic		

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<b>1705.12.1 Structural Steel Special Inspections for Seismic Resistance</b>					
1. Seismic force-resisting systems in SDC B, C, D, E, or F.	Shop (3) and Field Inspection	N	In Accordance with AISC 341		
2. Structural steel elements in SDC B, C, D, E, or F other than those in Item 1, including struts, collectors, chords, and foundation elements.	Shop (3) and Field Inspection	N	In Accordance with AISC 341		
<b>1705.12.2 Structural Wood Special Inspections for Seismic Resistance</b>					
1. Field gluing operations of elements of the seismic force-resisting system for SDC C, D, E, or F.	Field Inspection	N	Continuous		
2. Nailing, bolting, anchoring, and other fastening of components within the seismic force-resisting system, including wood shear walls, wood diaphragms, drag struts, shear panels, and hold-downs for SDC C, D, E, or F.	Shop (3) and Field Inspection	N	Periodic		

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<b>1705.12.3 Cold-Formed Steel Light-Frame Construction Special Inspections for Seismic Resistance</b>					
1. Welding operations of elements of the seismic force-resisting system for SDC C, D, E, or F.	Shop (3) and Field Inspection	N	Periodic		
2. Screw attachment, bolting, anchoring, and other fastening of components within the seismic force-resisting system, including shear walls, braces, diaphragms, collectors (drag struts), and hold-downs for SDC C, D, E, or F.	Shop (3) and Field Inspection	N	Periodic		
<b>1705.12.4 Designated Seismic Systems Verification Special Inspections for Seismic Resistance</b>					
1. For SDC C, D, E, or F, inspect and verify the component label and anchorage or mounting conforms to the certificate of compliance in accordance with ASCE 7, Section 13.2.2.	Field Inspection	N	Periodic		
<b>1705.12.5 Architectural Components Special Inspection for Seismic Resistance</b>					
1. For SDC D, E, or F, inspection during the erection and fastening of exterior cladding and interior or exterior veneer more than 30-feet above grade or walking surface and weighing more than 5 psf.	Field Inspection	N	Periodic		
2. For SDC D, E, or F, inspection during the erection and fastening of interior nonbearing walls more than 30-feet above grade or walking surface and weighing more than 15 psf.	Field Inspection	N	Periodic		
3. For SDC D, E, or F, inspection during the erection and fastening of exterior nonbearing walls more than 30-feet above grade or walking surface.	Field Inspection	N	Periodic		
4. For SDC D, E, or F, inspection during anchorage of access floors.	Field Inspection	N	Periodic		
<b>1705.12.6 Plumbing, Mechanical, &amp; Electrical Components Special Inspection for Seismic Resistance</b>					
1. Inspection during the anchorage of electrical equipment for emergency or standby power systems in SDC C, D, E, or F.	Field Inspection	Y	Periodic	1	
2. Inspection during the anchorage of other electrical equipment in SDC E or F.	Field Inspection	N	Periodic		
3. Inspection during the installation and anchorage of piping systems designed to carry hazardous materials, and their associated mechanical units in SDC C, D, E, or F.	Field Inspection	N	Periodic		
4. Inspection during the installation and anchorage of HVAC ductwork designed to contain hazardous materials in SDC C, D, E, or F.	Field Inspection	N	Periodic		

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5. Inspection during the installation and anchorage of vibration isolation systems in SDC C, D, E, or F where nominal clearance of 1/4-inch or less is required by the approved construction documents.	Field Inspection	N	Periodic		
6. Inspection during the installation of mechanical and electrical equipment, including ductwork, piping systems, and their structural supports, where automatic fire sprinkler systems are installed in structures assigned to SDC C, D, E, or F to verify one of the following unless flexible sprinkler hose fittings are used:					
a. ASCE/SEI 7, Section 13.2.3 minimum required clearances have been provided.	Field Inspection	Y	Periodic	1	
b. A 3-inch or greater nominal clearance has been provided between fire protection sprinkler system drops and sprigs and structural members not used collectively or independently to support the sprinklers, equipment attached to the building structure, and other systems' piping.	Field Inspection	Y	Periodic	1	
<b>1705.12.7 Storage Racks Special Inspections for Seismic Resistance</b>					
1. Inspection during the anchorage of storage racks 8-feet or greater in height in structures assigned to SDC D, E, or F.	Field Inspection	N	Periodic		
<b>1705.12.8 Seismic Isolation Systems</b>					
1. Inspection during the fabrication and installation of isolator units and energy dissipation devices used as part of the seismic isolation system in structures assigned to SDC B, C, D, E, or F.	Shop and Field Inspection	N	Periodic		
<b>1705.12.9 Cold-Formed Steel Special Bolted Moment Frames</b>					
1. Inspection of installation of cold-formed steel special bolted moment frames in the seismic force-resisting systems in structures assigned to SDC D, E, or F.	Field Inspection	N	Periodic		

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<b>1705.13.1 Structural Steel Testing for Seismic Resistance</b>					
1. Nondestructive testing of structural steel in the seismic force-resisting systems in accordance with AISC 341, in structures assigned to SDC B, C, D, E, or F.	Field Test	N	Periodic		
2. Nondestructive testing of structural steel elements in the seismic force-resisting systems not covered in Item 1 above, including struts, collectors, chords, and foundation elements in accordance with AISC 341 in structures assigned to SDC B, C, D, E, or F.	Field Test	N	Periodic		
<b>1705.13.2 Seismic Certification of Nonstructural Components</b>					
1. Review certificate of compliance for nonstructural components in structures assigned to SDC B, C, D, E, or F.	Certificate of Compliance Review	Y	Each Submittal	1	
<b>1705.13.3 Seismic Certification of Designated Seismic Systems</b>					
1. Review certificate of compliance for designated seismic system components in structures assigned to SDC C, D, E, or F.	Certificate of Compliance Review	N	Each Submittal		
<b>1705.13.4 Seismic Isolation Systems</b>					
1. Test seismic isolation system in accordance with ASCE 7, Section 17.8 in structures assigned to SDC B, C, D, E, or F.	Prototype Testing	N	Per ASCE 7		

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<b>1705.14 Sprayed Fire-resistant Materials</b>					
1. Verify surface condition preparation of structural members.	Field Inspection	N	Periodic		
2. Verify minimum thickness of sprayed fire-resistant materials applied to structural members.	Field Inspection	N	Periodic		
3. Verify density of the sprayed fire-resistant material complies with approved fire-resistant design.	Field Inspection and Testing	N	Per IBC Section 1705.14.5		
4. Verify the cohesive/adhesive bond strength of the cured sprayed fire-resistant material.	Field Inspection and Testing	N	Per IBC Section 1705.14.6		
5. Condition of finished application.	Field Inspection	N	Periodic		

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<b>1705.15 Mastic and Intumescent Fire-resistant Coatings</b>					
1. Inspect and test mastic and intumescent fire-resistant coatings applied to structural elements and decks per AWCI 12-B.	Field Inspection and Testing	N	Periodic		
<b>1705.16 Exterior Insulation and Finish Systems (EIFS)</b>					
1. Inspection of water-resistive barrier over sheathing substrate.	Field Inspection	N	Periodic		
<b>1705.17 Fire-resistance Penetrations and Joints</b>					
1. Inspect penetration firestop.	Field Testing	N	Per ASTM E2174		
2. Inspect fire-resistant joint systems.	Field Testing	N	Per ASTM E2393		
<b>1705.18 Smoke Control Systems</b>					
1. Leakage testing and recording of device locations prior to concealment.	Field Testing	N	Periodic		
2. Prior to occupancy and after sufficient completion, pressure difference testing, flow measurements, and detection and control verification.	Field Testing	N	Periodic		
<b>*INSPECTION AGENTS</b>					
<b>FIRM</b>	<b>ADDRESS</b>		<b>TELEPHONE NUMBER</b>		
1. Independent Testing Agency	TBD		TBD		
<p>Notes:</p> <ul style="list-style-type: none"> <li>(1) The inspection and testing agent(s) shall be engaged by the Owner or the Owner's Agent, and not by the Contractor or Subcontractor whose work is to be inspected or tested. Any conflict of interest must be disclosed to the Building Official prior to commencing work. The qualifications of the Special Inspector(s) and/or testing agencies may be subject to the approval of the Building Official and/or the Design Professional.</li> <li>(2) The list of Special Inspectors may be submitted as a separate document, if noted above.</li> <li>(3) Shop inspections of fabricated items are not required where the fabricator is approved in accordance with IBC Section 1704.2.5.1 and listed in activity 1709.2.</li> <li>(4) Observe: Observe on a random basis, operations need not be delayed pending these inspections. Perform: These tasks shall be performed for each welded joint, bolted connection, or steel element.</li> <li>(5) NDT of welds completed in an approved fabricator's shop may be performed by that fabricator when approved by the AHJ. Refer to AISC 360, N6.</li> </ul>					
Are Special Inspections for Wind Resistance included in the Statement of Special Inspections?				<b>NO</b>	
Are Special Inspections for Seismic Resistance included in the Statement of Special Inspections?				<b>YES</b>	
				DATE:	14 July 2023

# FINAL REPORT OF SPECIAL INSPECTIONS

**PROJECT:** Brookhaven PD Building Renovation

**LOCATION:** 2665 Buford Highway NE, Brookhaven, Georgia 30324

**PERMIT APPLICANT:** \_\_\_\_\_

**PERMIT APPLICANT'S ADDRESS:** \_\_\_\_\_

**ARCHITECT OF RECORD:** Roger Godwin, RA (HLGstudio)

**STRUCTURAL ENGINEER OF RECORD:** Eric D. Blackmore, PE, SE (Wallace Design Collective)

**MECHANICAL ENGINEER OF RECORD:** Jesse W. Foley, PE (AHA Consulting Engineers)

**ELECTRICAL ENGINEER OF RECORD:** Onogre L. Mayuga, PE (AHA Consulting Engineers)

**REGISTERED DESIGN PROFESSIONAL IN RESPONSIBLE CHARGE:** Roger Godwin, RA

To the best of my information, knowledge, and belief, which are based upon observations or diligent supervision of our inspection services for the above-referenced Project, I hereby state that the special inspections or testing required for this Project and designated for this Agent in the *Schedule of Special Inspection Services*, have been completed in accordance with the Contract Documents.

The Special Inspection program does not relieve the Contractor of the responsibility to comply with the Contract Documents. Jobsite safety and means and methods of construction are solely the responsibility of the Contractor.

Interim reports submitted prior to this final report and numbered \_\_\_\_\_ to \_\_\_\_\_ for a basis for and are considered to be an integral part of this final report. The following discrepancies that were outstanding since the last interim report dated \_\_\_\_\_ have been corrected:

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(Attach 8½" x 11" continuation sheet(s) if required to complete the description of corrections)

Prepared by:

\_\_\_\_\_  
Special Inspection Agent/Firm

\_\_\_\_\_  
Type or Print Name

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Date







**SECTION 01 45 25 – STRUCTURAL AND SPECIAL INSPECTION/TESTING AGENCY SERVICES****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Administrative and procedural requirements for structural inspections and tests related to quality assurance and quality control.
  - 2. Administrative and procedural requirements for special inspections and tests related to quality assurance and quality control.
- B. Special inspection and testing services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
  - 1. Specific quality-assurance and quality-control requirements for individual work results are specified in their respective specification sections. Requirements in individual Sections may also cover production of standard products.
  - 2. Specified inspections, tests, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
- C. Related Requirements:
  - 1. Section 01 33 00 – Submittal Procedures.
  - 2. Section 01 33 30 – Structural Submittal Procedures.
  - 3. Section 01 40 00 – Quality Requirements.

**1.2 REFERENCE STANDARDS**

- A. American Council of Independent Laboratories (ACIL):
  - 1. National Cooperation for Laboratory Accreditation (NACLA)
- B. ASTM International (ASTM):
  - 1. ASTM E329 – Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.
- C. National Institute of Standards and Technology (NIST):
  - 1. National Voluntary Laboratory Accreditation Program (NVLAP).

**1.3 DEFINITIONS**

- A. Special Inspection: Inspection of construction requiring the expertise of an approved special inspector in order to ensure compliance with the building code and the approved Construction Documents.
  - 1. Continuous Special Inspection: Special Inspection by the Special Inspector who is present continuously when and where the work to be inspected is being performed.
  - 2. Periodic Special Inspection: Special Inspection by the Special Inspector who is intermittently present where the work to be inspected has been or is being performed.
- B. Special Inspector: A qualified person employed or retained by an approved Inspection/Testing Agency having the competence necessary to inspect a particular type of construction requiring Special Inspection.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Special Inspection/Testing Agency Qualifications: Documentation of the qualifications for the Special Inspection/Testing Agency and for each Special Inspector assigned to the Project.
1. Identify names and qualifications of each technician, inspector, or engineer working on the Project.
  2. Identify what tests and inspections each technician, inspector, or engineer is responsible for conducting.
- B. Contractor's Statement of Responsibility: Signed and dated "Contractor's Statement of Responsibility" for each contractor responsible for the construction or fabrication of main windforce-resisting system, seismic force-resisting system, designated seismic system, or wind/seismic resisting component listed in the "Statement of Special Inspections" (including where applicable "Special Inspections for Wind Resistance" and "Special Inspections for Seismic Resistance"). Include the following minimum information:
1. Project name.
  2. Contractor's/Subcontractor's name and address.
  3. Contractor's/Subcontractor's license number.
  4. Description of building system and components covered.
- C. Fabricator's Certificate of Compliance: Signed and dated "Fabricator's Certificate of Compliance" for each approved fabricator that is exempt from Special Inspection of shop fabrication and implementation procedures. Include the following minimum information:
1. Project name.
  2. Fabricator's name and address.
  3. Certification or approval agency and certification number.
  4. Date of last audit or approval.
  5. Description of the fabricated structural members and assemblies covered.
- D. Special Inspection Daily Reports: Written, signed Special Inspection Daily Reports. Include the following minimum information:
1. Project name and location.
  2. Name of Special Inspection/Testing Agency and Special Inspector conducting the service.
  3. Date and time of service.
  4. Description of services, inspections, and tests made including whether coverage was continuous or periodic and location where applicable.
  5. Any deficiencies or discrepancies in the test or inspection.
  6. Any deficiencies or discrepancies corrected.
- E. Special Inspection Interim Reports: Written, signed special inspection interim reports at the frequency specified in the "Statement of Special Inspections." Include the following minimum information:
1. Project name and location.
  2. Report number
  3. Name of Special Inspection/Testing Agency and Special Inspector conducting the service.
  4. Date and time of service.
  5. Description of services, inspections, and tests made including whether coverage was continuous or periodic and location where applicable.
  6. Any deficiencies or discrepancies in the test or inspection.
  7. Any deficiencies or discrepancies corrected since the last interim report.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Final Report of Special Inspections: Submit a signed Final Report of Special Inspections. Include the following minimum information:
1. Project Name and Location.
  2. Name of Special Inspection/Testing Agency.
  3. Name and signature of the Special Inspection/Testing Agency representative completing the report.

4. Any prior Interim Special Inspection Reports considered to be integral to the Final Report.
5. A list of deficiencies or discrepancies corrected since the final Interim Special Inspection Report.

## 1.6 SPECIAL INSPECTION DOCUMENTS

- A. Statement of Special Inspections: Prepared by the Design Professional and identifying the following information:
  1. Project name and location.
  2. Registered Design Professional in Responsible Charge
  3. Frequency of interim report submittals.
  4. If Special Inspections for Wind Resistance are required.
  5. If Special Inspections for Seismic Resistance are required.
- B. Special Inspections for Wind Resistance: Prepared by the Design Professional and identifying the following information:
  1. Description of main windforce-resisting systems subject to special inspections for wind resistance.
  2. Description of wind force-resisting components subject to special inspections for wind resistance.
- C. Special Inspections for Seismic Resistance: Prepared by the Design Professional and identifying the following information:
  1. Description of seismic force-resisting system subject to special inspection and testing for seismic resistance.
  2. Description of designated seismic systems subject to special inspection and testing for seismic resistance.
  3. Description of additional seismic systems and components requiring special inspection.
  4. Description of additional seismic systems and components requiring testing.
- D. Schedule of Special Inspection Services: Prepared by the Design Professional identifying the following items:
  1. Materials, systems, components, and work required to have special inspections or tests.
  2. Type and extent of each special inspection
  3. Type and extent of each test.
  4. Identification if each special inspection will be continuous or periodic.
  5. Agent responsible for the test or inspection

## 1.7 STRUCTURAL INSPECTION/TESTING REQUIREMENT SUMMARY

- A. Specific structural Inspection/Testing requirements are given in the following specification sections:
  1. Division 03:
    - a. Section 03 10 00 – Concrete Forming and Accessories.
    - b. Section 03 20 00 – Concrete Reinforcing.
    - c. Section 03 30 00 – Cast-in-Place Concrete.
  2. Division 04:
    - a. Section 04 16 01 – Structural Post-Installed Masonry Anchoring.
  3. Division 05:
    - a. Section 05 12 00 – Structural Steel Framing.
  4. Division 31:
    - a. Section 31 23 01 – Excavation and Fill for Structures.

## 1.8 QUALITY ASSURANCE

- A. Structural Inspection/Testing Agency Qualifications: An NVLAP accredited, an NACLA accredited, or an independent agency with the experience and capability to conduct inspection and testing indicated as documented in accordance with ASTM E329, and with additional qualifications specified; and where required by the Authority Having Jurisdiction (AHJ), that is acceptable to that AHJ.

- B. Special Inspector Qualifications: Individual Special Inspectors of the Special Inspection/Testing Agencies with competence and relevant experience or training for the tests and inspections to which they are assigned. Experience or training shall be considered to be relevant where the documented experience or training is related in complexity to the same type of special inspection or testing activities for projects of similar complexity and material qualities. These qualifications are in addition to qualifications specified in other sections of the Building Code and any applicable amendments.

## 1.9 QUALITY CONTROL

- A. Owner Responsibilities: The Owner will engage a qualified Special Inspection/Testing Agency to perform the required Special Inspections.
1. Owner will furnish Contractor with names, addresses, and telephone numbers of the Special Inspection/Testing Agencies engaged and a description of types of testing and inspection they are engaged to perform.
  2. Owner will transmit the qualifications of the selected Special Inspection/Testing Agency and Special Inspectors to the Registered Design Professional in Responsible Charge for review and comment.
- B. Contractor Responsibilities:
1. Cooperate with Special Inspection/Testing Agencies and their personnel performing required tests and inspections.
  2. Provide reasonable auxiliary services as requested by the Special Inspection/Testing Agencies and their personnel.
  3. Notify agency sufficiently in advance of operations to permit assignment of personnel.
  4. Provide access to the Work.
  5. Provide incidental labor and facilities necessary to facilitate tests and inspections.
  6. Provide adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
  7. Provide facilities for storage and field curing of test samples.
  8. Provide preliminary design mix proposed for use for material mixes that require control by testing agency.
  9. Provide mill test reports when requested.
  10. Provide security and protection for samples and for testing and inspection equipment at Project site.
  11. Provide a copy of the Contract Documents to the Special Inspection/Testing Agencies.
  12. Submit Fabricator's Certificate of Compliance for structural, load-bearing or lateral load-resisting members or assemblies fabricated on the premises of an approved fabricator.
  13. Submit Certificate of compliance for the seismic qualification of nonstructural components, supports, and attachments identified in the Statement of Special Inspections and the Schedule of Special Inspections.
  14. Submit Certificates of compliance for designated seismic systems identified in the Statement of Special Inspections.
  15. Costs for retesting and reinspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to Contractor.
  16. Costs for any additional inspection/testing required for the Contractor's convenience are the Contractor's responsibility.
- C. Special Inspection/Testing Agency Responsibilities:
1. Verify that manufacturer maintains detailed fabrication and quality-control procedures, and reviewing the completeness and adequacy of those procedures to perform the Work.
  2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
  3. Notify the Design Professional in Responsible Charge and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.

4. Submit a certified written Special Inspection Daily Reports of each test, inspection, and similar quality-control service to the Registered Design Professional in Responsible Charge with copy to Contractor and to authorities having jurisdiction.
5. Submit certified written Special Inspection Interim Reports at the frequency specified in the "Statement of Special Inspections" to the Registered Design Professional in Responsible Charge with copy to Contractor and to authorities having jurisdiction.
6. Submit a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies to the Registered Design Professional in Responsible Charge with copy to Contractor and to authorities having jurisdiction.
7. Maintain a log of discrepancies in tests and inspections. Periodically update this log with corrective actions and Inspection/Testing of those corrective actions.
8. Interpret tests and inspections. State in each report whether tested and inspected Work complies with or deviates from the Contract Documents.
9. Leave copies of special inspector field notes with the Contractor prior to leaving the construction site. Field notes shall include the following information:
  - a. Name of the Inspection/Testing Agency's representative.
  - b. Message given to the Contractor
  - c. Date and time of message.
  - d. Name of the Contractor's representative informed.
  - e. Type and location of work or materials tested/inspected.
  - f. Determination if the work or materials complied with the Contract Documents.
10. Comply with Contractor's site access requirements and procedures.
11. Retesting and reinspecting corrected Work.
12. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
13. Do not perform duties of Contractor.

- D. Options: If the Special Inspection/Testing Agency is located sufficiently far from the Project that travel expenses will be a consideration, or if the amount of sampling performed is minor, and by mutual agreement of the Design Professional in Responsible Charge and the Contractor, the Contractor may be requested to take samples and forward them to the Special Inspection/Testing Agency for testing and inspection.

## PART 2 - PRODUCTS

NOT USED

## PART 3 - EXECUTION

### 3.1 REPAIR AND PROTECTION

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

## END OF SECTION 01 45 25

### STATEMENT OF SPECIAL INSPECTIONS

**PROJECT:** Brookhaven PD Building Renovation

**LOCATION:** 2665 Buford Highway NE, Brookhaven, Georgia 30324

**PERMIT APPLICANT:** \_\_\_\_\_

**PERMIT APPLICANT'S ADDRESS:** \_\_\_\_\_

**ARCHITECT OF RECORD:** Roger Godwin, RA (HLGstudio)

**STRUCTURAL ENGINEER OF RECORD:** Eric D. Blackmore, PE, SE (Wallace Design Collective)

**MECHANICAL ENGINEER OF RECORD:** Jesse W. Foley, PE (AHA Consulting Engineers)

**ELECTRICAL ENGINEER OF RECORD:** Onogre L. Mayuga, PE (AHA Consulting Engineers)

**REGISTERED DESIGN PROFESSIONAL IN RESPONSIBLE CHARGE:** Roger Godwin, RA

This *Statement of Special Inspections* is submitted in accordance with Section 1704.3 of the 2018 International Building Code. It includes a *Schedule of Special Inspection Services* applicable to the above-referenced Project as well as the identity of the individuals, agencies, or firms intended to be retained for conducting these inspections. If applicable, it includes *Special Inspections for Wind Resistance* and/or *Special Inspections for Seismic Resistance*.

Are *Special Inspections for Wind Resistance* included in the *Statement of Special Inspections*? NO  
Are *Special Inspections for Seismic Resistance* included in the *Statement of Special Inspections*? YES

The Special Inspector(s) shall keep records of all inspections and shall furnish interim inspection reports to the Building Official and to the Registered Design Professional in Responsible Charge at a frequency agreed upon by the Design Professional and the Building Official prior to the start of work. Discrepancies shall be brought to the immediate attention of the Contractor for correction. If the discrepancies are not corrected, the discrepancies shall be brought to the attention of the Building Official and the Registered Design Professional in Responsible Charge prior to completion of that phase of work. A *Final Report of Special Inspections* documenting required special inspections and corrections of any discrepancies noted in the inspections shall be submitted to the Building Official and the Registered Design Professional in Responsible Charge at the conclusion of the project.

Frequency of interim report submittals to the Registered Design Professional in Responsible Charge:

Weekly       Bi-Weekly       Monthly       Other; specify: \_\_\_\_\_

Frequency of interim report submittals to the Building Official:

Monthly       Bi-Monthly       Upon Completion       Other; specify: \_\_\_\_\_

The Special Inspection Program does not relieve the Contractor of the responsibility to comply with the Contract Documents. Jobsite safety and means and methods of construction are solely the responsibility of the Contractor.

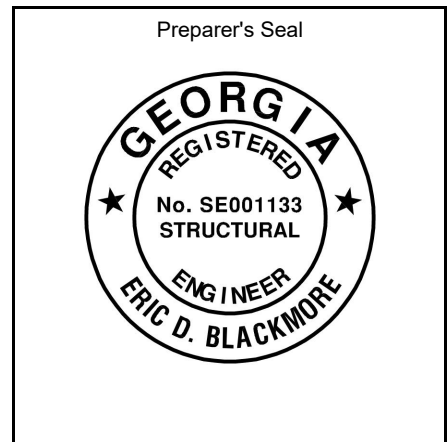
Statement of Special Inspections Prepared by:

Eric D. Blackmore  
Type or print name  
*Eric D. Blackmore*      28 April 2023  
Signature      Date

Building Officials Acceptance:

\_\_\_\_\_  
Signature      Date

Permit Number: \_\_\_\_\_



## **SPECIAL INSPECTIONS FOR WIND RESISTANCE**

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See the *Schedule of Special Inspections* for inspection and testing requirements

**Allowable Stress Design Wind Speed:** **V<sub>asd</sub> = 83 m.p.h.**

**Wind Exposure Category:** **Category B**

**Special Inspection for Wind Resistance Required:** **NO**

(Required in Wind Exposure Category B, where the Allowable Stress Design Wind Speed (V<sub>asd</sub>) is 120 miles-per-hour or greater. Required in Wind Exposure Category C or D, where the Allowable Stress Design Wind Speed (V<sub>asd</sub>) is 110 miles-per-hour or greater.)

**Description of structural wood and cold-formed steel light-frame construction, main windforce-resisting system subject to special inspections for wind resistance:**

(Required for systems noted in IBC Section 1705.11.1 and 1705.11.2.)

None

**Description of wind force-resisting components subject to special inspections for wind resistance:**

(Required for systems and components noted in IBC Section 1705.11.3.)

None

**Statement of Responsibility:**

Each contractor responsible for the construction or fabrication of a system or component described above must submit a *Contractor's Statement of Responsibility*.



## SPECIAL INSPECTIONS FOR SEISMIC RESISTANCE

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See the *Schedule of Special Inspections* for inspection and testing requirements

**Seismic Design Category:** SDC C

**Special Inspection for Seismic Resistance Required:** YES

**Description of seismic force-resisting system subject to special inspection and testing for seismic resistance:**

(Required for systems noted in IBC Section 1705.12.1, 1705.12.2, and 1705.12.3. Special inspections for seismic resistance of structural steel, where required, shall be in accordance with AISC 341.)

None

**Description of designated seismic systems subject to special inspection and testing for seismic resistance:**

(Required for architectural, electrical, and mechanical systems and their components that require design in accordance with ASCE 7, Chapter 13, have a component importance factor ( $I_p$ ) greater than one and are in Seismic Design Category C, D, E, or F.)

None

**Description of additional seismic systems and components requiring special inspections:**

(Required for systems noted in IBC Section 1705.12.5, 1705.12.6, 1705.12.7, and 1705.12.8.)

1. Anchorage of electrical equipment for emergency and standby power systems
2. Verify installation clearances of mechanical and electrical, including duct work, piping systems, and their structural supports meet one of the following: a) minimum clearances per Section 13.2.3 of ASCE/SEI 7, or b) nominal minimum clearance of 3 inches between sprinkler system drops and springs and sprinkler supports do not support other systems.

**Description of additional seismic systems and components requiring testing:**

(Required for systems and components noted in IBC Section 1705.12.13.)

Certificate of Compliance for Canopy System

**Statement of Responsibility:**

Each contractor responsible for the construction or fabrication of a system or component described above must submit a *Contractor's Statement of Responsibility*.

SCHEDULE OF SPECIAL INSPECTION SERVICES					
PROJECT	Brookhaven PD Building Renovation				
MATERIAL / ACTIVITY	SERVICE	APPLICABLE TO THIS PROJECT			
		Y/N	EXTENT	AGENT*	DATE COMPLETED
<b>1705.1.1 Special Cases</b>					
(work unusual in nature, including but not limited to alternative materials and systems, unusual design applications, materials, and systems with special manufacturer's requirements – add additional rows as needed)	Submittal Review, Shop (3) and/or Field Inspection				
1. Inspection of anchors post-installed in solid grouted masonry: Per research reports including verification of anchor type, anchor dimensions, hole dimensions, hole cleaning procedures, anchor spacing, edge distances, masonry unit, grout, masonry compressive strength, anchor embedment, and tightening torque.	Field Inspection	Y	Periodic or as required by the research report issued by an approved source	1	
2. Aggregate Pier Inspection:					
a. Before installation: Review of the aggregate pier designer's use of soil parameters as presented in the project soils report.	Submittal Review	N	Each Submittal		
b. During installation: Verification of aggregate properties, type and number of lifts of aggregate, hole size and depth, top elevations of the pier elements, and applied energy.	Field Inspection	N	Periodic or as required by the research report issued by an approved source		
c. After installation: Review of the results of qualitative tests on production aggregate pier elements such as modulus load testing, uplift pull-out testing, and dynamic cone penetration tests for compliance with the design specifications.	Review of Field Testing	N	Periodic		
3. Fall Arrest System Inspection:					
a. Prior to testing, visual inspection of welded and bolted connections of manufacturer hardware to support structure.	Field Inspection	N	Periodic		
b. Prior to testing, verification of support elements and bracing elements installed in accordance with Structural Documents.	Field Inspection	N	Periodic		
c. System testing and commissioning: Observation of testing procedures in accordance with the manufacturer's testing protocol. Record testing apparatus used, verify calibration of load measuring devices, record maximum test load attained and deflection of top of each anchor at maximum test load (relative to a fixed point).	Observation of Field Testing	N	Continuous		

SCHEDULE OF SPECIAL INSPECTION SERVICES					
PROJECT	Brookhaven PD Building Renovation				
MATERIAL / ACTIVITY	SERVICE	APPLICABLE TO THIS PROJECT			
		Y/N	EXTENT	AGENT*	DATE COMPLETED
<b>1705.2.1 Structural Steel Construction</b>					
1. Fabricator and erector documents (verify reports and certificates as listed in AISC 360, Section N3.2 for compliance with construction documents).	Submittal Review	Y	Each Submittal	1	
2. Material verification of structural steel.	Shop (3) and Field Inspection	Y	Periodic	1	
3. Structural steel welding:					
a. Inspection tasks prior to welding (Observe or perform for each welded joint or member, the QA tasks listed in AISC 360, Table N5.4-1).	Shop (3) and Field Inspection	Y	Observe or Perform as noted (4)	1	
b. Inspection tasks during welding (Observe or perform for each welded joint or member the QA tasks listed in AISC 360, Table N5.4-2).	Shop (3) and Field Inspection	Y	Observe (4)	1	
c. Inspection tasks after welding (Observe or perform for each welded joint or member the QA tasks listed in AISC 360, Table N5.4-3).	Shop (3) and Field Inspection	Y	Observe or Perform as noted (4)	1	
d. Nondestructive testing (NDT) of welded joints: ( <i>see commentary</i> )					
1) Complete penetration groove welds 5/16" or greater in Risk Category III or IV.	Shop (3) or Field Ultrasonic Testing – 100% of welds	N	Periodic		
2) Complete penetration groove welds 5/16" or greater in Risk Category II.	Shop (3) or Field Ultrasonic Testing – 10% of welds minimum	Y	Periodic	1	
3) Welded joints subject to fatigue when required by AISC 360, Appendix 3, Table A-3.1.	Shop (3) or Field Radiographic or Ultrasonic Testing	N	Periodic		
4) Fabricator's NDT reports when fabricator performs NDT.	Verify Reports	Y	Each Submittal (5)	1	
4. Structural steel bolting:	Shop (3) or Field Inspection				
a. Inspection tasks prior to bolting (Observe or perform tasks for each bolted connection in accordance with QA tasks listed in AISC 360, Table N5.6-1).		Y	Observe or Perform as noted (4)	1	
b. Inspection tasks during bolting (Observe the QA tasks listed in AISC 360, Table N5.6-2).		Y	Observe (4)	1	
1) Pre-tensioned and slip-critical joints:					
a) Turn-of-nut with match-marks.		Y	Periodic	1	
b) Direct tension indicator.		Y	Periodic	1	
c) Twist-off type tension control bolt.		Y	Periodic	1	
d) Turn-of-nut without match-marks.		N	Continuous		
e) Calibrated wrench.		N	Continuous		
2) Snug-tight joints.		Y	Periodic	1	

<b>SCHEDULE OF SPECIAL INSPECTION SERVICES</b>					
<b>PROJECT</b>	<b>Brookhaven PD Building Renovation</b>				
<b>MATERIAL / ACTIVITY</b>	<b>SERVICE</b>	<b>APPLICABLE TO THIS PROJECT</b>			
		<b>Y/N</b>	<b>EXTENT</b>	<b>AGENT*</b>	<b>DATE COMPLETED</b>
c. Inspection tasks after bolting (Perform tasks for each bolted connection in accordance with QA tasks listed in AISC 360, Table N5.6-3).		Y	Perform (4)	1	
5. Visual inspection of exposed cut surfaces of galvanized structural steel main members and exposed corners of the rectangular HSS for cracks subsequent to galvanizing.	Shop (3) or Field Inspection	Y	Periodic	1	
6. Embedded items (Verify diameter, grade, type, length, embedment. See 1705.3 for anchors).	Field Inspection	Y	Periodic	1	
7. Verify member locations, braces, stiffeners, and application of joint details at each connection comply with construction documents.	Field Inspection	Y	Periodic	1	
<b>1705.2.2 Cold-Formed Steel Deck</b>					
1. Manufacturer documents (Verify reports and certificates as listed in SDI QA/QC, Section 2, Paragraphs 2.1 and 2.2 for compliance with construction documents).	Submittal Review	N	Each Submittal		
2. Material verification of steel deck, mechanical fasteners, and welding materials.	Shop (3) and Field Inspection	N	Periodic		
3. Cold-formed steel deck placement:	Shop (3) and Field Inspection				
a. Inspection tasks prior to deck placement (Perform the QA tasks listed in SDI QA/QC, Appendix 1, Table 1.2).		N	Perform (4)		
b. Inspection tasks after deck placement (Perform the QA tasks listed in SDI QA/QC, Appendix 1, Table 1.2).		N	Perform (4)		
4. Cold-formed steel deck welding:	Shop (3) and Field Inspection				
a. Inspection tasks prior to welding (Observe the QA tasks listed in SDI QA/QC, Appendix 1, Table 1.3).		N	Observe (4)		
b. Inspection tasks during welding (Observe the QA tasks listed in SDI QA/QC, Appendix 1, Table 1.4).		N	Observe (4)		
c. Inspection tasks after welding (Observe the QA tasks listed in SDI QA/QC, Appendix 1, Table 1.5).		N	Perform (4)		
5. Cold-formed deck mechanical fastening:	Shop (3) and Field Inspection				
a. Inspection tasks prior to mechanical fastening (Observe the QA tasks listed in SDI QA/QC, Appendix 1, Table 1.6).		N	Observe (4)		
b. Inspection tasks during mechanical fastening (Observe the QA tasks listed in SDI QA/QC, Appendix 1, Table 1.7).		N	Observe (4)		

<b>SCHEDULE OF SPECIAL INSPECTION SERVICES</b>					
<b>PROJECT</b>	<b>Brookhaven PD Building Renovation</b>				
<b>MATERIAL / ACTIVITY</b>	<b>SERVICE</b>	<b>APPLICABLE TO THIS PROJECT</b>			
		<b>Y/N</b>	<b>EXTENT</b>	<b>AGENT*</b>	<b>DATE COMPLETED</b>
c. Inspection tasks after mechanical fastening (Observe the QA tasks listed in SDI QA/QC, Appendix 1, Table 1.8).		N	Perform (4)		
<b>1705.2.3 Open-Web Steel Joists and Joist Girders</b>					
1. Installation of open-web steel joists and joist girders:					
a. End connections – welded or bolted.	Per SJI CJ or SJI 100	N	Periodic		
b. Bridging – horizontal or diagonal:					
1) Standard bridging.	Per SJI CJ or SJI 100	N	Periodic		
2) Bridging that differs from the specifications listed in SJI CJ or SJI 100.		N	Periodic		
<b>1705.2.4 Cold-Formed Steel Trusses Spanning 60-feet or Greater</b>					
1. Verify temporary and permanent restraint/bracing are installed in accordance with the approved truss submittal package.	Field Inspection	N	Periodic		

<b>SCHEDULE OF SPECIAL INSPECTION SERVICES</b>					
<b>PROJECT</b>	<b>Brookhaven PD Building Renovation</b>				
<b>MATERIAL / ACTIVITY</b>	<b>SERVICE</b>	<b>APPLICABLE TO THIS PROJECT</b>			
		<b>Y/N</b>	<b>EXTENT</b>	<b>AGENT*</b>	<b>DATE COMPLETED</b>
<b>1705.3 Concrete Construction</b>					
1. Inspection and placement verification of reinforcing steel and prestressing tendons	Shop (3) and Field Inspection	Y	Periodic	1	
2. Reinforcing bar welding:					
a. Verification of weldability of bars other than ASTM A706.		N	Periodic		
b. Inspection of single-pass fillet welds 5/16-inch or less in size.		N	Periodic		
c. Inspection of all other welds.		N	Continuous		
3. Inspection of anchors cast in concrete.	Shop (3) and Field Inspection	Y	Periodic	1	

SCHEDULE OF SPECIAL INSPECTION SERVICES					
PROJECT	Brookhaven PD Building Renovation				
MATERIAL / ACTIVITY	SERVICE	APPLICABLE TO THIS PROJECT			
		Y/N	EXTENT	AGENT*	DATE COMPLETED
4. Inspection of anchors post-installed in hardened concrete members per research reports, or if no specific requirements are provided, requirements shall be provided by the registered design professional and approved by the building official, including verification of anchor type, anchor dimensions, hole dimensions, hole cleaning procedures, anchor spacing, edge distances, concrete minimum thickness, anchor embedment, and tightening torque.	Field Inspection		Periodic or as required by the research report issued by an approved source		
a. Adhesive anchors installed in horizontal or upward-inclined orientation that resists sustained tension loads.		Y	Continuous	1	
b. Mechanical and adhesive anchors not defined in 4.a.		Y	Periodic	1	
5. Verify use of approved design mix.	Shop (3) and Field Inspection	Y	Periodic	1	
6. Prior to placement, fresh concrete sampling, perform slump and air content tests, determine temperature of concrete, and perform any other tests as specified in construction documents.	Shop (3) and Field Inspection	Y	Continuous	1	
7. Inspection of concrete and shotcrete placement for proper application techniques.	Shop (3) and Field Inspection	Y	Continuous	1	
8. Verify maintenance of specified curing temperature and techniques.	Shop (3) and Field Inspection	Y	Periodic	1	
9. Inspection of prestressed concrete:	Shop (3) and Field Inspection				
a. Application of prestressing force.		N	Continuous		
b. Grouting of bonded prestressing tendons.		N	Continuous		
10. Inspect erection of precast concrete members.		N	Periodic		
11. Verification of in-situ concrete strength prior to stressing of tendons in post-tensioned concrete and prior to removal of shores and forms from beams and structural slabs.	Review Field Testing and Laboratory Reports	N	Periodic		
12. Inspection of formwork for shape, lines, locations, and dimensions.	Field Inspection	Y	Periodic	1	
13. Concrete strength testing and verification of compliance with construction documents.	Field Testing and Review of Laboratory Reports	Y	Periodic	1	

SCHEDULE OF SPECIAL INSPECTION SERVICES					
PROJECT	Brookhaven PD Building Renovation				
MATERIAL / ACTIVITY	SERVICE	APPLICABLE TO THIS PROJECT			
		Y/N	EXTENT	AGENT*	DATE COMPLETED
<b>1705.4 Masonry Construction</b>					
<b>(A) Level 1, 2, and 3 Quality Assurance</b>					
1. Prior to construction, verification of compliance of submittals.	Submittal Review	Y	Each Submittal	1	
<b>(B) Level 2 and 3 Quality Assurance:</b>					
1. Prior to construction, verification of $f'_m$ and $f'_{AAC}$ except where specifically required by the code.	Testing by Unit Strength Method or Prism Test Method	N	Periodic		
2. During construction, verification of slump flow and visual stability index (VSI) when self-consolidating grout is delivered to the project site.	Field Testing	N	Periodic		
3. Verify the following comply prior to the start of masonry construction:					
a. Proportions of the site-prepared mortar.	Field Inspection	N	Periodic		
b. Grade and size of prestressing tendons and anchorages.	Field Inspection	N	Periodic		
c. Grade, type, and size of reinforcement, anchor bolts, prestressing tendons, and prestressing anchorages.	Field Inspection	N	Periodic		
d. Prestressing technique.	Field Inspection	N	Periodic		
e. Properties of thin-bed mortar for AAC masonry.  <i>(Level 2: Continuous for first 5000 SF and periodic after)</i>	Field Inspection	N	Level 2: Continuous*		
		N	Level 3: Continuous		
f. Sample panel construction.	Field Inspection	N	Level 2: Periodic		
		N	Level 3: Continuous		
4. Verify the following comply prior to grouting:					
a. Grout space.	Field Inspection	N	Level 2: Periodic		
		N	Level 3: Continuous		
b. Placement of prestressing tendons and anchorages.	Field Inspection	N	Periodic		
c. Placement of reinforcement, connectors, and anchor bolts.	Field Inspection	N	Level 2: Periodic		
		N	Level 3: Continuous		
d. Proportions of site-prepared grout and prestressing grout for bonded tendons.	Field Inspection	N	Periodic		
5. Verify compliance of the following during construction:					
a. Materials and procedures with the approved submittal.	Field Inspection	N	Periodic		
b. Placement of masonry units and mortar joint construction.	Field Inspection	N	Periodic		
c. Size and location of structural members.	Field Inspection	N	Periodic		

SCHEDULE OF SPECIAL INSPECTION SERVICES					
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MATERIAL / ACTIVITY	SERVICE	APPLICABLE TO THIS PROJECT			
		Y/N	EXTENT	AGENT*	DATE COMPLETED
<b>(B) Level 2 and 3 Quality Assurance (Continued):</b>					
d. Type, size, anchor location, and other details of anchorage of masonry to structural members, frames, or other construction.	Field Inspection	N	Level 2: Periodic		
		N	Level 3: Continuous		
e. Welding of reinforcement.	Field Inspection	N	Continuous		
f. Preparation, construction, and protection of masonry during cold weather (temperature below 40°F) or hot weather (temperature above 90°F).	Field Inspection	N	Periodic		
g. Application and measurement of prestressing force.	Field Testing	N	Continuous		
h. Placement of grout and prestressing grout for bonded tendons is in compliance.	Field Inspection	N	Continuous		
i. Placement of AAC masonry units and construction of thin-bed mortar joints.  <i>(Level 2: Continuous for first 5000 SF and periodic after)</i>	Field Inspection	N	Level 2: Continuous*		
		N	Level 3: Continuous		
j. Observe preparation of grout specimens, mortar specimens, and/or prisms.	Field Inspection	N	Level 2: Periodic		
		N	Level 3: Continuous		
<b>(C) Level 3 Quality Assurance:</b>					
1. During construction, verification of $f_m$ and $f_{AAC}$ for every 5000 SF.	Testing by Unit Strength Method or Prism Test Method	N	Periodic		
2. During construction, verification of proportions of materials as delivered to the project site for premixed or preblended mortar, prestressing grout, and grout other than self-consolidating grout.	Field Inspection	N	Periodic		



SCHEDULE OF SPECIAL INSPECTION SERVICES					
PROJECT	Brookhaven PD Building Renovation				
MATERIAL / ACTIVITY	SERVICE	APPLICABLE TO THIS PROJECT			
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<b>1705.5 Wood Construction</b>					
1. For prefabricated wood structural elements, inspection of the fabrication process and assemblies in accordance with Section 1704.2.5.	In-Plant Review (3)	N	Periodic		
2. For high-load diaphragms, verify grade and thickness of structural panel sheathing agree with approved building plans.	Field Inspection	N	Periodic		
3. For high-load diaphragms, verify nominal size of framing members at adjoining panel edges, nail or staple diameter and length, number of fastener lines, and that spacing between fasteners in each line and at edge margins agree with approved building plans.	Field Inspection	N	Periodic		
4. Metal-plate-connected wood trusses:					
a. For trusses with heights greater than or equal to 60-inches: verify permanent individual truss member restraint/bracing has been installed in accordance with the approved truss submittal package.	Field Inspection	N	Periodic		
b. For trusses spanning 60-feet or greater: verify temporary and permanent restraint/bracing are installed in accordance with the approved truss submittal package.	Field Inspection	N	Periodic		

SCHEDULE OF SPECIAL INSPECTION SERVICES					
PROJECT	Brookhaven PD Building Renovation				
MATERIAL / ACTIVITY	SERVICE	APPLICABLE TO THIS PROJECT			
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<b>1705.6 Soils</b>					
1. Verify materials below shallow foundations are adequate to achieve the design bearing capacity.	Field Inspection	Y	Periodic	1	
2. Verify excavations are extended to proper depth and have reached proper material	Field Inspection	Y	Periodic	1	
3. Perform classification and testing of compacted fill materials	Field Inspection	Y	Periodic	1	
4. Verify use of proper materials, densities, and lift thicknesses during placement and compaction of controlled fill	Field Inspection	Y	Continuous	1	

<b>SCHEDULE OF SPECIAL INSPECTION SERVICES</b>					
<b>PROJECT</b>	<b>Brookhaven PD Building Renovation</b>				
<b>MATERIAL / ACTIVITY</b>	<b>SERVICE</b>	<b>APPLICABLE TO THIS PROJECT</b>			
		<b>Y/N</b>	<b>EXTENT</b>	<b>AGENT*</b>	<b>DATE COMPLETED</b>
5. Prior to placement of controlled fill, inspect subgrade and verify that site has been prepared properly.	Field Inspection	Y	Periodic	1	
<b>1705.7 Driven Deep Foundations</b>					
1. Verify element materials, sizes, and lengths comply with requirements	Field Inspection	N	Continuous		
2. Determine capacities of test elements and conduct additional load tests as required.	Field Inspection	N	Continuous		
3. Inspect driving operations and maintain complete and accurate records for each element	Field Inspection	N	Continuous		
4. Verify placement locations and plumbness, confirm type and size of hammer, record number of blows per foot of penetration, determine required penetrations to achieve design capacity, record tip and butt elevations, and document any damage to foundation elements.	Field Inspection	N	Continuous		
5. For steel elements, perform additional inspections per Section 1705.2.	See IBC Section 1705.2	N	See IBC Section 1705.2		
6. For concrete elements and concrete-filled elements, perform tests and additional inspections per Section 1705.3.	See IBC Section 1705.3	N	See IBC Section 1705.3		
7. For specialty elements, perform additional inspections as determined by the registered design professional in responsible charge.	Field Inspection	N	In Accordance with Construction Documents		
<b>1705.8 Cast-in-Place Deep Foundations</b>					
1. Inspect drilling operations and maintain complete and accurate records for each element.	Field Inspection	N	Continuous		
2. Verify placement locations and plumbness, confirm element diameters, bell diameters (if applicable), lengths, embedment into bedrock (if applicable), and adequate end-bearing strata capacity. Record concrete or grout volumes.	Field Inspection	N	Continuous		
3. For concrete elements, perform tests and additional inspections per Section 1705.3.	See IBC Section 1705.3	N	See IBC Section 1705.3		
<b>1705.9 Helical Pile Foundations</b>					
1. Verify installation equipment, pile dimensions, tip elevations, final depth, final installation torque, and other installation data as required by construction documents.	Field Inspection	N	Continuous		

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		<b>Y/N</b>	<b>EXTENT</b>	<b>AGENT*</b>	<b>DATE COMPLETED</b>
<b>1705.10 Fabricated Items</b>					
1. List of fabricated items requiring special inspection during fabrication:	Shop Inspection		As noted in each applicable shop activity		
a. None					
2. List of fabricated items to be fabricated on the premises of a fabricator approved to perform such work without special inspection (including name of approved agency providing periodic audit)					
a. None					

<b>SCHEDULE OF SPECIAL INSPECTION SERVICES</b>					
<b>PROJECT</b>	<b>Brookhaven PD Building Renovation</b>				
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		<b>Y/N</b>	<b>EXTENT</b>	<b>AGENT*</b>	<b>DATE COMPLETED</b>
<b>1705.11.1 Structural Wood Special Inspections for Wind Resistance</b>					
1. Inspection of field gluing operations of elements of the main windforce-resisting system.	Field Inspection	N	Continuous		
2. Inspection of nailing, bolting, anchoring, and other fastening of components within the main windforce-resisting system, including wood shear walls, wood diaphragms, drag struts, braces, and hold-downs.	Shop (3) and Field Inspection	N	Periodic		
<b>1705.11.2 Cold-Formed Steel Special Inspections for Wind Resistance</b>					
1. Inspection during welding operations of elements of the main windforce-resisting system.	Shop (3) and Field Inspection	N	Periodic		
2. Inspection of screw attachment, bolting, anchoring, and other fastening of components within the main windforce-resisting system, including shear walls, braces, diaphragms, collectors (drag struts), and hold-downs.	Shop (3) and Field Inspection	N	Periodic		
<b>1705.11.3 Wind-Resisting Components</b>					
1. Roof covering, roof deck, and roof framing connections.	Shop (3) and Field Inspection	N	Periodic		
2. Exterior wall covering and wall connections to roof and floor diaphragms.	Shop (3) and Field Inspection	N	Periodic		

<b>SCHEDULE OF SPECIAL INSPECTION SERVICES</b>					
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<b>MATERIAL / ACTIVITY</b>	<b>SERVICE</b>	<b>APPLICABLE TO THIS PROJECT</b>			
		<b>Y/N</b>	<b>EXTENT</b>	<b>AGENT*</b>	<b>DATE COMPLETED</b>
<b>1705.12.1 Structural Steel Special Inspections for Seismic Resistance</b>					
1. Seismic force-resisting systems in SDC B, C, D, E, or F.	Shop (3) and Field Inspection	N	In Accordance with AISC 341		
2. Structural steel elements in SDC B, C, D, E, or F other than those in Item 1, including struts, collectors, chords, and foundation elements.	Shop (3) and Field Inspection	N	In Accordance with AISC 341		
<b>1705.12.2 Structural Wood Special Inspections for Seismic Resistance</b>					
1. Field gluing operations of elements of the seismic force-resisting system for SDC C, D, E, or F.	Field Inspection	N	Continuous		
2. Nailing, bolting, anchoring, and other fastening of components within the seismic force-resisting system, including wood shear walls, wood diaphragms, drag struts, shear panels, and hold-downs for SDC C, D, E, or F.	Shop (3) and Field Inspection	N	Periodic		

<b>SCHEDULE OF SPECIAL INSPECTION SERVICES</b>					
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<b>MATERIAL / ACTIVITY</b>	<b>SERVICE</b>	<b>APPLICABLE TO THIS PROJECT</b>			
		<b>Y/N</b>	<b>EXTENT</b>	<b>AGENT*</b>	<b>DATE COMPLETED</b>
<b>1705.12.3 Cold-Formed Steel Light-Frame Construction Special Inspections for Seismic Resistance</b>					
1. Welding operations of elements of the seismic force-resisting system for SDC C, D, E, or F.	Shop (3) and Field Inspection	N	Periodic		
2. Screw attachment, bolting, anchoring, and other fastening of components within the seismic force-resisting system, including shear walls, braces, diaphragms, collectors (drag struts), and hold-downs for SDC C, D, E, or F.	Shop (3) and Field Inspection	N	Periodic		
<b>1705.12.4 Designated Seismic Systems Verification Special Inspections for Seismic Resistance</b>					
1. For SDC C, D, E, or F, inspect and verify the component label and anchorage or mounting conforms to the certificate of compliance in accordance with ASCE 7, Section 13.2.2.	Field Inspection	N	Periodic		
<b>1705.12.5 Architectural Components Special Inspection for Seismic Resistance</b>					
1. For SDC D, E, or F, inspection during the erection and fastening of exterior cladding and interior or exterior veneer more than 30-feet above grade or walking surface and weighing more than 5 psf.	Field Inspection	N	Periodic		
2. For SDC D, E, or F, inspection during the erection and fastening of interior nonbearing walls more than 30-feet above grade or walking surface and weighing more than 15 psf.	Field Inspection	N	Periodic		
3. For SDC D, E, or F, inspection during the erection and fastening of exterior nonbearing walls more than 30-feet above grade or walking surface.	Field Inspection	N	Periodic		
4. For SDC D, E, or F, inspection during anchorage of access floors.	Field Inspection	N	Periodic		
<b>1705.12.6 Plumbing, Mechanical, &amp; Electrical Components Special Inspection for Seismic Resistance</b>					
1. Inspection during the anchorage of electrical equipment for emergency or standby power systems in SDC C, D, E, or F.	Field Inspection	Y	Periodic	1	
2. Inspection during the anchorage of other electrical equipment in SDC E or F.	Field Inspection	N	Periodic		
3. Inspection during the installation and anchorage of piping systems designed to carry hazardous materials, and their associated mechanical units in SDC C, D, E, or F.	Field Inspection	N	Periodic		
4. Inspection during the installation and anchorage of HVAC ductwork designed to contain hazardous materials in SDC C, D, E, or F.	Field Inspection	N	Periodic		

<b>SCHEDULE OF SPECIAL INSPECTION SERVICES</b>					
<b>PROJECT</b>	<b>Brookhaven PD Building Renovation</b>				
<b>MATERIAL / ACTIVITY</b>	<b>SERVICE</b>	<b>APPLICABLE TO THIS PROJECT</b>			
		<b>Y/N</b>	<b>EXTENT</b>	<b>AGENT*</b>	<b>DATE COMPLETED</b>
5. Inspection during the installation and anchorage of vibration isolation systems in SDC C, D, E, or F where nominal clearance of 1/4-inch or less is required by the approved construction documents.	Field Inspection	N	Periodic		
6. Inspection during the installation of mechanical and electrical equipment, including ductwork, piping systems, and their structural supports, where automatic fire sprinkler systems are installed in structures assigned to SDC C, D, E, or F to verify one of the following unless flexible sprinkler hose fittings are used:					
a. ASCE/SEI 7, Section 13.2.3 minimum required clearances have been provided.	Field Inspection	Y	Periodic	1	
b. A 3-inch or greater nominal clearance has been provided between fire protection sprinkler system drops and sprigs and structural members not used collectively or independently to support the sprinklers, equipment attached to the building structure, and other systems' piping.	Field Inspection	Y	Periodic	1	
<b>1705.12.7 Storage Racks Special Inspections for Seismic Resistance</b>					
1. Inspection during the anchorage of storage racks 8-feet or greater in height in structures assigned to SDC D, E, or F.	Field Inspection	N	Periodic		
<b>1705.12.8 Seismic Isolation Systems</b>					
1. Inspection during the fabrication and installation of isolator units and energy dissipation devices used as part of the seismic isolation system in structures assigned to SDC B, C, D, E, or F.	Shop and Field Inspection	N	Periodic		
<b>1705.12.9 Cold-Formed Steel Special Bolted Moment Frames</b>					
1. Inspection of installation of cold-formed steel special bolted moment frames in the seismic force-resisting systems in structures assigned to SDC D, E, or F.	Field Inspection	N	Periodic		

SCHEDULE OF SPECIAL INSPECTION SERVICES					
PROJECT	Brookhaven PD Building Renovation				
MATERIAL / ACTIVITY	SERVICE	APPLICABLE TO THIS PROJECT			
		Y/N	EXTENT	AGENT*	DATE COMPLETED
<b>1705.13.1 Structural Steel Testing for Seismic Resistance</b>					
1. Nondestructive testing of structural steel in the seismic force-resisting systems in accordance with AISC 341, in structures assigned to SDC B, C, D, E, or F.	Field Test	N	Periodic		
2. Nondestructive testing of structural steel elements in the seismic force-resisting systems not covered in Item 1 above, including struts, collectors, chords, and foundation elements in accordance with AISC 341 in structures assigned to SDC B, C, D, E, or F.	Field Test	N	Periodic		
<b>1705.13.2 Seismic Certification of Nonstructural Components</b>					
1. Review certificate of compliance for nonstructural components in structures assigned to SDC B, C, D, E, or F.	Certificate of Compliance Review	Y	Each Submittal	1	
<b>1705.13.3 Seismic Certification of Designated Seismic Systems</b>					
1. Review certificate of compliance for designated seismic system components in structures assigned to SDC C, D, E, or F.	Certificate of Compliance Review	N	Each Submittal		
<b>1705.13.4 Seismic Isolation Systems</b>					
1. Test seismic isolation system in accordance with ASCE 7, Section 17.8 in structures assigned to SDC B, C, D, E, or F.	Prototype Testing	N	Per ASCE 7		

SCHEDULE OF SPECIAL INSPECTION SERVICES					
PROJECT	Brookhaven PD Building Renovation				
MATERIAL / ACTIVITY	SERVICE	APPLICABLE TO THIS PROJECT			
		Y/N	EXTENT	AGENT*	DATE COMPLETED
<b>1705.14 Sprayed Fire-resistant Materials</b>					
1. Verify surface condition preparation of structural members.	Field Inspection	N	Periodic		
2. Verify minimum thickness of sprayed fire-resistant materials applied to structural members.	Field Inspection	N	Periodic		
3. Verify density of the sprayed fire-resistant material complies with approved fire-resistant design.	Field Inspection and Testing	N	Per IBC Section 1705.14.5		
4. Verify the cohesive/adhesive bond strength of the cured sprayed fire-resistant material.	Field Inspection and Testing	N	Per IBC Section 1705.14.6		
5. Condition of finished application.	Field Inspection	N	Periodic		

SCHEDULE OF SPECIAL INSPECTION SERVICES					
PROJECT	Brookhaven PD Building Renovation				
MATERIAL / ACTIVITY	SERVICE	APPLICABLE TO THIS PROJECT			
		Y/N	EXTENT	AGENT*	DATE COMPLETED
<b>1705.15 Mastic and Intumescent Fire-resistant Coatings</b>					
1. Inspect and test mastic and intumescent fire-resistant coatings applied to structural elements and decks per AWCI 12-B.	Field Inspection and Testing	N	Periodic		
<b>1705.16 Exterior Insulation and Finish Systems (EIFS)</b>					
1. Inspection of water-resistive barrier over sheathing substrate.	Field Inspection	N	Periodic		
<b>1705.17 Fire-resistance Penetrations and Joints</b>					
1. Inspect penetration firestop.	Field Testing	N	Per ASTM E2174		
2. Inspect fire-resistant joint systems.	Field Testing	N	Per ASTM E2393		
<b>1705.18 Smoke Control Systems</b>					
1. Leakage testing and recording of device locations prior to concealment.	Field Testing	N	Periodic		
2. Prior to occupancy and after sufficient completion, pressure difference testing, flow measurements, and detection and control verification.	Field Testing	N	Periodic		
<b>*INSPECTION AGENTS</b>					
<b>FIRM</b>	<b>ADDRESS</b>			<b>TELEPHONE NUMBER</b>	
1. Independent Testing Agency	TBD			TBD	
<p>Notes:</p> <ul style="list-style-type: none"> <li>(1) The inspection and testing agent(s) shall be engaged by the Owner or the Owner's Agent, and not by the Contractor or Subcontractor whose work is to be inspected or tested. Any conflict of interest must be disclosed to the Building Official prior to commencing work. The qualifications of the Special Inspector(s) and/or testing agencies may be subject to the approval of the Building Official and/or the Design Professional.</li> <li>(2) The list of Special Inspectors may be submitted as a separate document, if noted above.</li> <li>(3) Shop inspections of fabricated items are not required where the fabricator is approved in accordance with IBC Section 1704.2.5.1 and listed in activity 1709.2.</li> <li>(4) Observe: Observe on a random basis, operations need not be delayed pending these inspections. Perform: These tasks shall be performed for each welded joint, bolted connection, or steel element.</li> <li>(5) NDT of welds completed in an approved fabricator's shop may be performed by that fabricator when approved by the AHJ. Refer to AISC 360, N6.</li> </ul>					
Are Special Inspections for Wind Resistance included in the Statement of Special Inspections?				<b>NO</b>	
Are Special Inspections for Seismic Resistance included in the Statement of Special Inspections?				<b>YES</b>	
				DATE:	28 April 2023



# FINAL REPORT OF SPECIAL INSPECTIONS

**PROJECT:** Brookhaven PD Building Renovation

**LOCATION:** 2665 Buford Highway NE, Brookhaven, Georgia 30324

**PERMIT APPLICANT:** \_\_\_\_\_

**PERMIT APPLICANT'S ADDRESS:** \_\_\_\_\_

**ARCHITECT OF RECORD:** Roger Godwin, RA (HLGstudio)

**STRUCTURAL ENGINEER OF RECORD:** Eric D. Blackmore, PE, SE (Wallace Design Collective)

**MECHANICAL ENGINEER OF RECORD:** Jesse W. Foley, PE (AHA Consulting Engineers)

**ELECTRICAL ENGINEER OF RECORD:** Onogre L. Mayuga, PE (AHA Consulting Engineers)

**REGISTERED DESIGN PROFESSIONAL IN RESPONSIBLE CHARGE:** Roger Godwin, RA

To the best of my information, knowledge, and belief, which are based upon observations or diligent supervision of our inspection services for the above-referenced Project, I hereby state that the special inspections or testing required for this Project and designated for this Agent in the *Schedule of Special Inspection Services*, have been completed in accordance with the Contract Documents.

The Special Inspection program does not relieve the Contractor of the responsibility to comply with the Contract Documents. Jobsite safety and means and methods of construction are solely the responsibility of the Contractor.

Interim reports submitted prior to this final report and numbered \_\_\_\_\_ to \_\_\_\_\_ for a basis for and are considered to be an integral part of this final report. The following discrepancies that were outstanding since the last interim report dated \_\_\_\_\_ have been corrected:

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(Attach 8½" x 11" continuation sheet(s) if required to complete the description of corrections)

Prepared by:

\_\_\_\_\_  
Special Inspection Agent/Firm

\_\_\_\_\_  
Type or Print Name

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Date





## SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

## PART 1 - GENERAL

## 1.1 SUMMARY

A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

B. Related Requirements:

1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.

## 1.2 USE CHARGES

A. Installation, removal, and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, **Owner's forces**, Architect, testing agencies, and authorities having jurisdiction.

B. Water and Sewer Service Provide connections and extensions of services **and metering** as required for construction operations.

C. Electric Power Service

D. Provide connections and extensions of services **and metering** as required for construction operations.

## 1.3 INFORMATIONAL SUBMITTALS

A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.

B. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.

C. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.

D. Moisture- and Mold-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage and mold. Describe delivery, handling, storage, installation, and protection provisions for materials subject to water absorption or water damage.

1. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and requirements for replacing water-damaged Work.
2. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
3. Indicate methods to be used to avoid trapping water in finished work.

## 1.4 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.
- C. Accessible Temporary Egress: Comply with applicable provisions in **the United States Access Board's ADA-ABA Accessibility Guidelines and the Florida Building Code** as required.

## 1.5 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

## PART 2 - PRODUCTS

### 2.1 TEMPORARY FACILITIES

- A. Field Offices: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect, Contractor, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:
  - 1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
  - 2. Conference room of sufficient size to accommodate meetings Provide electrical power service and 120-V ac duplex receptacles, with no fewer than one receptacle on each wall. Furnish room with conference table, chairs, and **4-foot- (1.2-m-)** square tack and marker boards.
  - 3. Drinking water and private toilet.
  - 4. Heating and cooling equipment necessary to maintain a uniform indoor temperature of **68 to 72 deg F (20 to 22 deg C)**.
  - 5. Lighting fixtures capable of maintaining average illumination of **20 fc (215 lx)** at desk height.

### 2.2 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

## PART 3 - EXECUTION

### 3.1 TEMPORARY FACILITIES, GENERAL

- A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.

1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work.

### 3.2 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.
- C. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.

### 3.3 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
  1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
  1. Connect temporary sewers to as directed by authorities having jurisdiction.
- C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.
- D. Sanitary Facilities: Provide temporary toilets, wash facilities, safety shower and eyewash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
- E. Temporary Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
  1. Provide temporary dehumidification systems when required to reduce ambient and substrate moisture levels to level required to allow installation or application of finishes and their proper curing or drying.
- F. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
  1. Install electric power service as indicated.
- G. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
  1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
- H. Electronic Communication Service: Provide secure WiFi wireless connection to internet with provisions for access by Architect and Owner.

1. Internet Service: Broadband modem, router, and ISP, equipped with hardware firewall, providing minimum **10.0** Mbps upload and **15** -Mbps download speeds at each computer.
2. Internet Security: Integrated software, providing software firewall, virus, spyware, phishing, and spam protection in a combined application.

### 3.4 SUPPORT FACILITIES INSTALLATION

#### A. Comply with the following:

1. Provide construction for temporary field offices, shops, and sheds located within construction area or within **30 feet (9 m)** of building lines that is noncombustible according to ASTM E136. Comply with NFPA 241.

#### B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas **within construction limits indicated** on Drawings.

1. Provide dust-control treatment that is nonpolluting and non-tracking. Reapply treatment as required to minimize dust.

#### C. Traffic Controls: Comply with requirements of authorities having jurisdiction.

1. Protect existing site improvements to remain including curbs, pavement, and utilities.
2. Maintain access for fire-fighting equipment and access to fire hydrants.

#### D. Parking: parking areas for construction personnel.

#### E. Storage and Staging: **Use designated areas of Project site** for storage and staging needs.

#### F. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.

1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.

#### G. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.

1. Identification Signs: Provide Project identification signs as indicated on Drawings.
2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
  - a. Provide temporary, directional signs for construction personnel and visitors.
3. Maintain and touch up signs so they are legible at all times.

#### H. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 017300 "Execution."

#### I. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.

1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

- J. Temporary Elevator Use: **Use of elevators is not permitted.**
- K. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.
- L. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

### 3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
  - 1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.
- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
- C. Temporary Erosion and Sedimentation Control: Comply with **requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.**
- D. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to **erosion- and sedimentation-control Drawings or authorities having jurisdiction, whichever is more stringent.**
  - 1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant-protection zones.
  - 2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
  - 3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
  - 4. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- E. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- F. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
- G. Site Enclosure Fence: **Before construction operations begin**, furnish and install site enclosure fence in a manner that will prevent people from easily entering site except by entrance gates.
  - 1. Extent of Fence: **As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.**
- H. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday.



- I. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- J. Temporary Egress: Provide temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction. Provide signage directing occupants to temporary egress.
- K. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
  - 1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.
- L. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate finished areas from fumes and noise.
  - 1. Construct dustproof partitions with gypsum wallboard with joints taped on occupied side, and fire-retardant-treated plywood on construction operations side.
  - 2. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
  - 3. Provide walk-off mats at each entrance through temporary partition.
- M. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.
  - 1. Prohibit smoking in construction areas. Comply with additional limits on smoking specified in other Sections.
  - 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
  - 3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site.
  - 4. Comply with the requirements of the Florida Building

### 3.6 MOISTURE AND MOLD CONTROL

- A. Moisture and Mold Protection: Protect stored materials and installed Work in accordance with Moisture and Mold Protection Plan.
- B. Exposed Construction Period: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
  - 1. Protect porous materials from water damage.
  - 2. Protect stored and installed material from flowing or standing water.
  - 3. Keep porous and organic materials from coming into prolonged contact with concrete.
  - 4. Remove standing water from decks.
  - 5. Keep deck openings covered or dammed.
- C. Partially Enclosed Construction Period: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
  - 1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.

2. Keep interior spaces reasonably clean and protected from water damage.
3. Periodically collect and remove waste containing cellulose or other organic matter.
4. Discard or replace water-damaged material.
5. Do not install material that is wet.
6. Discard and replace stored or installed material that begins to grow mold.
7. Perform work in a sequence that allows wet materials adequate time to dry before enclosing the material in gypsum board or other interior finishes.

D. Controlled Construction Period: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:

1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
2. Use temporary or permanent HVAC system to control humidity within ranges specified for installed and stored materials.
3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.

### 3.7 OPERATION, TERMINATION, AND REMOVAL

A. Maintenance: Maintain facilities in good operating condition until removal.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

B. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

C. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
2. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 015000

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**SECTION 01 70 00 - CONTRACT CLOSEOUT****PART 1 - GENERAL****REQUIREMENTS:**

Closeout is hereby defined to include general requirement near end of Contract Time in preparation for final acceptance, final payment, normal termination of contract, occupancy by Owner and similar actions evidencing completion of the Work. Time of closeout is directly related to "Substantial Completion" and therefore may be either a single time period for entire work or a series of time periods for individual parts of the work which have been certified as substantially complete at different dates. That time variation (if any) shall be applicable to other provisions of this section.

**PREREQUISITES TO SUBSTANTIAL COMPLETION:**

- A. Prior to requesting Architect's/Engineer's inspection for certification of substantial completion for either entire Work or portions thereof, complete the following and list known exceptions in request:
1. In progress payment request, show either 100% completion for portion of work claimed as "substantially complete" or list incomplete items, value of incompleteness and reasons for being incomplete.
  2. Include supporting documentation for completion as indicated in these Contract Documents.
  3. Submit statement showing accounting of changes to the Contract sum.
  4. Advise Owner of pending insurance change-over requirements.
  5. Submit specific warranties, workmanship/maintenance bonds, maintenance agreements, final certifications and similar documents.
  6. Obtain and submit releases enabling Owner's full and unrestricted use of the Work and access to services and utilities, including (where required) occupancy permits, operating certificates and similar releases.
  7. Deliver tools, spare parts, extra stocks of materials and similar physical items to Owner.
  8. Complete start-up testing of systems and instructions of Owner's operating/maintenance personnel. Discontinue (or change over) and remove from project site temporary facilities and services, along with construction tools and facilities, mock-ups and similar elements.
  9. **Deliver original, fully executed hard PERMIT Card with all appropriate signatures indicating each applicable Division is finally completed and signed off by the appropriate tradesperson.**
- B. Upon receipt of Contractor's request, Architect/Engineer will either proceed with inspection or advise contractor of prerequisites not fulfilled. Following initial inspection, Architect/Engineer will either prepare certificate of substantial completion or advise the contractor of work which must be performed prior to issuance of certificate; and repeat inspection when requested and assured that work has been substantially completed. Results of completed inspection will form initial "punch-list" for final acceptance.

**PREREQUISITES TO FINAL ACCEPTANCE**

- A. Prior to requesting Architect's/Engineer's final inspection for certification of final acceptance and final payment as required by General Conditions, complete the following and list known exceptions (if any) in request:
1. Submit final payment request with final releases and supporting documentation not previously

submitted and accepted. Include certificates of insurance for products and completed operations where required.

2. Submit updated final statement accounting for additional (final) changes to Contract Sum.
3. Submit certified copy of Architect's/Engineer's final punch-list of itemized work to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance, endorsed and dated by Architect/Engineer.
4. Submit final meter readings for utilities, measured record of stored fuel and similar data as of time of substantial completion or when Owner took possession of and responsibility for corresponding elements of the work.
5. Submit original Consent of Surety.
6. Submit final liquidated damages settlement statement, acceptable to Owner.
7. Submit record drawings, maintenance manuals, final project photographs, damage or settlement survey, property survey and similar final record information.
8. Complete final cleaning up requirements, including touch-up of marred surfaces.
9. Touch-up and otherwise repair and restore marred exposed finishes.
10. Revise and submit evidence of final, continuing insurance coverage complying with insurance requirements.
11. Certificates of elevator inspection.
12. Mechanical:
  - a. Air System Test and Balance (prepared by Owner's independent agent)
  - b. Piping pressure tests and certificates
  - c. Project certification
13. Electrical:
  - a. System tests
  - b. Project certification

**B. Re-inspection Procedure:**

Upon receipt of Contractor's notice that work has been completed including punch-list items resulting from earlier inspections, and excepting incomplete items delayed because of acceptable circumstances, Architect/Engineer will re-inspect work. Upon completion of re-inspection, Architect/Engineer will either prepare certificate of final acceptance or advise Contractor of work not completed or obligations not fulfilled as required for final acceptance. If necessary, procedure will be repeated.

If re-inspections of above referenced items are required by the Architect/Engineer due to the failure of any of the Work to comply with the claims made by the Contractor as to the status of their completeness, the Owner will deduct the costs incurred by such re-inspections from the Contract amount.

**RECORD DOCUMENT SUBMITTAL:**

- A. Specific requirements for record documents are indicated in individual sections of these specifications. Other

requirements are indicated in General Conditions. General submittal requirements are indicated in Section 01 33 00. Do not use record documents for construction purposes; protect from deterioration and loss in a secure, fire-resistive location; provide access to record documents for Architect's/Engineer's reference during normal working hours.

At time of final acceptance, submit complete sets of all required record documents to the Architect/Engineer for Owner's records.

**B. Record Drawings:**

Maintain a white-print set of contract drawings and shop drawings in clean, undamaged condition with mark-up of actual installations which vary substantially from the work as originally shown. Mark whichever drawings are most capable of showing "field" condition fully and accurately; however, where shop drawings are used for mark-up, record a cross-reference at corresponding location on working drawings. Mark-up new information which is recognized to be of importance to Owner but was for some reason not shown on either contract drawings or shop drawings. Give particular attention to concealed work which would be difficult to measure and record at a later date. Note related change order numbers where applicable.

Upon completion of the Work, this data shall be recorded to scale, by a competent draftsman on transparent paper of the Contract Drawings. Where changes are to be recorded, the prints shall be erased in such a way as to properly represent the work as installed. Where the work was installed exactly as shown on the Contract drawings, the prints shall not be disturbed. In showing the changes, the same legend shall be used to identify piping, etc., as was used on the Contract Drawings.

The Contractor shall review the completed record drawings and ascertain that all data furnished on the drawings are accurate and truly represent the Work as actually installed. When manholes, boxes, underground conduits, plumbing, hot or chilled water lines, etc., are involved as part of the Work, the Contractor shall furnish true elevations and locations, all properly referenced for the site. Information for reference data can be obtained from the office of the Architect/Engineer. Upon completion, the subcontractor involved shall date and sign the drawings, signifying compliance with the requirements set forth herein prior to submission of prints required.

The Contractor shall sign all pages to certify completeness of the Record Set of Drawings. Contractor shall submit the two sets of prints to the Architect/Engineer for the Owner.

**C. Record Specifications:**

Maintain one copy of specifications including addenda, change orders and similar modifications issued in printed form during construction and mark-up variations (of substance) in actual Work in comparison with text of specifications and modifications as issued. Give particular attention to substitutions, selection of options and similar information on work where it is concealed or cannot otherwise be readily discerned at a later date by direct observation. Note related record drawing information and product data where applicable.

**D. Record Shop Drawings and Product Data:**

Maintain one copy of each product data submittal and mark-up significant variations in actual work in comparison with submitted information. Include both variations from manufacturer's instructions and recommendations for installation. Give particular attention to concealed products and portions of the Work which cannot otherwise be readily discerned at a later date by direct observation. Note related change orders and mark-up or record drawings and specifications.

**E. Record Sample Submittal:**

Immediately prior to date(s) of substantial completion, Architect/Engineer (and including Owner's personnel where desired) will meet with Contractor at site and will determine which (if any) of submitted samples maintained by Contractor during progress of the work are to be transmitted to Owner for record purposes. Comply with Architect's/Engineer's instructions for packaging, identification marking and delivery to owner's

sample storage space.

F. Miscellaneous Record Submittals:

Refer to other sections of these specifications for requirements of miscellaneous record-keeping and submittals in connection with actual performance of the Work. Immediately prior to date(s) of substantial completion, complete miscellaneous records and place in good order, properly identified and bound or filed, ready for continued use and reference.

G. Operation and Maintenance Data: See section 01 78 23

I. Warranties and Bonds: See section 01 78 00

FINAL CLEANING

A. Special cleaning for specific units of work is specified in sections of Divisions 2 through 16. General cleaning during progress or work is specified in General Conditions and as temporary service in "Temporary Facilities" section of this Division. Provide final cleaning of the work at time indicated, consisting of cleaning each surface or unit of Work to normal "clean" condition expected for a first-class building cleaning and maintenance program. Comply with manufacturer's instructions for cleaning operations. The following are examples of cleaning levels required:

1. Remove labels which are not required as permanent labels.
2. Clean transparent materials including mirrors and window or glass to a polished condition removing substances which are noticeable as vision-obscuring materials. replace broken glass and damaged transparent materials.
3. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of dust, stains, films and similar noticeable distracting substances. Avoid disturbance of natural weathering of exterior surfaces. Restore reflective surfaces to original reflective condition.
4. Wipe surfaces of mechanical and electrical equipment clean; remove excess lubrication and other substance.
5. Remove debris and surface dust from limited-access spaces including roofs, plenums, shafts, trenches, equipment vaults, manholes and similar spaces.
6. Clean concrete floors in non-occupied spaces broom clean.
7. Vacuum clean carpeted surfaces and similar soft surfaces.
8. Clean plumbing fixtures to a sanitary condition free of stains including those resulting from water exposure.
9. Clean light fixtures and lamps so as to function with full efficiency.
10. Clean project site (yard and grounds) of litter and foreign substances. Sweep paved areas to a broom-clean condition; remove stains, petro-chemical spills and other foreign deposits. Rake grounds which are neither planted nor paved, to a smooth, even-textured surface.
11. Vacuum clean and sanitize all cabinetwork, equipment, etc. for a move-in condition.

B. Removal of Protection:

Remove temporary protection devices and facilities which were installed during course of the Work to protect

previously completed Work during remainder of construction period.

C. Compliances:

Comply with safety standards and governing regulations for cleaning operations. Do not burn waste materials at site or bury debris or excess materials on Owner's property or discharge volatile or other harmful or dangerous materials into drainage systems; remove waste materials from site and dispose of in a lawful manner.

Where extra materials of value remaining after completion of associated Work have become Owner's property, dispose of these to Owner's best advantage as directed.

CLOSEOUT DOCUMENTS CHECKLIST

All items listed below, with the exception of Item No. 1 and Item No. 2 shall be bound in individual heavy duty 3-ring vinyl covered binders. Mark appropriate identification on front and spine of each binder.

All items shall be submitted in triplicate within fifteen day of Substantial Completion for the project.

1. Application and Certification for Payment (Final). Four copies with original signatures and seals.
2. Final schedule of contract values. Four copies attached to Application and Certification for Payment.
3. Contractor's Affidavit of Payment of Debts (AIA G706).
4. Contractor's Affidavit of Release of Liens from all Contractors, Subcontractors, and Suppliers (AIA G706A).
5. Power of Attorney from Surety to make Final Payment.
6. Consent of Surety to Final Payment (AIA G707).
7. Contractor's Guarantee and Warranties as specified under Division 01740.
8. Fully executed Roof Warranty in the name of the Owner.
9. Special warranties as required by the specifications, in the name of the Owner.
10. Provide a list summarizing the various guarantees and warranties and stating the following with respect to each:
  - a. Character of work affected.
  - b. Name, address and telephone number of each Subcontractor.
  - c. Name, address and telephone number of each local firm designated to provide warranty service for an out-of-town firm. Copy of agreement between the firms.
  - d. Period of guarantee and effective date.
  - e. Statement of guarantee in the following form.

"If within any guarantee period, repairs or changes are required in conjunction with the guarantee work, which in the opinion of the Architect or Engineer is rendered necessary as the result of the use of materials, equipment or workmanship, which are defective or inferior, or not in accordance with the terms of the Contract, the Contractor shall, upon written notice from the Owner, and without expense to the Owner, proceed within twenty four (24) hours to place in satisfactory condition in every particular all of such guaranteed work, correct all defects therein; and make good all damages to the structure or site or equipment or contents thereof disturbed in fulfilling any such guarantee work.

11. Verification that the Owner's personnel has been trained in the use of their new equipment. Submit attendance lists and videotape record of all training sessions.



12. Operation and Maintenance Manuals.
13. Equipment Inventory List - A list of the following equipment furnished for the project, to include drawings code designation, location (FISH number) description, manufacturer, full model number, serial number, warranty period and warranty expiration date.
  - a. All HVAC equipment.
  - b. Any plumbing equipment which carries a serial number (water heaters, compressors, electric water coolers, etc.)
  - c. Emergency generator.
  - d. Contractor furnished appliances.
14. Notarized Affidavit of all Subcontractor payrolls, bills for materials/equipment and other indebtedness paid and satisfied.
15. As-built drawings. Provide in accordance with other specification sections.
16. Energy management system programming, operation, maintenance, and parts service manuals. Guaranteed parts price list.
17. Punch lists signed off by Owner's Representatives.

**END OF SECTION 01 70 00**

## SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
  - 1. Disposing of nonhazardous **demolition and construction** waste.

## 1.2 DEFINITIONS

- A. Construction Waste: Building, structure, and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building, structure, and site improvement materials resulting from demolition operations.
- C. Disposal: Removal of demolition or construction waste and subsequent salvage, sale, recycling, or deposit in landfill, incinerator acceptable to authorities having jurisdiction, or designated spoil areas on Owner's property.

## 1.3 QUALITY ASSURANCE

- A. Waste Management Coordinator Qualifications: Experienced firm, or individual employed and assigned by General Contractor, with a record of successful waste management coordination of projects with similar requirements.

## 1.4 WASTE MANAGEMENT PLAN

- A. Submit waste management plan.

## PART 2 - PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

## PART 3 - EXECUTION

## 3.1 PLAN IMPLEMENTATION

- A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
- B. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Comply with Section 015000 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

### 3.2 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged or recycled, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
  1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
  2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. General: Except for items or materials to be salvaged or recycled, remove waste materials and legally dispose of at designated spoil areas on Owner's property.
- C. Burning: Do not burn waste materials.

END OF SECTION 017419

**SECTION 01 74 00 - WARRANTIES AND BONDS****PART 1 - GENERAL****REQUIREMENTS:**

- A. Preparation and submittal of warranties and bonds.
- B. Schedule of submittals.

**RELATED REQUIREMENTS:**

- A. Section of 01 70 00 - Contract Closeout
- B. Individual Specifications Sections: Warranties and bonds required for specific Products or work.

**FORM OF SUBMITTALS:**

Bind with operation and maintenance manuals specified in Section 01 73 00.

**PREPARATION OF SUBMITTALS:**

- A. Obtain warranties and bonds, executed in triplicate (3) by responsible subcontractors, suppliers, and manufacturers within ten days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until the Date of Substantial completion is determined.
- B. Verify that documents are in proper form, contain full information, and are notarized.
- C. Co-execute submittals when required.
- D. Retain warranties and bonds until time specified for submittal.

**TIME OF SUBMITTALS:**

- A. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within ten days after acceptance.
- B. For items of Work when acceptance is delayed beyond Date of Substantial Completion, submit within ten days after acceptance, listing the date of acceptance as the beginning of the warranty period.

**PART 2 - PRODUCTS**

Not used.

**PART 3 - EXECUTION****WARRANTY SERVICE**

- A. The Contractor shall proceed with warranty repair or replacement within 24 hours of being notified that a warranty deficiency exists.
- B.

**END OF SECTION 01 74 00**

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## SECTION 01 73 00 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERALREQUIREMENTS:

- A. Format and content of manuals.
- B. Instruction of Owner's personnel.
- C. Schedule of submittals.

RELATED REQUIREMENTS:

- A. Shop Drawings, Product Data, and Samples.
- B. Testing, Adjusting, and Balancing of Systems: Test and balance reports.
- C. Section 01 70 00 - Contract Closeout
- D. Warranties and Bonds
- E. Individual Specification Sections: Specific requirements for operation and maintenance data.

FORMAT:

- A. Prepare data in the form of an instructional manual.
- B. Electronic Format on DVD
- C. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; list title of Project; use volumes as needed.
- D. Arrange content by systems, process flow, under section numbers and sequence of Table of Contents of this Project Manual.
- E. Provide tabbed fly leaf for each separate project and system, with typed description of product and major component parts of equipment.
- F. Text: Manufacturer's printed data, or typewritten data.pdf format on DVD
- G. Drawings: Electronic on DVD

CONTENTS OF EACH VOLUME:

- A. Table of Contents: Provide title of Project; names, addresses, and telephone numbers of Architect/Engineer and Contractor with name of responsible parties; schedule of products and systems, indexed to content of the volume.
- B. For Each Product or System: List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
- C. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation; delete inapplicable information.
- D. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to

show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.

- E. Warranties and Bonds: Bind in copy of each.

MANUAL FOR MATERIALS AND FINISHES:

- A. Building Products, Applied Materials, and Finishes: Include product data, with catalog number, size, composition, color and texture designations. provide information for re-ordering custom manufactured products.
- B. Instructions for Care and Maintenance: Include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- C. Moisture-protection and Weather-exposed Products: Include product data listing applicable reference standards, chemical composition, and details of installation; delete inapplicable information.
- D. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.
- E. Warranties and Bonds: Bind in copy of each.

MANUAL FOR MATERIALS AND FINISHES:

- A. Building Products, Applied Materials, and Finishes: Include product data, with catalog number, size, composition, and color and texture designations. Provide information for re-ordering custom manufactured products.
- B. Instructions for Care and Maintenance: Include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- C. Moisture-protection and Weather-exposed Products: Include product data listing applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance, and repair.
- D. Additional Requirements: As specified in individual Specifications sections.

MANUAL FOR EQUIPMENT AND SYSTEMS:

- A. Each Item of Equipment and Each System: Include description of unit or system, and component parts. Give function, normal operating characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number or replaceable parts.
- B. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications.
- C. Include as-installed color coded wiring diagrams.
- D. Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
- E. Maintenance Requirements: Include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- F. provide servicing and lubrication schedule, and list of lubricants required.

- G. Include manufacturer's printed operations and maintenance instructions.
- H. Include sequence of operation by controls manufacturer.
- I. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- J. Provide as-installed control diagrams by controls manufacturer.
- K. Provide Contractor's coordination drawings, with as-installed color coded piping diagrams.
- L. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- M. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- N. Include test and balancing reports as specified.
- O. Additional Requirements: As specified individual specifications sections.
- P. Provide a listing in Table of Contents for design data, with tabbed fly sheet and space for insertion of data.

INSTRUCTION OF OWNER PERSONNEL:

- A. Before final inspection, instruct Owner's designated personnel in operation, adjustment, and maintenance of products, equipment, and systems, at agreed upon times.
- B. Use operation and maintenance manuals as basis of instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.
- C. Prepare and insert additional data in Operation and Maintenance Manual when need for such data become apparent during instruction.

SUBMITTALS:

- A. Submit one (1) copy of completed volumes in final form 15 days prior to final inspection. Copy will be returned after final inspection, with Architect/Engineer comments. Revise content of documents as required prior to final submittal.
- B. Submit three (3) copies of revised volumes of data in final form within ten days after final inspection.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

**END OF SECTION 01 73 00**



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## SECTION 017839 - PROJECT RECORD DOCUMENTS

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for Project Record Documents, including the following:
1. Record Drawings.
  2. Record specifications.
  3. Record Product Data.
- B. Related Requirements:
1. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

## 1.2 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
- 1) Submit PDF electronic files of scanned Record Prints.
  2. Final Submittal:
    - 1) Submit Record Digital Data Files.
- B. Record Product Data: Submit **annotated PDF electronic files and directories** of each submittal.
1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

## 1.3 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
1. Preparation: Mark record prints to show the actual installation, where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
    1. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
    2. Accurately record information in an acceptable drawing technique.
    3. Record data as soon as possible after obtaining it.
    4. Record and check the markup before enclosing concealed installations.
    5. Cross-reference record prints to corresponding photographic documentation.
  2. Content: Types of items requiring marking include, but are not limited to, the following:

1. Dimensional changes to Drawings.
  2. Revisions to details shown on Drawings.
  3. Depths of foundations.
  4. Locations and depths of underground utilities.
  5. Revisions to routing of piping and conduits.
  6. Revisions to electrical circuitry.
  7. Actual equipment locations.
  8. Duct size and routing.
  9. Locations of concealed internal utilities.
  10. Changes made by Change Order or **Construction Work** Change Directive.
  11. Changes made following Architect's written orders.
  12. Details not on the original Contract Drawings.
  13. Field records for variable and concealed conditions.
  14. Record information on the Work that is shown only schematically.
3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
  4. Mark record prints with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
  5. Mark important additional information that was either shown schematically or omitted from original Drawings.
  6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
1. Format: Annotated PDF electronic file **with comment function enabled**.
  2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
  3. Architect will furnish Contractor with one set of PDF files of the Contract Drawings for use in recording information.
- C. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
  2. Format: Annotated PDF electronic file **with comment function enabled**.
  3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
  4. Identification: As follows:
    1. Project name.
    2. Date.
    3. Designation "PROJECT RECORD DRAWINGS."
    4. Name of Architect
    5. Name of General Contractor and Trade Contractor.
    6. Name of Contractor.

#### 1.4 RECORD PRODUCT DATA

- A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and revisions to Project Record Documents as they occur; do not wait until end of Project.
- B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
  - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
  - 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
- C. Format: Submit Record Product Data as **annotated PDF electronic file** or **scanned PDF electronic file(s) of marked-up paper copy of Product Data**.
  - 1. Include Record Product Data directory organized by Specification Section number and title, electronically linked to each item of Record Product Data.

#### 1.5 MAINTENANCE OF RECORD DOCUMENTS

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017839

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**SECTION 01 79 00 - DEMONSTRATION AND TRAINING****PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
  - 1. Demonstration of operation of systems, subsystems, and equipment.
  - 2. Training in operation and maintenance of systems, subsystems, and equipment.
- B. See Divisions 02 through 49 Sections for specific requirements for demonstration and training for products in those Sections.

**PART 2 - PRODUCTS****2.1 INSTRUCTION PROGRAM**

- A. Program Structure: Develop an instruction program that includes individual training for each system and equipment not part of a system, as required by individual Specification Sections, and as follows:
- B. Training Modules: For each module, include instruction for the following:
  - 1. Basis of System Design, Operational Requirements, and Criteria: Include system and equipment descriptions, operating standards, regulatory requirements, equipment function, operating characteristics, limiting conditions, and performance curves.
  - 2. Documentation: Review emergency, operations, and maintenance manuals; Project Record Documents; identification systems; warranties and bonds; and maintenance service agreements.
  - 3. Emergencies: Include instructions on stopping; shutdown instructions; operating instructions for conditions outside normal operating limits; instructions on meaning of warnings, trouble indications, and error messages; and required sequences for electric or electronic systems.
  - 4. Operations: Include startup, break-in, control, and safety procedures; stopping and normal shutdown instructions; routine, normal, seasonal, and weekend operating instructions; operating procedures for emergencies and equipment failure; and required sequences for electric or electronic systems.
  - 5. Adjustments: Include alignments and checking, noise, vibration, economy, and efficiency adjustments.
  - 6. Troubleshooting: Include diagnostic instructions and test and inspection procedures.
  - 7. Maintenance: Include inspection procedures, types of cleaning agents, methods of cleaning, procedures for preventive and routine maintenance, and instruction on use of special tools.
  - 8. Repairs: Include diagnosis, repair, and disassembly instructions; instructions for identifying parts; and review of spare parts needed for operation and maintenance.

**PART 3 - EXECUTION**

**3.1 INSTRUCTION**

- A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
- 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 with at least seven days' advance notice.

**END OF SECTION 01 79 00**

**SECTION 01 8900 - SITE CONSTRUCTION PERFORMANCE REQUIREMENTS****PART 1 GENERAL****1.01 SCOPE OF WORK**

- A. Site work includes the work shown and reasonably inferred from the drawings, technical specifications, and contract documents. Provide materials, labor, equipment and supervision required to perform the work complete.
- B. The scope of site work includes, but is not limited to the following:
  - 1. Construction staking and other construction engineering required to control the work.
  - 2. Erosion and sedimentation control construction.
  - 3. Temporary groundwater control.
  - 4. Site preparation, including stripping and undercutting unsuitable subgrade soils, demolition, and removal from the project lands of materials not to be used for construction.
  - 5. Site grading, including excavation, filling, compaction, and preparation of subgrades for paving. Site grading includes importing material, stockpiling and hauling from stockpiles, and other work necessary to construct embankments and excavations as shown and specified.
  - 6. Construction and building pads and staging areas.
  - 7. Coordination of temporary utilities.
  - 8. Installation of the site drainage system complete, including building roof drain laterals.
  - 9. Installation of water distribution and sanitary sewer system complete, including service laterals.
  - 10. Construction of curbs.
  - 11. Construction of paving.
  - 12. Striping and traffic control.
  - 13. Backfilling curbs and islands with approved soils for planting.
  - 14. Backfilling walls.
  - 15. Installation and coordination of temporary warning signs, directional signs, barricades and fences required to direct, control and protect the public throughout the construction period.
  - 16. Coordination of installation of light poles and conduits.

**1.02 SAFETY**

- A. Safety & Protection: Initiate, maintain, and supervise safety precautions and programs in connection with the Work. Take necessary precautions for the safety of, and provide the necessary protection to prevent damage, injury or loss to employees on the job and other persons or organizations.
- B. Safe trench construction is mandatory. Lay back slopes or shore as necessary.
- C. Control traffic during operations on existing streets.
- D. Erect and maintain barricades, fences, and other physical blockages sufficient to exclude the public from construction areas.

**1.03 PROTECTION OF ADJACENT LANDS**

- A. Limit construction to areas so indicated on the drawings and designated by the Owner. Protect areas beyond the construction which are subject to the effect or byproduct of the construction effort.
- B. Make special effort to prevent soil erosion and sediment transport onto adjacent lands. Restore disturbance to areas outside the designated construction limits to a satisfactory condition, as determined by the Owner or governing authority, at no cost to the Owner.
- C. Take precautionary measures to prevent damage to the adjoining public street system. Clean mud or debris deposited as a result of this construction.
- D. Perform construction on the right-of-way or on other properties not in possession of the Owner in strict accordance with the terms of the permits or easements. Obtain copies of permit and easement conditions affecting the work.



#### 1.04 CONSTRUCTION ENGINEERING

- A. Provide construction staking, dimensional control, and related construction engineering for phases of the Work.

#### 1.05 GEOTECHNICAL ENGINEERING

- A. Geotechnical quality control services will be performed by a geotechnical engineering firm (referred to as the Geotechnical Engineer) selected and hired by the Owner.
- B. Provide in cooperation with the Geotechnical Engineer, as a minimum, monitoring and testing services of earthwork, drainage, utility construction, site preparation and demucking, underdrain construction, and pavement construction. Report results of tests verbally on completion of the work and provide daily written reports at the job site.
  1. Fill Placement: Monitor placement of fill for suitability of fill materials, uniformity of compaction operations, and compliance with aspects of these Specifications. Test soil fill for compliance with compaction requirements. Monitor rock fill for appropriate placement procedures, particle size, and lift thickness.
  2. Stripping and Demucking: Evaluate subgrades upon which fill is to be placed prior to fill placement. Monitor conditions and make appropriate recommendations. In the event of unstable subgrades, soil bridging, or provide stabilization stone as required. Discuss with the Owner, who will then authorize the procedure to be used.
  3. Underdrains: Monitor underdrain construction for compliance with the plans and specifications. If unforeseen conditions which impact the design and construction of underdrains are encountered, make appropriate recommendations to the Owner.
  4. Underground Utilities: Monitor installation of underground utilities and structures for compliance to specifications for materials, procedures, and workmanship. Evaluate the suitability of the subgrade upon which the pipes are to be constructed. Issue appropriate recommendations if unsuitable conditions are detected.
  5. Backfilling: Monitor backfills and test to evaluate compliance with the specifications.
  6. Retaining Walls: Provide monitoring and testing services during construction of retaining walls. The actual scope of these services will be dependent upon the type of wall used. Comply with the practice recommended by the designer of the wall system.
  7. Pavements: Monitor preparation and proofrolling of the soil subgrade upon which pavements are to be constructed. When unstable soils are encountered, recommend appropriate remedial action to the Owner, who will then direct the Contractor as to the course of action. Monitor construction of the pavement system. Test thickness, gradations, and compactions of base course and surface course.

#### 1.06 RESPONSIBILITY OF THE CONTRACTOR

- A. The Contractor is responsible for compliance with the Contract Documents. Monitoring and testing by the Geotechnical Engineer does not infer acceptance of responsibility by the Geotechnical Engineer, the Architect, the Engineer, or the Owner. When monitoring and testing indicates that construction does not meet Specification requirements, rework to obtain compliance.

#### 1.07 AS-BUILT PLANS

- A. Maintain "Contractor's mark-up as-built" plans of construction. Certify the accuracy and completeness of these plans and deliver to the Owner. The Owner shall deliver a sepia reproducible, if requested, to facilitate final recording.
- B. Prepare as-built plans of construction to be dedicated to Governmental entities and deliver in a form that is acceptable to the receiving agency.
- C. As-built topographic maps of detention structures are required. Provide a topographic survey sufficient to confirm structure volume as well as dimensions and deviations of outlet structures.
- D. Retain a registered surveyor to certify as-built surveys required above.

#### 1.08 PAYMENT

- A. The Technical Specifications for Sitework contain limited information relative to payment. Consult other divisions for detailed payment provisions.

**END OF SECTION**

**SECTION 02 4113 - SELECTIVE SITE DEMOLITION****PART 1 GENERAL****1.01 SCOPE OF WORK**

- A. Provide labor, material and equipment necessary to remove existing building, equipment pads, foundations, paving, curb and gutter, underground tanks, pipes and utilities and site items as required.

**1.02 SUBMITTALS**

- A. Schedule: Submit proposed methods and operations of demolition to the Owner for review prior to the start of work. Include in the schedule the coordination for shut-off, capping and continuation of utility services as required. Obtain necessary permits required for demolition and submit copies to the Owner before beginning demolition work.

**1.03 PROTECTION**

- A. Protection of Existing Work: Before beginning cutting or demolition work, carefully survey the existing work and examine the drawings and specifications to determine the extent of the work. Take necessary precautions to insure against damage to existing work to remain in place, to be reused, or to remain the property of the Owner. Repair or replace damage to work at no additional cost to the Owner. Carefully coordinate the work of this section with other work and construct and maintain shoring, bracing and supports, as required. Ensure that structural elements are not overloaded. Increase structural supports or add new supports as required as a result of cutting, removal, or demolition work performed.

**PART 2 PRODUCTS****2.01 MATERIALS**

- A. Use the proper tools and equipment to complete the work in a safe, non-hazardous manner.

**PART 3 EXECUTION****3.01 DEMOLITION**

- A. Structures: Demolish existing structures by breaking these materials into smaller pieces for transport. The use of explosives is not permitted.
- B. Utilities: Remove or abandon in place existing utilities as indicated on the drawings. Disconnect utility services, with related meters and equipment, employing appropriate utility company. When utility lines are encountered that are not indicated on the drawings, notify the Owner.

**3.02 DISPOSITION OF MATERIALS**

- A. Dispose of demolished materials off of the project site unless otherwise notified by the Owner. Transport materials in a manner that will prevent spillage on streets and adjacent areas. Dispose of materials in a manner acceptable to the regulatory agency having jurisdiction.

**3.03 PROTECTION OF TREES**

- A. Protect trees to remain in the manner described in the Section CLEARING AND GRUBBING.
- B. Provide tree protection measures prior to beginning of demolition and maintain throughout the work period.

**3.04 BACKFILLING AND COMPACTION**

- A. Backfill holes and depressions resulting from demolition as specified in the Section EARTHWORK.
- B. Meet backfill requirements for the final intended use of the area. Where the final use is undefined, meet as a minimum the backfill requirements for General Area Fill.

END OF SECTION

## SECTION 024119 - SELECTIVE DEMOLITION

## PART 1 - GENERAL

## 1.1 SUMMARY

## A. Section Includes:

1. Demolition and removal of selected portions of building or structure.

## 1.2 MATERIALS OWNERSHIP

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

## 1.3 PREINSTALLATION MEETINGS

- A. Pre-demolition Conference: Conduct conference at **Project site**.

## 1.4 INFORMATIONAL SUBMITTALS

- A. Engineering Survey: Submit engineering survey of condition of building.
- B. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, **for environmental protection , for dust control and , for noise control** . Indicate proposed locations and construction of barriers.
- C. Schedule of selective demolition activities with starting and ending dates for each activity.
- D. Pre-demolition photographs or video.

## 1.5 CLOSEOUT SUBMITTALS

- A. Inventory of items that have been removed and salvaged.

## 1.6 FIELD CONDITIONS

1. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- B. Storage or sale of removed items or materials on-site is not permitted.
- C. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.
- D. Arrange selective demolition schedule so as not to interfere with Owner's operations.

## 1.7 WARRANTY

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

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI/ASSP A10.6 and NFPA 241.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. **Perform** an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.

### 3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.
  1. Arrange to shut off utilities with utility companies.
  2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
  3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.

- a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
  - b. Equipment to Be Removed: Disconnect and cap services and remove equipment.
  - c. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
- C. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
- D. Rooftop mechanical equipment scheduled to be removed. See mechanical: Seal abandoned curb with rovide Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 (Z275) coating designation Provide supplemental steel framing as required to support new cap. Nominal Thickness: **0.052 inch (1.32 mm)**. Insulate with Batt Insulation to match R value of existing roof.
- 1)

### 3.3 PROTECTION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
- B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
- C. Remove temporary barricades and protections where hazards no longer exist.

### 3.4 SELECTIVE DEMOLITION

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
  - 1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
  - 2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
  - 3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
  - 4. Maintain fire watch during and for at least hours after flame-cutting operations.
  - 5. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
  - 6. Dispose of demolished items and materials promptly.

- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- C. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition.

### 3.5 CLEANING

- A. Remove demolition waste materials from Project site
  - 1. Do not allow demolished materials to accumulate on-site.
  - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
  - 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
- B. Burning: Do not burn demolished materials.
- C. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 024119

**SECTION 03 10 00 – CONCRETE FORMING AND ACCESSORIES****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Form-facing material for cast-in-place concrete.
  - 2. Shoring, bracing, and anchoring.
- B. Related Requirements:
  - 1. Section 01 33 00 – Submittal Procedures.
  - 2. Section 01 33 30 – Structural Submittal Procedures.
  - 3. Section 01 40 00 – Quality Requirements.
  - 4. Section 01 45 25 – Structural and Special Inspection/Testing Agency Services.
  - 5. Section 03 20 00 – Concrete Reinforcing.
  - 6. Section 03 30 00 – Cast-in-Place Concrete.

**1.2 REFERENCE STANDARDS**

- A. American Concrete Institute (ACI):
  - 1. ACI 117 – Specification for Tolerances for Concrete Construction and Materials.
  - 2. ACI 301 – Specifications for Structural Concrete.
  - 3. ACI 318 – Building Code Requirements for Structural Concrete.
- B. American Institute of Steel Construction (AISC):
  - 1. ANSI/AISC 303 – Code of Standard Practice for Steel Buildings and Bridges.
- C. APA – The Engineered Wood Association (APA):
  - 1. APA Form No. V345 – Concrete Forming: Design/Construction Guide.

**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 ACTION SUBMITTALS**

- A. Product Data: For each of the following:
  - 1. Exposed surface form-facing material.
  - 2. Concealed surface form-facing material.
  - 3. Form ties.
  - 4. 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. Indicate the proposed schedule and sequence of stripping of forms, shoring removal, and reshoring installation and removal.

**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 the 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 "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.

## 2.2 FORM-FACING MATERIALS

- A. Exposed As-Cast Surface Form-Facing Material:
  - 1. Provide continuous, true, and smooth concrete surfaces.
  - 2. Furnish in the largest practicable sizes to minimize the number of joints.
  - 3. Acceptable Materials: As required to comply with Surface Finish designations specified in Section 03 30 00 – Cast-in-Place Concrete, and as follows:
    - a. Plywood, metal, or other approved panel materials.
- B. Concealed Surface Form-Facing Material: Lumber, plywood, metal, plastic, or another approved material.
  - 1. Provide lumber dressed on at least two edges and one side for a tight fit.

## 2.3 RELATED MATERIALS

- A. Form Ties: Factory-fabricated, removable or snap-off, glass-fiber-reinforced plastic or metal form ties designed to resist the lateral pressure of fresh concrete on forms and designed 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.
- B. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 inch by 3/4 inch, minimum.
- C. 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.

## 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 03 30 00 – Cast-in-Place Concrete for as-cast finishes.
  - 1. Where indicated on the drawings, camber formwork as directed.
- C. Limit concrete surface irregularities as follows:
  - 1. Surface Finish-1.0: ACI 117 Class D, 1 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, 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. Chamfer exterior corners and edges of permanently exposed concrete.
- I. At construction joints, overlap forms onto previously placed concrete not less than 12 inches.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.
  - 1. Do not allow form-release agent to accumulate in formwork.
  - 2. Do not allow form-release agent to contact concrete surfaces that fresh concrete will be placed against.

### 3.2 FORMING OF FOUNDATION ELEMENTS

- A. Foundation elements may be earth-formed if soil and site conditions permit.
- B. Sides of the following foundation elements may not be earth-formed:
  - 1. Exterior grade beams
  - 2. Foundation walls
  - 3. Turned-down slabs

### 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 ANSI/AISC 303, Section 7.5. Locate anchor rods by using templates with two nuts to secure rod in position.
  - 3. Clean embedded items immediately before concrete placement.

### 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 °F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing operations and protection operations need to be maintained.
  - 1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support the weight of concrete in place until the 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 the Architectural Design Professional.

### 3.5 FIELD QUALITY CONTROL

- A. Special Inspections: The Special Inspection/Testing Agency shall perform inspections and field tests and prepare test reports as required by the Building Code and Section 01 45 25 – Structural and Special Inspection/Testing Agency Services.
- B. Inspections:
  - 1. Inspect formwork for shape, location, and dimensions of the concrete member being formed.

**END OF SECTION 03 10 00**

**SECTION 03 10 00 – CONCRETE FORMING AND ACCESSORIES****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Form-facing material for cast-in-place concrete.
  - 2. Shoring, bracing, and anchoring.
- B. Related Requirements:
  - 1. Section 01 33 00 – Submittal Procedures.
  - 2. Section 01 33 30 – Structural Submittal Procedures.
  - 3. Section 01 40 00 – Quality Requirements.
  - 4. Section 01 45 25 – Structural and Special Inspection/Testing Agency Services.
  - 5. Section 03 20 00 – Concrete Reinforcing.
  - 6. Section 03 30 00 – Cast-in-Place Concrete.

**1.2 REFERENCE STANDARDS**

- A. American Concrete Institute (ACI):
  - 1. ACI 117 – Specification for Tolerances for Concrete Construction and Materials.
  - 2. ACI 301 – Specifications for Structural Concrete.
  - 3. ACI 318 – Building Code Requirements for Structural Concrete.
- B. American Institute of Steel Construction (AISC):
  - 1. ANSI/AISC 303 – Code of Standard Practice for Steel Buildings and Bridges.
- C. APA – The Engineered Wood Association (APA):
  - 1. APA Form No. V345 – Concrete Forming: Design/Construction Guide.

**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 ACTION SUBMITTALS**

- A. Product Data: For each of the following:
  - 1. Exposed surface form-facing material.
  - 2. Concealed surface form-facing material.
  - 3. Form ties.
  - 4. 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. Indicate the proposed schedule and sequence of stripping of forms, shoring removal, and reshoring installation and removal.

**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 the 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 "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.

## 2.2 FORM-FACING MATERIALS

- A. Exposed As-Cast Surface Form-Facing Material:
1. Provide continuous, true, and smooth concrete surfaces.
  2. Furnish in the largest practicable sizes to minimize the number of joints.
  3. Acceptable Materials: As required to comply with Surface Finish designations specified in Section 03 30 00 – Cast-in-Place Concrete, and as follows:
    - a. Plywood, metal, or other approved panel materials.
- B. Concealed Surface Form-Facing Material: Lumber, plywood, metal, plastic, or another approved material.
1. Provide lumber dressed on at least two edges and one side for a tight fit.

## 2.3 RELATED MATERIALS

- A. Form Ties: Factory-fabricated, removable or snap-off, glass-fiber-reinforced plastic or metal form ties designed to resist the lateral pressure of fresh concrete on forms and designed 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.
- B. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 inch by 3/4 inch, minimum.
- C. 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.

## 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 03 30 00 – Cast-in-Place Concrete for as-cast finishes.
1. Where indicated on the drawings, camber formwork as directed.
- C. Limit concrete surface irregularities as follows:
1. Surface Finish-1.0: ACI 117 Class D, 1 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, 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. Chamfer exterior corners and edges of permanently exposed concrete.
- I. At construction joints, overlap forms onto previously placed concrete not less than 12 inches.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.
  - 1. Do not allow form-release agent to accumulate in formwork.
  - 2. Do not allow form-release agent to contact concrete surfaces that fresh concrete will be placed against.

### 3.2 FORMING OF FOUNDATION ELEMENTS

- A. Foundation elements may be earth-formed if soil and site conditions permit.
- B. Sides of the following foundation elements may not be earth-formed:
  - 1. Exterior grade beams
  - 2. Foundation walls
  - 3. Turned-down slabs

### 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 ANSI/AISC 303, Section 7.5. Locate anchor rods by using templates with two nuts to secure rod in position.
  - 3. Clean embedded items immediately before concrete placement.

### 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 °F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing operations and protection operations need to be maintained.
  - 1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support the weight of concrete in place until the 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 the Architectural Design Professional.

### 3.5 FIELD QUALITY CONTROL

- A. Special Inspections: The Special Inspection/Testing Agency shall perform inspections and field tests and prepare test reports as required by the Building Code and Section 01 45 25 – Structural and Special Inspection/Testing Agency Services.
- B. Inspections:
  - 1. Inspect formwork for shape, location, and dimensions of the concrete member being formed.

**END OF SECTION 03 10 00**

**SECTION 03 20 00 – CONCRETE REINFORCING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Steel reinforcement bars.
  - 2. Welded-wire reinforcement.
- B. Related Requirements:
  - 1. Section 01 33 00 – Submittal Procedures.
  - 2. Section 01 33 30 – Structural Submittal Procedures.
  - 3. Section 01 40 00 – Quality Requirements.
  - 4. Section 01 45 25 – Structural and Special Inspection/Testing Agency Services.
  - 5. Section 03 30 00 – Cast-in-Place Concrete.

**1.2 REFERENCE STANDARDS**

- A. American Concrete Institute (ACI):
  - 1. ACI 117 – Specification for Tolerances for Concrete Construction and Materials.
  - 2. ACI 318 – Building Code Requirements for Structural Concrete.
  - 3. ACI MNL-66 – ACI Detailing Manual.
- B. American Welding Society (AWS):
  - 1. AWS D1.4 – Structural Welding Code – Reinforcing Steel.
- C. ASTM International (ASTM):
  - 1. ASTM A615 – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
  - 2. ASTM A706 – Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement.
  - 3. ASTM A970 – Standard Specification for Headed Steel Bars for Concrete Reinforcement.
  - 4. ASTM A1064 – Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
- D. Concrete Reinforcing Steel Institute (CRSI):
  - 1. CSRI Manual of Standard Practice.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For the following:
  - 1. Each type of steel reinforcement.
  - 2. Bar supports.
  - 3. Mechanical splice couplers.
- B. Shop Drawings: Comply with ACI MNL-66:
  - 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.



#### 1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
  - 1. Welded Reinforcement: Welding procedure specification in accordance with AWS D1.4.
- 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.
  - 2. Mechanical splice couplers.

#### 1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.4.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage and to avoid damaging coatings on steel reinforcement.
  - 1. Store reinforcement to avoid contact with earth.

### PART 2 - PRODUCTS

#### 2.1 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A615, Grade 60, deformed, unless noted otherwise.
- B. Low-Alloy Steel Reinforcing Bars: ASTM A706, Grade 60, deformed.
- C. Plain-Steel Welded-Wire Reinforcement: ASTM A1064, plain, fabricated from as-drawn steel wire into flat sheets.

#### 2.2 REINFORCEMENT ACCESSORIES

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

#### 2.3 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI "Manual of Standard Practice."
  - 1. Cold bend steel reinforcement.
  - 2. Do not flame cut steel reinforcement.

**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 “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 the size of large aggregate, whichever is greater.
- D. Provide concrete coverage in accordance with ACI 318.
- E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- F. Splices: Lap splices as indicated on Drawings.
  - 1. Bars indicated to be continuous, and all vertical bars to be lapped not less than 36 bar diameters at splices, or 24 inches, whichever is greater.
  - 2. Stagger splices in accordance with ACI 318.
  - 3. Mechanical Splice Couplers: Install in accordance with manufacturer’s instructions.
  - 4. Weld reinforcing bars in accordance with AWS D1.4, where indicated on Drawings.
- G. Provide dowels or mechanical splices at the intersection of walls, columns, and piers to fully develop reinforcing.

**3.3 INSTALLATION TOLERANCES**

- A. Comply with ACI 117.

**3.4 FIELD QUALITY CONTROL**

- A. Special Inspections: The Special Inspection/Testing Agency shall perform inspections and field tests and prepare test reports as required by the Building Code and Section 01 45 25 – Structural and Special Inspection/Testing Agency Services.
- B. Inspections:
  - 1. Steel-reinforcement placement including cover.
  - 2. Steel-reinforcement mechanical splice couplers.
  - 3. Steel-reinforcement welding.

**END OF SECTION 03 20 00**

**SECTION 03 20 00 – CONCRETE REINFORCING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Steel reinforcement bars.
  - 2. Welded-wire reinforcement.
- B. Related Requirements:
  - 1. Section 01 33 00 – Submittal Procedures.
  - 2. Section 01 33 30 – Structural Submittal Procedures.
  - 3. Section 01 40 00 – Quality Requirements.
  - 4. Section 01 45 25 – Structural and Special Inspection/Testing Agency Services.
  - 5. Section 03 30 00 – Cast-in-Place Concrete.

**1.2 REFERENCE STANDARDS**

- A. American Concrete Institute (ACI):
  - 1. ACI 117 – Specification for Tolerances for Concrete Construction and Materials.
  - 2. ACI 318 – Building Code Requirements for Structural Concrete.
  - 3. ACI MNL-66 – ACI Detailing Manual.
- B. American Welding Society (AWS):
  - 1. AWS D1.4 – Structural Welding Code – Reinforcing Steel.
- C. ASTM International (ASTM):
  - 1. ASTM A615 – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
  - 2. ASTM A706 – Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement.
  - 3. ASTM A970 – Standard Specification for Headed Steel Bars for Concrete Reinforcement.
  - 4. ASTM A1064 – Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
- D. Concrete Reinforcing Steel Institute (CRSI):
  - 1. CSRI Manual of Standard Practice.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For the following:
  - 1. Each type of steel reinforcement.
  - 2. Bar supports.
  - 3. Mechanical splice couplers.
- B. Shop Drawings: Comply with ACI MNL-66:
  - 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.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
  - 1. Welded Reinforcement: Welding procedure specification in accordance with AWS D1.4.
- 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.
  - 2. Mechanical splice couplers.

#### 1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.4.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage and to avoid damaging coatings on steel reinforcement.
  - 1. Store reinforcement to avoid contact with earth.

### PART 2 - PRODUCTS

#### 2.1 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A615, Grade 60, deformed, unless noted otherwise.
- B. Low-Alloy Steel Reinforcing Bars: ASTM A706, Grade 60, deformed.
- C. Plain-Steel Welded-Wire Reinforcement: ASTM A1064, plain, fabricated from as-drawn steel wire into flat sheets.

#### 2.2 REINFORCEMENT ACCESSORIES

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

#### 2.3 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI "Manual of Standard Practice."
  - 1. Cold bend steel reinforcement.
  - 2. Do not flame cut steel reinforcement.

**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 “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 the size of large aggregate, whichever is greater.
- D. Provide concrete coverage in accordance with ACI 318.
- E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- F. Splices: Lap splices as indicated on Drawings.
  - 1. Bars indicated to be continuous, and all vertical bars to be lapped not less than 36 bar diameters at splices, or 24 inches, whichever is greater.
  - 2. Stagger splices in accordance with ACI 318.
  - 3. Mechanical Splice Couplers: Install in accordance with manufacturer’s instructions.
  - 4. Weld reinforcing bars in accordance with AWS D1.4, where indicated on Drawings.
- G. Provide dowels or mechanical splices at the intersection of walls, columns, and piers to fully develop reinforcing.

**3.3 INSTALLATION TOLERANCES**

- A. Comply with ACI 117.

**3.4 FIELD QUALITY CONTROL**

- A. Special Inspections: The Special Inspection/Testing Agency shall perform inspections and field tests and prepare test reports as required by the Building Code and Section 01 45 25 – Structural and Special Inspection/Testing Agency Services.
- B. Inspections:
  - 1. Steel-reinforcement placement including cover.
  - 2. Steel-reinforcement mechanical splice couplers.
  - 3. Steel-reinforcement welding.

**END OF SECTION 03 20 00**

**SECTION 03 30 00 – CAST-IN-PLACE CONCRETE****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
1. Structural cast-in-place concrete materials, concrete mixture design, placement procedures, and finishes.
  2. Section not intended for concrete pavements, sidewalks, and ground-supported slabs not shown on the structural documents.
- B. Related Requirements:
1. Section 01 33 00 – Submittal Procedures.
  2. Section 01 33 30 – Structural Submittal Procedures.
  3. Section 01 40 00 – Quality Requirements.
  4. Section 01 45 25 – Structural and Special Inspection/Testing Agency Services.
  5. Section 03 10 00 – Concrete Forming and Accessories.
  6. Section 03 20 00 – Concrete Reinforcing.

**1.2 REFERENCE STANDARDS**

- A. American Association of State Highway and Transportation Officials (AASHTO):
1. AASHTO M 182 – Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats.
- B. American Concrete Institute (ACI):
1. ACI 117 – Specification for Tolerances for Concrete Construction and Materials.
  2. ACI 301 – Specifications for Structural Concrete
  3. ACI 302.1R – Guide to Concrete Floor and Slab Construction
  4. ACI 305.1 – Specification for Hot Weather Concreting.
  5. ACI 306.1 – Standard Specification for Cold Weather Concreting.
  6. ACI 308.1 – Specification for Curing Concrete.
  7. ACI 318 – Building Code Requirements for Structural Concrete.
- C. American Institute of Steel Construction (AISC):
1. ANSI/AISC 303 – Code of Standard Practice for Steel Buildings and Bridges.
- D. ASTM International (ASTM):
1. ASTM C31 – Standard Practice for Making and Curing Concrete Test Specimens in the Field.
  2. ASTM C33 – Standard Specification for Concrete Aggregates.
  3. ASTM C39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
  4. ASTM C42 – Stand Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
  5. ASTM C94 – Standard Specification for Ready-Mixed Concrete.
  6. ASTM C109 – Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50 mm] Cube Specimens).
  7. ASTM C138 – Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
  8. ASTM C143 – Standard Test Method for Slump of Hydraulic-Cement Concrete.
  9. ASTM C150 – Standard Specification for Portland Cement.
  10. ASTM C171 – Standard Specification for Sheet Materials for Curing Concrete.
  11. ASTM C172 – Standard Practice for Sampling Freshly Mixed Concrete.
  12. ASTM C173 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.

13. ASTM C219 – Standard Terminology Relating to Hydraulic and Other Inorganic Cements.
14. ASTM C231 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
15. ASTM C260 – Standard Specification for Air-Entraining Admixtures for Concrete.
16. ASTM C309 – Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
17. ASTM C494 – Standard Specification for Chemical Admixtures for Concrete.
18. ASTM C595 – Standard Specification for Blended Hydraulic Cements.
19. ASTM C618 – Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
20. ASTM C920 – Standard Specification for Elastomeric Joint Sealants.
21. ASTM C989 – Standard Specification for Slag Cement for Use in Concrete and Mortars.
22. ASTM C1017 – Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
23. ASTM C1059 – Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete.
24. ASTM C1064 – Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
25. ASTM C1240 – Standard Specification for Silica Fume Used in Cementitious Mixtures.
26. ASTM C1293 – Standard Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction.
27. ASTM C1315 – Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
28. ASTM C1567 – Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method).
29. ASTM C1602 – Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete.
30. ASTM C1778 – Standard Guide for Reducing the Risk of Deleterious Alkali-Aggregate Reaction in Concrete.
31. ASTM D1751 – Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
32. ASTM D2240 – Standard Test Method for Rubber Property – Durometer Hardness.
33. ASTM E1155 – Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers.
34. ASTM E1745 – Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

E. U.S. Army Corps of Engineers (USACE):

1. CRD-C 48 – Standard Test Method for Water Permeability of Concrete.

### 1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.
- B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.
- C. Concrete Elements in an Aggressive Environment: Concrete in any of the following elements:
  1. Exterior exposed concrete

### 1.4 ACTION SUBMITTALS

- A. Product Data: For each of the following.
  1. Portland cement.
  2. Fly ash.

3. Slag cement.
  4. Blended hydraulic cement.
  5. Silica fume.
  6. Aggregates.
  7. 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.
  8. Curing materials.
    - a. Include documentation from color pigment manufacturer, indicating that proposed methods of curing are recommended by color pigment manufacturer.
  9. 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.
  4. Maximum w/cm.
  5. Slump limit.
  6. Air content.
  7. Nominal maximum aggregate size.
  8. Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.
  9. Intended placement method.
  10. 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 Architectural Design Professional and Structural Design Professional.
- 1.5 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For the following:
1. Installer: Include copies of applicable ACI certificates.
  2. Ready-mixed concrete manufacturer.
- B. Material Certificates: For each of the following, signed by manufacturers:
1. Cementitious materials.
  2. Admixtures.
  3. Curing compounds.
  4. Bonding agents.
  5. Adhesives.
  6. Repair materials.
- 1.6 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 or an ACI Concrete Flatwork Technician.



- B. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94 requirements for production facilities and equipment.
  - 1. Manufacturer certified in accordance with NRMCA “Certification of Ready Mixed Concrete Production Facilities.”

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with ASTM C94 and ACI 301.

#### 1.8 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 301 and ACI 306.1 and as follows.
  - 1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
  - 2. When average high and low temperature is expected to fall below 40 °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 °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 °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 GENERAL REQUIREMENTS FOR CONCRETE

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

#### 2.2 CONCRETE MATERIALS

- A. Source Limitations:
  - 1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.
  - 2. Obtain each type or class of cementitious material of the same brand from the same manufacturer’s plant.
  - 3. Obtain aggregate from single source.
  - 4. Obtain each type of admixture from single source from single manufacturer.
- B. Cementitious Materials:
  - 1. Portland Cement: ASTM C150, Type I, unless noted otherwise.
  - 2. Fly Ash: ASTM C618, Class C or Class F.
  - 3. Slag Cement: ASTM C989, Grade 100 or Grade 120.
  - 4. Silica Fume: ASTM C1240 amorphous silica.
  - 5. Blended Hydraulic Cement: ASTM C595, Type IS, portland blast furnace slag cement, ASTM C595, Type IP, portland-pozzolan cement, ASTM C595, Type IL, portland-limestone cement, or ASTM C595, Type IT, ternary blended cement.

- C. Normal-Weight Aggregates: ASTM C33, 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 pounds per cubic yard for moderately reactive aggregate or 3 pounds per cubic yard 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 and Gradation:
    - a. General Use: Size normal-weight aggregate in accordance with ACI and the clear distances between reinforcing and between formwork, unless specifically noted otherwise.
  - 3. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- D. Air-Entraining Admixture: ASTM C260.
- E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
  - 1. Water-Reducing Admixture: ASTM C494, Type A.
  - 2. Retarding Admixture: ASTM C494, Type B.
  - 3. Water-Reducing and -Retarding Admixture: ASTM C494, Type D.
  - 4. High-Range, Water-Reducing Admixture: ASTM C494, Type F.
  - 5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494, Type G.
  - 6. Plasticizing and Retarding Admixture: ASTM C1017, Type II.
  - 7. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C494, Type C.
  - 8. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.
- F. Water and water used to make ice: ASTM C94, potable

### 2.3 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 ounces per square yard when dry.
- C. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.
  - 1. Color:
    - a. Ambient temperature Below 50 °F: Black.
    - b. Ambient temperature between 50 °F and 85 °F: Any color.
    - c. Ambient temperature Above 85 °F: White.
- D. Curing Paper: 8 feet-wide paper, consisting of two layers of fibered kraft paper laminated with double coating of asphalt.
- E. Water: Potable or complying with ASTM C1602.

- F. Clear, Waterborne, Membrane-Forming, Dissipating Curing Compound: ASTM C309, Type 1, Class B.
- G. Clear, Waterborne, Membrane-Forming, Curing Compound: ASTM C309, Type 1, Class B, 18 percent to 25 percent solids, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.
- H. Clear, Solvent-Borne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A.
  - 1. Verify products comply with the requirements of the California Department of Public Health “Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers.” Verify formaldehyde emissions do not exceed 16.5 micrograms per cubic meter or 13.5 parts per billion, whichever is less.
- I. Clear, Waterborne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A.
  - 1. Verify products comply with the requirements of the California Department of Public Health “Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers.” Verify formaldehyde emissions do not exceed 16.5 micrograms per cubic meter or 13.5 parts per billion, whichever is less.

## 2.4 RELATED MATERIALS

- A. Bonding Agent: ASTM C1059, Type II, nonredispersible, acrylic emulsion or styrene butadiene.
- B. Floor Slab Protective Covering: 8 feet-wide cellulose fabric.

## 2.5 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 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 inch to 1/4 inch or coarse sand, as recommended by underlayment manufacturer.
  - 4. Compressive Strength: Not less than 5000 psi at 28 days when tested in accordance with ASTM C109.
- 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 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 inch to 1/4 inch or coarse sand as recommended by topping manufacturer.
  - 4. Compressive Strength: Not less than 5000 psi at 28 days when tested in accordance with ASTM C109.

## 2.6 CONCRETE MIXTURES

- 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.
  - 2. Mixture designs must be compatible with conveyance method and placement technique.

- B. Cement:
1. Provide portland cement in concrete other than mass concrete.
- C. Other Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
1. Fly Ash or Other Pozzolans: 25 percent by mass.
  2. Slag Cement: 50 percent by mass.
  3. Silica Fume: 10 percent by mass.
  4. Total of Fly Ash or Other Pozzolans, Slag Cement, and Silica Fume: 50 percent by mass, with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.
  5. Total of Fly Ash or Other Pozzolans and Silica Fume: 35 percent by mass with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.
- D. 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. Do not use accelerating admixtures in Mass Concrete.
  4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.
- E. Exposure Class: As indicated in the structural general notes.
- F. Minimum Compressive Strength: As indicated in the structural general notes.
- G. Maximum w/cm ratio: As indicated in the structural general notes.
- H. Air Content: Provide entrained air content per the following table for the defined exposure class and the selected aggregate size:

Nominal Maximum Aggregate Size	Air Content (+/- 1.5 %)			
	Exposure Class F3	Exposure Class F2	Exposure Class F1	Exposure Class F0
3/8 inch	7.5%	7.5%	6.0%	0%
1/2 inch	7.0%	7.0%	5.5%	0%
3/4 inch	6.0%	6.0%	5.0%	0%
1 inch	6.0%	6.0%	4.5%	0%
1-1/2 inch	5.5%	5.5%	4.5%	0%

1. Air content may be reduced by 1.0 percent for concrete with compressive strength greater than 5000 psi.
- I. Limit water-soluble, chloride-ion content in hardened concrete as follows:
1. Exposure Class C0: 1.00 percent by weight of cement.
  2. Exposure Class C1: 0.30 percent by weight of cement.
  3. Exposure Class C2: 0.15 percent by weight of cement.
- J. Slump Limit:
1. 4 inches, plus or minus 1 inch
  2. 8 inches, plus or minus 1 inch for concrete with verified slump of 3 inches plus or minus 1 inch before adding high-range water-reducing admixture or plasticizing admixture at Project site.

- K. Density:
  - 1. Normal-weight concrete:
    - a. Fresh Density (Unit Weight): 145 pounds per cubic foot, plus or minus 5 pounds per cubic foot as determined by ASTM C138.

## 2.7 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94 and furnish batch ticket information.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete in accordance with ASTM C94. Mix concrete materials in appropriate drum-type batch machine mixer.
  - 1. For mixer capacity of 1 cubic yard or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
  - 2. For mixer capacity larger than 1 cubic yard, increase mixing time by 15 seconds for each additional 1 cubic yard.
  - 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

## 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 ANSI/AISC 303, Section 7.5.

### 3.4 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.
  - 1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.

2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.
- B. Notify The Structural Design Professional and the Structural Testing/Inspection Agencies 48 hours prior to commencement of concrete placement.
  - C. 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.
  - D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.
    1. If a section cannot be placed continuously, provide construction joints as indicated.
    2. Deposit concrete to avoid segregation.
    3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
    4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.
      - a. Do not use vibrators to transport concrete inside forms.
      - b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
      - c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
      - d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
  - E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
    1. Do not place concrete floors and slabs in a checkerboard sequence.
    2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
    3. Maintain reinforcement in position on chairs during concrete placement.
    4. Screed slab surfaces with a straightedge and strike off to correct elevations.
      - a. Where formwork is cambered, set screeds to a matching camber to maintain the specified depth.
    5. Level concrete, cut high areas, and fill low areas.
    6. Slope surfaces uniformly to drains where required.
    7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
    8. Do not further disturb slab surfaces before starting finishing operations.

### 3.5 FINISHING FORMED SURFACES

- A. As-Cast Surface Finishes:
  1. ACI 301 Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.
    - a. Locations: Apply to concrete surfaces not exposed to public view, unless noted otherwise.
    - b. Patch voids larger than 1-1/2 inches wide or 1/2 inch deep.
    - c. Remove projections larger than 1 inch.
    - d. Tie holes do not require patching.
    - e. Surface Tolerance: ACI 117 Class D.
- B. Rubbed Finishes: Apply smooth-rubbed finishes, grout-cleaned rubbed finishes, and cork-floated finishes to as cast surface finishes where indicated on Drawings:
  1. Finish in accordance with ACI 301.
  2. Maintain required patterns or variances as shown on Drawings or as approved by the Architectural Design Professional.

- 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.

### 3.6 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

- A. Equipment Bases and Foundations:
  - 1. Coordinate sizes and locations of concrete bases with actual equipment provided.
  - 2. Construct concrete bases 6 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 in the structural drawings.
  - 4. 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.
- B. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items.
  - 1. Cast-in inserts and accessories, as shown on Drawings.
  - 2. Screed, tamp, and trowel finish concrete surfaces.

### 3.7 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 pounds per square foot per hour, 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. Cure concrete containing color pigments in accordance with color pigment manufacturer's instructions.
  - 3. If forms remain during curing period, moist cure after loosening forms.
  - 4. 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. Except as noted below, Contractor has option of the following:
    - a. 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.
      - 1) Lap edges and ends of absorptive cover not less than 12 inches.
      - 2) Maintain absorptive cover water saturated, and in place, for during of curing period, but not less than 7 days.
    - b. 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.
      - 1) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
      - 2) Cure for not less than 7 days.
    - c. Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than 7 days, utilizing one, or a combination of the following:
      - 1) Water.
      - 2) Continuous water-fog spray.
    - d. Membrane-Forming 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. Membrane-Forming 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.

### 3.8 TOLERANCES

- A. Conform to ACI 117.

### 3.9 CONCRETE SURFACE REPAIRS

- A. Defective Concrete:
1. Repair and patch defective areas when approved by The Structural Design Professional.
  2. Remove and replace concrete that cannot be repaired and patched to The Structural Design Professional's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete.
    - a. Limit cut depth to 3/4 inch.
    - b. Make edges of cuts perpendicular to concrete surface.



- c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
  - d. Fill and compact with patching mortar before bonding agent has dried.
  - e. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
  2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement, so that, when dry, patching mortar matches surrounding color.
    - a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
    - b. Compact mortar in place and strike off slightly higher than surrounding surface.
  3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance as determined by the Structural Design Professional.
- 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 receive floor coverings with a repair underlayment.
    - a. Prepare, mix, and apply repair underlayment and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
    - b. Feather edges to match adjacent floor elevations.
  6. 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.
    - 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.
  7. 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.
  8. 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 the Structural Design Professional's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to the Structural Design Professional's approval.

### 3.10 FIELD QUALITY CONTROL

- A. Special Inspections: The Special Inspection/Testing Agency shall perform inspections and field tests and prepare test reports as required by the Building Code and Section 01 45 25 – Structural and Special Inspection/Testing Agency Services.
1. Special Inspection/Testing Agency to be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31.
  2. Special Inspection/Testing Agency to immediately report to The Architectural Design Professional and Structural Design Professional, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
  3. Special Inspection/Testing Agency to report results of tests and inspections, in writing, to Owner, The Architectural Design Professional and Structural Design Professional, Contractor, and concrete manufacturer within 48 hours of inspections and tests.
    - a. Test reports to include reporting requirements of ASTM C31, ASTM C39, 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 7 days and 28 days.
- B. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.
- C. Inspections:
1. Headed bolts, studs, and other items cast in concrete.
  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.
  6. Batch Plant Inspections: On a random basis, as determined by The Structural Design Professional.
- D. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C172 to be performed in accordance with the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture up to 75 cubic yards, plus one set for each additional 75 cubic yards or fraction thereof.
    - a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing to be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
  2. Slump: ASTM C143:
    - a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.

- b. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C231 pressure method, for normal-weight concrete; ASTM C173 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:
  - a. One test hourly when air temperature is 40 °F and below or 80 °F and above, and one test for each composite sample.
5. Unit Weight of Concrete: ASTM C138 fresh unit weight of structural normal weight concrete.
  - a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
6. Compression Test Specimens: ASTM C31:
  - a. Conventionally Reinforced Concrete: Cast and laboratory cure one set of four 6 inch by 12 inch or five 4 inch by 8 inch cylinder specimens for each composite sample.
7. Compressive-Strength Tests: ASTM C39.
  - a. Conventionally Reinforced Concrete: Test one laboratory-cured specimen at 7 days. Test one set of two 6 inch by 12 inch or one set of three 4 inch by 8 inch laboratory-cured specimens at 28 days. Retain extra specimens for additional testing as directed by the Design Professional.
  - b. A compressive-strength test to be the average compressive strength from a set of two 6 inch by 12 inch specimens or a set of three 4 inch by 8 inch specimens obtained from same composite sample and tested at age indicated.
8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi if specified compressive strength is 5000 psi, or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi.
9. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by The Structural Design Professional but will not be used as sole basis for approval or rejection of concrete.
10. Additional Tests:
  - a. Special Inspection/Testing Agency to make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by The Structural Design Professional.
  - b. Special Inspection/Testing Agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42 or by other methods as directed by The Structural Design Professional.
    - 1) Acceptance criteria for concrete strength to be in accordance with ACI 301, Section 1.6.6.3.
11. Additional inspection and testing, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
12. Correct deficiencies in the Work that inspections and test reports indicate do not comply with the Contract Documents.

### 3.11 PROTECTION

- A. Protect concrete surfaces as follows:
  1. Protect from petroleum stains.
  2. Prohibit the use of acids or acidic detergents over concrete surfaces.

**END OF SECTION 03 30 00**

**SECTION 03 30 00 – CAST-IN-PLACE CONCRETE****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
1. Structural cast-in-place concrete materials, concrete mixture design, placement procedures, and finishes.
  2. Section not intended for concrete pavements, sidewalks, and ground-supported slabs not shown on the structural documents.
- B. Related Requirements:
1. Section 01 33 00 – Submittal Procedures.
  2. Section 01 33 30 – Structural Submittal Procedures.
  3. Section 01 40 00 – Quality Requirements.
  4. Section 01 45 25 – Structural and Special Inspection/Testing Agency Services.
  5. Section 03 10 00 – Concrete Forming and Accessories.
  6. Section 03 20 00 – Concrete Reinforcing.

**1.2 REFERENCE STANDARDS**

- A. American Association of State Highway and Transportation Officials (AASHTO):
1. AASHTO M 182 – Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats.
- B. American Concrete Institute (ACI):
1. ACI 117 – Specification for Tolerances for Concrete Construction and Materials.
  2. ACI 301 – Specifications for Structural Concrete
  3. ACI 302.1R – Guide to Concrete Floor and Slab Construction
  4. ACI 305.1 – Specification for Hot Weather Concreting.
  5. ACI 306.1 – Standard Specification for Cold Weather Concreting.
  6. ACI 308.1 – Specification for Curing Concrete.
  7. ACI 318 – Building Code Requirements for Structural Concrete.
- C. American Institute of Steel Construction (AISC):
1. ANSI/AISC 303 – Code of Standard Practice for Steel Buildings and Bridges.
- D. ASTM International (ASTM):
1. ASTM C31 – Standard Practice for Making and Curing Concrete Test Specimens in the Field.
  2. ASTM C33 – Standard Specification for Concrete Aggregates.
  3. ASTM C39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
  4. ASTM C42 – Stand Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
  5. ASTM C94 – Standard Specification for Ready-Mixed Concrete.
  6. ASTM C109 – Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50 mm] Cube Specimens).
  7. ASTM C138 – Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
  8. ASTM C143 – Standard Test Method for Slump of Hydraulic-Cement Concrete.
  9. ASTM C150 – Standard Specification for Portland Cement.
  10. ASTM C171 – Standard Specification for Sheet Materials for Curing Concrete.
  11. ASTM C172 – Standard Practice for Sampling Freshly Mixed Concrete.
  12. ASTM C173 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.

13. ASTM C219 – Standard Terminology Relating to Hydraulic and Other Inorganic Cements.
14. ASTM C231 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
15. ASTM C260 – Standard Specification for Air-Entraining Admixtures for Concrete.
16. ASTM C309 – Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
17. ASTM C494 – Standard Specification for Chemical Admixtures for Concrete.
18. ASTM C595 – Standard Specification for Blended Hydraulic Cements.
19. ASTM C618 – Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
20. ASTM C920 – Standard Specification for Elastomeric Joint Sealants.
21. ASTM C989 – Standard Specification for Slag Cement for Use in Concrete and Mortars.
22. ASTM C1017 – Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
23. ASTM C1059 – Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete.
24. ASTM C1064 – Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
25. ASTM C1240 – Standard Specification for Silica Fume Used in Cementitious Mixtures.
26. ASTM C1293 – Standard Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction.
27. ASTM C1315 – Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
28. ASTM C1567 – Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method).
29. ASTM C1602 – Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete.
30. ASTM C1778 – Standard Guide for Reducing the Risk of Deleterious Alkali-Aggregate Reaction in Concrete.
31. ASTM D1751 – Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
32. ASTM D2240 – Standard Test Method for Rubber Property – Durometer Hardness.
33. ASTM E1155 – Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers.
34. ASTM E1745 – Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

E. U.S. Army Corps of Engineers (USACE):

1. CRD-C 48 – Standard Test Method for Water Permeability of Concrete.

### 1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.
- B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.
- C. Concrete Elements in an Aggressive Environment: Concrete in any of the following elements:
  1. Exterior exposed concrete

### 1.4 ACTION SUBMITTALS

- A. Product Data: For each of the following.
  1. Portland cement.
  2. Fly ash.

3. Slag cement.
  4. Blended hydraulic cement.
  5. Silica fume.
  6. Aggregates.
  7. 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.
  8. Curing materials.
    - a. Include documentation from color pigment manufacturer, indicating that proposed methods of curing are recommended by color pigment manufacturer.
  9. 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.
  4. Maximum w/cm.
  5. Slump limit.
  6. Air content.
  7. Nominal maximum aggregate size.
  8. Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.
  9. Intended placement method.
  10. 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 Architectural Design Professional and Structural Design Professional.
- 1.5 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For the following:
1. Installer: Include copies of applicable ACI certificates.
  2. Ready-mixed concrete manufacturer.
- B. Material Certificates: For each of the following, signed by manufacturers:
1. Cementitious materials.
  2. Admixtures.
  3. Curing compounds.
  4. Bonding agents.
  5. Adhesives.
  6. Repair materials.
- 1.6 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 or an ACI Concrete Flatwork Technician.

- B. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94 requirements for production facilities and equipment.
  - 1. Manufacturer certified in accordance with NRMCA “Certification of Ready Mixed Concrete Production Facilities.”

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with ASTM C94 and ACI 301.

#### 1.8 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 301 and ACI 306.1 and as follows.
  - 1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
  - 2. When average high and low temperature is expected to fall below 40 °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 °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 °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 GENERAL REQUIREMENTS FOR CONCRETE

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

#### 2.2 CONCRETE MATERIALS

- A. Source Limitations:
  - 1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.
  - 2. Obtain each type or class of cementitious material of the same brand from the same manufacturer’s plant.
  - 3. Obtain aggregate from single source.
  - 4. Obtain each type of admixture from single source from single manufacturer.
- B. Cementitious Materials:
  - 1. Portland Cement: ASTM C150, Type I, unless noted otherwise.
  - 2. Fly Ash: ASTM C618, Class C or Class F.
  - 3. Slag Cement: ASTM C989, Grade 100 or Grade 120.
  - 4. Silica Fume: ASTM C1240 amorphous silica.
  - 5. Blended Hydraulic Cement: ASTM C595, Type IS, portland blast furnace slag cement, ASTM C595, Type IP, portland-pozzolan cement, ASTM C595, Type IL, portland-limestone cement, or ASTM C595, Type IT, ternary blended cement.

- C. Normal-Weight Aggregates: ASTM C33, 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 pounds per cubic yard for moderately reactive aggregate or 3 pounds per cubic yard 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 and Gradation:
    - a. General Use: Size normal-weight aggregate in accordance with ACI and the clear distances between reinforcing and between formwork, unless specifically noted otherwise.
  - 3. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- D. Air-Entraining Admixture: ASTM C260.
- E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
  - 1. Water-Reducing Admixture: ASTM C494, Type A.
  - 2. Retarding Admixture: ASTM C494, Type B.
  - 3. Water-Reducing and -Retarding Admixture: ASTM C494, Type D.
  - 4. High-Range, Water-Reducing Admixture: ASTM C494, Type F.
  - 5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494, Type G.
  - 6. Plasticizing and Retarding Admixture: ASTM C1017, Type II.
  - 7. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C494, Type C.
  - 8. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.
- F. Water and water used to make ice: ASTM C94, potable

### 2.3 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 ounces per square yard when dry.
- C. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.
  - 1. Color:
    - a. Ambient temperature Below 50 °F: Black.
    - b. Ambient temperature between 50 °F and 85 °F: Any color.
    - c. Ambient temperature Above 85 °F: White.
- D. Curing Paper: 8 feet-wide paper, consisting of two layers of fibered kraft paper laminated with double coating of asphalt.
- E. Water: Potable or complying with ASTM C1602.



- F. Clear, Waterborne, Membrane-Forming, Dissipating Curing Compound: ASTM C309, Type 1, Class B.
- G. Clear, Waterborne, Membrane-Forming, Curing Compound: ASTM C309, Type 1, Class B, 18 percent to 25 percent solids, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.
- H. Clear, Solvent-Borne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A.
  - 1. Verify products comply with the requirements of the California Department of Public Health “Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers.” Verify formaldehyde emissions do not exceed 16.5 micrograms per cubic meter or 13.5 parts per billion, whichever is less.
- I. Clear, Waterborne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A.
  - 1. Verify products comply with the requirements of the California Department of Public Health “Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers.” Verify formaldehyde emissions do not exceed 16.5 micrograms per cubic meter or 13.5 parts per billion, whichever is less.

## 2.4 RELATED MATERIALS

- A. Bonding Agent: ASTM C1059, Type II, nonredispersible, acrylic emulsion or styrene butadiene.
- B. Floor Slab Protective Covering: 8 feet-wide cellulose fabric.

## 2.5 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 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 inch to 1/4 inch or coarse sand, as recommended by underlayment manufacturer.
  - 4. Compressive Strength: Not less than 5000 psi at 28 days when tested in accordance with ASTM C109.
- 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 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 inch to 1/4 inch or coarse sand as recommended by topping manufacturer.
  - 4. Compressive Strength: Not less than 5000 psi at 28 days when tested in accordance with ASTM C109.

## 2.6 CONCRETE MIXTURES

- 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.
  - 2. Mixture designs must be compatible with conveyance method and placement technique.

- B. Cement:
1. Provide portland cement in concrete other than mass concrete.
- C. Other Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
1. Fly Ash or Other Pozzolans: 25 percent by mass.
  2. Slag Cement: 50 percent by mass.
  3. Silica Fume: 10 percent by mass.
  4. Total of Fly Ash or Other Pozzolans, Slag Cement, and Silica Fume: 50 percent by mass, with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.
  5. Total of Fly Ash or Other Pozzolans and Silica Fume: 35 percent by mass with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.
- D. 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. Do not use accelerating admixtures in Mass Concrete.
  4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.
- E. Exposure Class: As indicated in the structural general notes.
- F. Minimum Compressive Strength: As indicated in the structural general notes.
- G. Maximum w/cm ratio: As indicated in the structural general notes.
- H. Air Content: Provide entrained air content per the following table for the defined exposure class and the selected aggregate size:

Nominal Maximum Aggregate Size	Air Content (+/- 1.5 %)			
	Exposure Class F3	Exposure Class F2	Exposure Class F1	Exposure Class F0
3/8 inch	7.5%	7.5%	6.0%	0%
1/2 inch	7.0%	7.0%	5.5%	0%
3/4 inch	6.0%	6.0%	5.0%	0%
1 inch	6.0%	6.0%	4.5%	0%
1-1/2 inch	5.5%	5.5%	4.5%	0%

1. Air content may be reduced by 1.0 percent for concrete with compressive strength greater than 5000 psi.
- I. Limit water-soluble, chloride-ion content in hardened concrete as follows:
1. Exposure Class C0: 1.00 percent by weight of cement.
  2. Exposure Class C1: 0.30 percent by weight of cement.
  3. Exposure Class C2: 0.15 percent by weight of cement.
- J. Slump Limit:
1. 4 inches, plus or minus 1 inch
  2. 8 inches, plus or minus 1 inch for concrete with verified slump of 3 inches plus or minus 1 inch before adding high-range water-reducing admixture or plasticizing admixture at Project site.

- K. Density:
  - 1. Normal-weight concrete:
    - a. Fresh Density (Unit Weight): 145 pounds per cubic foot, plus or minus 5 pounds per cubic foot as determined by ASTM C138.

## 2.7 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94 and furnish batch ticket information.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete in accordance with ASTM C94. Mix concrete materials in appropriate drum-type batch machine mixer.
  - 1. For mixer capacity of 1 cubic yard or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
  - 2. For mixer capacity larger than 1 cubic yard, increase mixing time by 15 seconds for each additional 1 cubic yard.
  - 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

## 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 ANSI/AISC 303, Section 7.5.

### 3.4 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.
  - 1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.

2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.
- B. Notify The Structural Design Professional and the Structural Testing/Inspection Agencies 48 hours prior to commencement of concrete placement.
  - C. 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.
  - D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.
    1. If a section cannot be placed continuously, provide construction joints as indicated.
    2. Deposit concrete to avoid segregation.
    3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
    4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.
      - a. Do not use vibrators to transport concrete inside forms.
      - b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
      - c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
      - d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
  - E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
    1. Do not place concrete floors and slabs in a checkerboard sequence.
    2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
    3. Maintain reinforcement in position on chairs during concrete placement.
    4. Screed slab surfaces with a straightedge and strike off to correct elevations.
      - a. Where formwork is cambered, set screeds to a matching camber to maintain the specified depth.
    5. Level concrete, cut high areas, and fill low areas.
    6. Slope surfaces uniformly to drains where required.
    7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
    8. Do not further disturb slab surfaces before starting finishing operations.

### 3.5 FINISHING FORMED SURFACES

- A. As-Cast Surface Finishes:
  1. ACI 301 Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.
    - a. Locations: Apply to concrete surfaces not exposed to public view, unless noted otherwise.
    - b. Patch voids larger than 1-1/2 inches wide or 1/2 inch deep.
    - c. Remove projections larger than 1 inch.
    - d. Tie holes do not require patching.
    - e. Surface Tolerance: ACI 117 Class D.
- B. Rubbed Finishes: Apply smooth-rubbed finishes, grout-cleaned rubbed finishes, and cork-floated finishes to as cast surface finishes where indicated on Drawings:
  1. Finish in accordance with ACI 301.
  2. Maintain required patterns or variances as shown on Drawings or as approved by the Architectural Design Professional.

- 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.

### 3.6 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

- A. Equipment Bases and Foundations:
  - 1. Coordinate sizes and locations of concrete bases with actual equipment provided.
  - 2. Construct concrete bases 6 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 in the structural drawings.
  - 4. 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.
- B. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items.
  - 1. Cast-in inserts and accessories, as shown on Drawings.
  - 2. Screed, tamp, and trowel finish concrete surfaces.

### 3.7 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 pounds per square foot per hour, 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. Cure concrete containing color pigments in accordance with color pigment manufacturer's instructions.
  - 3. If forms remain during curing period, moist cure after loosening forms.
  - 4. 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. Except as noted below, Contractor has option of the following:
    - a. 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.
      - 1) Lap edges and ends of absorptive cover not less than 12 inches.
      - 2) Maintain absorptive cover water saturated, and in place, for during of curing period, but not less than 7 days.
    - b. 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.
      - 1) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
      - 2) Cure for not less than 7 days.
    - c. Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than 7 days, utilizing one, or a combination of the following:
      - 1) Water.
      - 2) Continuous water-fog spray.
    - d. Membrane-Forming 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. Membrane-Forming 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.

### 3.8 TOLERANCES

- A. Conform to ACI 117.

### 3.9 CONCRETE SURFACE REPAIRS

- A. Defective Concrete:
1. Repair and patch defective areas when approved by The Structural Design Professional.
  2. Remove and replace concrete that cannot be repaired and patched to The Structural Design Professional's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete.
    - a. Limit cut depth to 3/4 inch.
    - b. Make edges of cuts perpendicular to concrete surface.

- c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
  - d. Fill and compact with patching mortar before bonding agent has dried.
  - e. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
  2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement, so that, when dry, patching mortar matches surrounding color.
    - a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
    - b. Compact mortar in place and strike off slightly higher than surrounding surface.
  3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance as determined by the Structural Design Professional.
- 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 receive floor coverings with a repair underlayment.
    - a. Prepare, mix, and apply repair underlayment and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
    - b. Feather edges to match adjacent floor elevations.
  6. 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.
    - 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.
  7. 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.
  8. 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 the Structural Design Professional's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to the Structural Design Professional's approval.

### 3.10 FIELD QUALITY CONTROL

- A. Special Inspections: The Special Inspection/Testing Agency shall perform inspections and field tests and prepare test reports as required by the Building Code and Section 01 45 25 – Structural and Special Inspection/Testing Agency Services.
1. Special Inspection/Testing Agency to be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31.
  2. Special Inspection/Testing Agency to immediately report to The Architectural Design Professional and Structural Design Professional, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
  3. Special Inspection/Testing Agency to report results of tests and inspections, in writing, to Owner, The Architectural Design Professional and Structural Design Professional, Contractor, and concrete manufacturer within 48 hours of inspections and tests.
    - a. Test reports to include reporting requirements of ASTM C31, ASTM C39, 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 7 days and 28 days.
- B. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.
- C. Inspections:
1. Headed bolts, studs, and other items cast in concrete.
  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.
  6. Batch Plant Inspections: On a random basis, as determined by The Structural Design Professional.
- D. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C172 to be performed in accordance with the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture up to 75 cubic yards, plus one set for each additional 75 cubic yards or fraction thereof.
    - a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing to be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
  2. Slump: ASTM C143:
    - a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.



- b. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C231 pressure method, for normal-weight concrete; ASTM C173 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:
  - a. One test hourly when air temperature is 40 °F and below or 80 °F and above, and one test for each composite sample.
5. Unit Weight of Concrete: ASTM C138 fresh unit weight of structural normal weight concrete.
  - a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
6. Compression Test Specimens: ASTM C31:
  - a. Conventionally Reinforced Concrete: Cast and laboratory cure one set of four 6 inch by 12 inch or five 4 inch by 8 inch cylinder specimens for each composite sample.
7. Compressive-Strength Tests: ASTM C39.
  - a. Conventionally Reinforced Concrete: Test one laboratory-cured specimen at 7 days. Test one set of two 6 inch by 12 inch or one set of three 4 inch by 8 inch laboratory-cured specimens at 28 days. Retain extra specimens for additional testing as directed by the Design Professional.
  - b. A compressive-strength test to be the average compressive strength from a set of two 6 inch by 12 inch specimens or a set of three 4 inch by 8 inch specimens obtained from same composite sample and tested at age indicated.
8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi if specified compressive strength is 5000 psi, or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi.
9. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by The Structural Design Professional but will not be used as sole basis for approval or rejection of concrete.
10. Additional Tests:
  - a. Special Inspection/Testing Agency to make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by The Structural Design Professional.
  - b. Special Inspection/Testing Agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42 or by other methods as directed by The Structural Design Professional.
    - 1) Acceptance criteria for concrete strength to be in accordance with ACI 301, Section 1.6.6.3.
11. Additional inspection and testing, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
12. Correct deficiencies in the Work that inspections and test reports indicate do not comply with the Contract Documents.

### 3.11 PROTECTION

- A. Protect concrete surfaces as follows:
  1. Protect from petroleum stains.
  2. Prohibit the use of acids or acidic detergents over concrete surfaces.

**END OF SECTION 03 30 00**

**SECTION 04 16 01 – STRUCTURAL POST-INSTALLED MASONRY ANCHORING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Anchorage to grout-filled and hollow masonry, including the following:
    - a. Adhesive anchoring.
- B. Related Requirements:
  - 1. Section 01 33 00 – Submittal Procedures.
  - 2. Section 01 33 30 – Structural Submittal Procedures.
  - 3. Section 01 40 00 – Quality Requirements.
  - 4. Section 01 45 25 – Structural and Special Inspection/Testing Agency Services.
  - 5. Section 05 12 00 – Structural Steel Framing.

**1.2 REFERENCE STANDARDS**

- A. ASTM International (ASTM):
  - 1. ASTM A36 – Standard Specification for Carbon Structural Steel.
  - 2. ASTM A193 – Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
  - 3. ASTM A510 – Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel, and Alloy Steel.
  - 4. ASTM A615 – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
  - 5. ASTM A706 – Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement.
  - 6. ASTM B633 – Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
  - 7. ASTM F1554 – Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
- B. International Code Council, Inc. (ICC):
  - 1. ICC-ES AC58 – Acceptance Criteria for Adhesive Anchors in Masonry Elements.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each of the following:
  - 1. Adhesive.
  - 2. Anchor elements for use with adhesive anchors.
  - 3. Adhesive anchor accessories.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: for each installer.
- B. Evaluation Reports: For each of the following:
  - 1. Adhesive anchors.

## 1.5 QUALITY ASSURANCE

- A. Installer Qualifications:
  - 1. A qualified installer trained by the manufacturer's field representative to install the anchor products used. Training to include but not limited to:
    - a. Hole drilling procedure.
    - b. Hole preparation and cleaning.
    - c. Adhesive injecting technique and dispensing.
    - d. Anchor element preparation and installation.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products in manufacturer's or distributor's packaging with installation instructions.
- B. Store and handle anchors in accordance with manufacturer's recommendations to prevent damage or deterioration.
- C. Store and handle anchor adhesives in accordance with manufacturer's recommendations, including temperature, to prevent damage or deterioration. Do not use adhesives beyond the printed expiration date.

## 1.7 FIELD CONDITIONS

- A. Comply with the environmental conditions of the anchor manufacturer's recommendations for installation. Environmental conditions include but are not limited to the following:
  - 1. Installation temperature.
  - 2. Moisture conditions.

## PART 2 - PRODUCTS

### 2.1 ADHESIVE ANCHORS

- A. Adhesive: Tested and qualified for performance in grout-filled and hollow masonry in accordance with ICC-ES AC58. Adhesives must have a valid ICC-ES or IAPMO-UES evaluation report.
- B. Anchor Elements:
  - 1. Threaded Rod: ASTM A36, ASTM A193, Grade B6, or ASTM F1554, Grade 36.
    - a. Size and embedment as indicated on Structural Drawings.
    - b. Finish: ASTM A153, Class C or Class D zinc coated.
  - 2. Proprietary Anchor Elements: ASTM A510.
    - a. Size and embedment as indicated on Structural Drawings.
    - b. Finish: zinc plated in accordance with ASTM B633, Class SC1, Type III.
  - 3. Screen Tubes: Carbon steel, stainless steel, plastic, or a combination of the preceding.
    - a. Screen tubes must be compatible with the adhesive provided and produced by the manufacturer of the adhesive.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine supporting base masonry and environmental conditions. Do not begin installation until base masonry has been properly prepared.
- B. Identify the position of reinforcing steel and other embedded items prior to installation. Notify the Structural Design Professional of any potential interference with required anchor location.

### 3.2 INSTALLATION HOLES

- A. Provide holes sized according to the anchor manufacturer's recommendation.
- B. Drill holes perpendicular to the masonry surface unless otherwise shown on the Structural Drawings.
- C. Drill holes with rotary impact hammer drills using carbide-tipped bits or hollow drill bit system.
  - 1. Do not core drill holes using diamond core bits, unless approved in writing by the Structural Design Professional prior to installation.
- D. Notify the Structural Design Professional of any reinforcing steel or other embedded items encountered during drilling.

### 3.3 INSTALLATION OF ADHESIVE ANCHORS

- A. Prepare and clean holes in accordance with hole drilling technique and in accordance with the manufacturer's instructions and procedures.
  - 1. Provide screen tubes with size and length in accordance with the manufacturer's requirements and recommendations. Install screen tubes in accordance with the manufacturer's recommendations.
- B. Inject adhesive into holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets and voids in the adhesive.
  - 1. Follow manufacturer's recommendations and use manufacturer's accessories to ensure proper mixing of adhesive components.
  - 2. Inject sufficient adhesive to ensure the annular gap is filled to the masonry surface.
- C. Positively locate anchors to ensure the anchor is centered in the hole.
  - 1. Do not disturb or load anchors before the manufacturer specified cure time has elapsed.
  - 2. Remove excess adhesive from surface of the masonry after anchor elements are installed and before cure time has elapsed.
- D. Comply with manufacturer's limitations on applied torque to the anchor elements.

### 3.4 REPAIR OF DEFECTIVE ANCHOR INSTALLATIONS

- A. Remove and replace misplaced anchors, malfunctioning anchors, or anchors that fail testing protocols.
  - 1. Fill empty anchor holes and patch failed anchor locations with high-strength, nonshrink, nonmetallic grout.

### 3.5 FIELD QUALITY CONTROL

- A. Special Inspections: The Special Inspection/Testing Agency shall perform inspections and field tests and prepare test reports as required by the Building Code and Section 01 45 25 – Structural and Special Inspection/Testing Agency Services.

- B. Inspections:
1. Verification of anchor type and dimensions.
  2. Anchor spacing, edge distances, and masonry minimum thickness.
  3. Hole dimensions.
  4. Hole cleaning procedures.
  5. Anchor embedment.
  6. Anchor tightening torque.
  7. Adherence to manufacturer's published installation instructions.

**END OF SECTION 04 16 01**

**SECTION 04 16 01 – STRUCTURAL POST-INSTALLED MASONRY ANCHORING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Anchorage to grout-filled and hollow masonry, including the following:
    - a. Adhesive anchoring.
- B. Related Requirements:
  - 1. Section 01 33 00 – Submittal Procedures.
  - 2. Section 01 33 30 – Structural Submittal Procedures.
  - 3. Section 01 40 00 – Quality Requirements.
  - 4. Section 01 45 25 – Structural and Special Inspection/Testing Agency Services.
  - 5. Section 05 12 00 – Structural Steel Framing.

**1.2 REFERENCE STANDARDS**

- A. ASTM International (ASTM):
  - 1. ASTM A36 – Standard Specification for Carbon Structural Steel.
  - 2. ASTM A193 – Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
  - 3. ASTM A510 – Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel, and Alloy Steel.
  - 4. ASTM A615 – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
  - 5. ASTM A706 – Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement.
  - 6. ASTM B633 – Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
  - 7. ASTM F1554 – Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
- B. International Code Council, Inc. (ICC):
  - 1. ICC-ES AC58 – Acceptance Criteria for Adhesive Anchors in Masonry Elements.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each of the following:
  - 1. Adhesive.
  - 2. Anchor elements for use with adhesive anchors.
  - 3. Adhesive anchor accessories.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: for each installer.
- B. Evaluation Reports: For each of the following:
  - 1. Adhesive anchors.

## 1.5 QUALITY ASSURANCE

- A. Installer Qualifications:
  - 1. A qualified installer trained by the manufacturer's field representative to install the anchor products used. Training to include but not limited to:
    - a. Hole drilling procedure.
    - b. Hole preparation and cleaning.
    - c. Adhesive injecting technique and dispensing.
    - d. Anchor element preparation and installation.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products in manufacturer's or distributor's packaging with installation instructions.
- B. Store and handle anchors in accordance with manufacturer's recommendations to prevent damage or deterioration.
- C. Store and handle anchor adhesives in accordance with manufacturer's recommendations, including temperature, to prevent damage or deterioration. Do not use adhesives beyond the printed expiration date.

## 1.7 FIELD CONDITIONS

- A. Comply with the environmental conditions of the anchor manufacturer's recommendations for installation. Environmental conditions include but are not limited to the following:
  - 1. Installation temperature.
  - 2. Moisture conditions.

## PART 2 - PRODUCTS

### 2.1 ADHESIVE ANCHORS

- A. Adhesive: Tested and qualified for performance in grout-filled and hollow masonry in accordance with ICC-ES AC58. Adhesives must have a valid ICC-ES or IAPMO-UES evaluation report.
- B. Anchor Elements:
  - 1. Threaded Rod: ASTM A36, ASTM A193, Grade B6, or ASTM F1554, Grade 36.
    - a. Size and embedment as indicated on Structural Drawings.
    - b. Finish: ASTM A153, Class C or Class D zinc coated.
  - 2. Proprietary Anchor Elements: ASTM A510.
    - a. Size and embedment as indicated on Structural Drawings.
    - b. Finish: zinc plated in accordance with ASTM B633, Class SC1, Type III.
  - 3. Screen Tubes: Carbon steel, stainless steel, plastic, or a combination of the preceding.
    - a. Screen tubes must be compatible with the adhesive provided and produced by the manufacturer of the adhesive.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine supporting base masonry and environmental conditions. Do not begin installation until base masonry has been properly prepared.
- B. Identify the position of reinforcing steel and other embedded items prior to installation. Notify the Structural Design Professional of any potential interference with required anchor location.

### 3.2 INSTALLATION HOLES

- A. Provide holes sized according to the anchor manufacturer's recommendation.
- B. Drill holes perpendicular to the masonry surface unless otherwise shown on the Structural Drawings.
- C. Drill holes with rotary impact hammer drills using carbide-tipped bits or hollow drill bit system.
  - 1. Do not core drill holes using diamond core bits, unless approved in writing by the Structural Design Professional prior to installation.
- D. Notify the Structural Design Professional of any reinforcing steel or other embedded items encountered during drilling.

### 3.3 INSTALLATION OF ADHESIVE ANCHORS

- A. Prepare and clean holes in accordance with hole drilling technique and in accordance with the manufacturer's instructions and procedures.
  - 1. Provide screen tubes with size and length in accordance with the manufacturer's requirements and recommendations. Install screen tubes in accordance with the manufacturer's recommendations.
- B. Inject adhesive into holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets and voids in the adhesive.
  - 1. Follow manufacturer's recommendations and use manufacturer's accessories to ensure proper mixing of adhesive components.
  - 2. Inject sufficient adhesive to ensure the annular gap is filled to the masonry surface.
- C. Positively locate anchors to ensure the anchor is centered in the hole.
  - 1. Do not disturb or load anchors before the manufacturer specified cure time has elapsed.
  - 2. Remove excess adhesive from surface of the masonry after anchor elements are installed and before cure time has elapsed.
- D. Comply with manufacturer's limitations on applied torque to the anchor elements.

### 3.4 REPAIR OF DEFECTIVE ANCHOR INSTALLATIONS

- A. Remove and replace misplaced anchors, malfunctioning anchors, or anchors that fail testing protocols.
  - 1. Fill empty anchor holes and patch failed anchor locations with high-strength, nonshrink, nonmetallic grout.

### 3.5 FIELD QUALITY CONTROL

- A. Special Inspections: The Special Inspection/Testing Agency shall perform inspections and field tests and prepare test reports as required by the Building Code and Section 01 45 25 – Structural and Special Inspection/Testing Agency Services.



- B. Inspections:
1. Verification of anchor type and dimensions.
  2. Anchor spacing, edge distances, and masonry minimum thickness.
  3. Hole dimensions.
  4. Hole cleaning procedures.
  5. Anchor embedment.
  6. Anchor tightening torque.
  7. Adherence to manufacturer's published installation instructions.

**END OF SECTION 04 16 01**

## SECTION 042613 - MASONRY VENEER (Infill at demolished window)

## PART 1 - GENERAL

## 1.1 SUMMARY

## A. Section Includes:

1. Split Face Concrete Masonry.
2. Mortar materials.
3. Ties and anchors.
4. Embedded flashing.
5. Accessories.
6. Mortar mixes.

## 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each type and color of **brick and colored mortar**.

## 1.3 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each type and size of product.

## 1.4 FIELD CONDITIONS

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

## 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. (6 m) vertically and horizontally of a walking surface.**

## 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 shapes produced by sawing would result in sawed surfaces being exposed to view.
- B. Clay Face Brick: **Facing brick complying with ASTM C216.**
1. ***Match existing campus brick, to the extent possible, a. (Basis of Design) . BELDEN 470-479 Dark Range Smooth.***
  2. Initial Rate of Absorption: Less than 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested in accordance with ASTM C67/C67M.
  3. Efflorescence: Provide brick that has been tested in accordance with ASTM C67/C67M and is rated "not effloresced."
  4. Size (Actual Dimensions): **3-5/8 inches (92 mm) wide by 2-1/4 inches (57 mm) high by 7-1/2 inches (190 mm) 7-5/8 inches (194 mm) long.**
  5. Color and Texture: Red, Matte, Extruded..

## 2.3 MORTAR MATERIALS

- A. Preblended Dry Mortar Mix: Packaged blend made from **portland cement and hydrated lime or masonry cement**, sand, **mortar pigments**, and admixtures and complying with ASTM C1714/C1714M.
1. Preblended Dry Portland Cement Mortar Mix:
    - a. Spec Mix,LLC (Basis of Design).
  2. Preblended Dry Masonry Cement Mortar Mix:
    - a. Spec Mix,LLC (Basis of Design).
- B. Aggregate for Mortar: ASTM C144.
1. White-Mortar Aggregates: Natural white sand or crushed white stone.
  2. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.
- C. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with **ASTM C494/C494M, Type C, ASTM C138**, and recommended by manufacturer for use in masonry mortar of composition

- D. Water: Potable.

## 2.4 TIES AND ANCHORS

- A. General: Ties and anchors extend at least 1-1/2 inches (38 mm) into veneer but with at least a 5/8-inch (16-mm) 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. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A1064/A1064M, with ASTM A153/A153M, Class B-2 coating.
  2. Stainless Steel Wire: ASTM A580/A580M, **Type 304**.
  3. Steel Sheet, Galvanized after Fabrication: ASTM A1008/A1008M, Commercial Steel, with ASTM A153/A153M, Class B coating.
- 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- (6.4-mm-) diameter, **hot-dip galvanized steel** wire.
  2. Tie Section: Triangular-shaped wire tie made from **0.187-inch- (4.76-mm-)hot-dip galvanized steel** wire.
- D. Adjustable Masonry-Veneer Anchors:
1. General: Provide anchors that allow vertical adjustment but resist a 100 lbf (445 N) load in both tension and compression perpendicular to plane of wall without deforming or developing play in excess of 1/16 inch (1.6 mm).
  2. Fabricate sheet metal anchor sections and other sheet metal parts from **0.0785-inch- (1.99-mm-) thick steel sheet, galvanized after fabrication**.
  3. Fabricate wire ties from **0.187-inch- (4.76-mm-)**wire unless otherwise indicated.
  4. Masonry-Veneer Anchors; Vertical Slotted L-Plate: Rib-stiffened, sheet metal anchor section with screw holes at top and bottom, projecting vertical leg with slotted hole for wire tie **and washer at face of insulation**.
    - a. Manufacturer's include but are not limited to the following
      - 1) Hohman and Barnard
      - 2) Prosoco – Masonry Veneer Tie (Basis of Design)
      - 3) Wire Bond
  5. Stainless Steel Drill Screws for Steel Studs: ASTM C954 except manufactured with hex washer head and neoprene or EPDM washer, No. 10 (4.83 mm) 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:
- B. Flexible Flashing: Use **one of** the following unless otherwise indicated:
  - 1. Copper Fabric Flashing: **5 oz./sq. ft. (1.5 kg/sq. m) self-adhesive** copper sheet bonded between two layers of glass-fiber cloth. Use only where flashing is fully concealed in masonry.
  - 2. Manufacturer's include but are not limited to the following:
    - a. Wire-Bond # 4150 (Basis of Design).

## 2.6 ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from **neoprene**.
- B. 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 (3.2 mm) less than depth of outer wythe, in color selected from manufacturer's standard.
    - a. Manufacturer's: Include but are not limited to:
      - 1) Mortar net Cell Vent.
      - 2) Heckman Building Products.
      - 3) Wirebond
- C. 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** that prevent clogging with mortar droppings.
  - 2. Manufacturer's include but are not limited to the following:
    - a. Mortar Net.
    - b. Wire-Bond. (Basis of Design)
- D. Proprietary Acidic Masonry 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. Prosoco SureKlen 101 Lime Solvent. (Basis of Design).
  - 2. NMD Masonry Detergent.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- B. 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.
- C. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. (30 g/194 sq. cm) 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.

### 3.2 TOLERANCES

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

1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch (13 mm) or minus 1/4 inch (6.4 mm).
2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch (13 mm).
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch (6.4 mm) in a story height or 1/2 inch (13 mm) 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. (6.4 mm in 3 m), or 1/2-inch (13-mm) 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. (3.2 mm in 3 m), 1/4 inch in 20 ft. (6.4 mm in 6 m), or 1/2-inch (13-mm) maximum.
3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 ft. (6.4 mm in 3 m), 3/8 inch in 20 ft. (10 mm in 6 m), or 1/2-inch (13-mm) 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. (3.2 mm in 3 m), 1/4 inch in 20 ft. (6.4 mm in 6 m), or 1/2-inch (13-mm) maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 ft. (6.4 mm in 3 m), 3/8 inch in 20 ft. (10 mm in 6 m), or 1/2-inch (13-mm) maximum.

#### C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3.2 mm), with a maximum thickness limited to 1/2 inch (13 mm).
2. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3.2 mm). **Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch (3.2 mm).**

### 3.3 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in **running bond**; do not use units with less-than-nominal 4-inch (102-mm) horizontal face dimensions at corners or jambs.
- C. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

### 3.4 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.

### 3.5 ANCHORED MASONRY VENEERS

- A. Anchor masonry veneers to **wall framing** 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 **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 16 inches (406 mm) o.c. vertically and 25 inches (635 mm) o.c. horizontally, with not less than one anchor for each **2.67 sq. ft. (0.25 sq. m)** of wall area. Install additional anchors within 12 inches (305 mm) of openings and at intervals, not exceeding 36 inches (914 mm), around perimeter.
- B. Provide not less than **2 inches (51 mm)** of airspace between back of masonry veneer and face of **[sheathing] [insulation]**.

### 3.6 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 (203 mm); with upper edge tucked under **water-resistive barrier [air barrier]**, lapping at least 4 inches (102 mm).
  3. At lintels and shelf angles, extend flashing 6 inches (152 mm) minimum, **to edge of next full unit** at each end. At heads and sills, extend flashing 6 inches (152 mm) minimum[, **to edge of next full unit**] and turn ends up not less than 2 inches (51 mm) to form end dams.
- C. Install weep holes in veneers in head joints of first course of masonry immediately above embedded flashing.
1. Use **specified weep/cavity vent products** to form weep holes.
  2. Space weep holes 24 inches (610 mm) o.c. unless otherwise indicated.
- D. Place cavity drainage material in airspace behind veneers to comply with configuration requirements for cavity drainage material in "Accessories" Article.

### 3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections. 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 will be at Contractor's expense.
- B. Inspections: Special inspections in accordance with Level 2 in TMS 402.
1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.

### 3.8 CLEANING

- A. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
1. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
  2. 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.
  3. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.



4. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.

### 3.9 MASONRY WASTE DISPOSAL

- A. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
  1. Do not dispose of masonry waste as fill within 18 inches (457 mm) of finished grade.
- B. 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 042613

## SECTION 044200 - EXTERIOR STONE CLADDING (SITE SIGN)

## PART 1 - GENERAL

## 1.1 SUMMARY

## A. Section Includes:

1. Stone panels set with individual anchors.
2. Stone trim units as detailed.

## 1.2 ACTION SUBMITTALS

- A. Product Data: For each[ **variety of stone,**] stone accessory, and manufactured product.
- B. Shop Drawings: Show fabrication and installation details for stone cladding assembly, including dimensions and profiles of stone units.
  1. Show locations and project specific details of joints both within stone cladding assembly and between stone cladding assembly and other construction.
  2. Show locations and details of anchors **and backup structure.**
  3. Show direction of veining, grain, or other directional pattern.
- C. Stone Samples: Sets for each variety, color, and finish of stone required; not less than **12 inches (300 mm)** square.
- D. Colored Pointing Mortar Samples: For each color required.
- E. Sealant Samples: For each type and color of joint sealant required.
- F. Delegated-Design Submittal: For stone cladding assembly.

## 1.3 INFORMATIONAL SUBMITTALS

## A. Material Test Reports:

1. Stone Test Reports: For **each** stone variety proposed for use on Project, by a qualified testing agency, indicating compliance with required physical properties, other than abrasion resistance, according to referenced ASTM standards. Base reports on testing done within previous **five** years.
- B. Preconstruction test reports.
- C. Source quality-control reports.

#### 1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.

#### 1.5 PRECONSTRUCTION TESTING

#### 1.6 FIELD CONDITIONS

- A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Remove and replace stone cladding damaged by frost or freezing conditions. Comply with cold-weather construction and protection requirements for masonry contained in TMS 602/ACI 530.1/ASCE 6.
- B. Hot-Weather Requirements: Comply with hot-weather construction and protection requirements for masonry contained in TMS 602/ACI 530.1/ASCE 6.
- C. Environmental Limitations for Sealants: Do not install sealants when ambient and substrate temperatures are outside limits permitted by sealant manufacturer or below 40 deg F (5 deg C) or when joint substrates are wet.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design stone cladding assembly.
- B. General: Design stone anchors and anchoring systems according to ASTM C1242.
1. Stone anchors withstand not less than two times the weight of the stone cladding in both compression and tension.
- C. Structural Performance: Stone cladding assembly withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
1. Wind Loads: As indicated.
  2. Equipment Loads: Allow for loads due to window cleaning and maintenance equipment.
- D. Seismic Performance: Stone cladding assembly withstand the effects of earthquake motions determined according to **ASCE/SEI 7**.
1. Component Importance Factor: **1.0**.
- E. Safety Factors for Stone: Design stone cladding assembly to withstand loads indicated without exceeding stone's allowable working stress determined by dividing stone's average ultimate strength, as established by testing, by safety factors. Refer to the drawings.

## 2.2 GRANITE

- A. Material Standard: Comply with ASTM C615/C615M.
- B. Varieties and Sources: Refer to the drawings.
- C. Finish: Refer to the drawings.

## 2.3 ANCHORS AND FASTENERS

- A. Fabricate anchors, **including shelf angles**, from stainless steel, ASTM A240/A240M or ASTM A666, **Type 316**; temper as required to support loads imposed without exceeding allowable design stresses. Fabricate dowels and pins for anchors from stainless steel, ASTM A276, **Type 316**.
- B. Fabricate shelf angles for limestone from hot-dip galvanized steel, ASTM A36/A36M for materials and ASTM A123/A123M for galvanizing.
- C. Postinstalled Anchor Bolts for Concrete and Masonry: **Chemical anchors** made from stainless steel components complying with **ASTM F593 and ASTM F594, Alloy Group 1 or 2 (ASTM F738M and ASTM F836M, Alloy Group A1 or A4)** for bolts and nuts; ASTM A240/A240M, ASTM A276, or ASTM A666, Type 304 or 316, for anchors, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed, for masonry, as determined by testing per ASTM E488/E488M, conducted by a qualified independent testing agency.

## 2.4 MORTAR MATERIALS

- A. Portland Cement: ASTM C150/C150M, Type I or Type II, except Type III may be used for cold-weather construction, natural color or white as required to produce mortar color indicated.
- B. Hydrated Lime: ASTM C207.
- C. Aggregate: ASTM C144; except for **joints narrower than 1/4 inch (6 mm) and pointing mortar**, 100 percent pass **No. 16 (1.18-mm)** sieve.
- D. Water: Potable.

## 2.5 STONE ACCESSORIES

- A. Setting Shims: Strips of [**resilient plastic**, nonstaining to stone, of thickness needed to prevent point loading of stone on anchors and of depths to suit anchors without intruding into required depths of pointing materials.
- B. Concealed Sheet Metal Flashing: Fabricated from stainless steel in thicknesses indicated, but not less than **0.0156 inch (0.4 mm)** thick.
- C. Weep and Vent Tubes: **Medium-density polyethylene tubing, 1/4-inch (6-mm) OD]** of length required to extend from exterior face of stone to cavity behind.

- D. Sealants for Joints in Stone Cladding: Manufacturer's standard chemically curing, elastomeric sealants of base polymer and characteristics indicated below that comply with applicable requirements in Section 079200 "Joint Sealants" and do not stain stone:
1. Joint Sealant: Silicone, nonstaining, **S, NS, 100/50, NT**.
- E. Sealant for Filling Kerfs: **Manufacturer's standard chemically curing, elastomeric sealants of base polymer and characteristics indicated below that comply with applicable requirements in Section 079200 "Joint Sealants" and that do not stain stone:**
1. Silicone, Nonstaining, S, NS, 50, NT: Nonstaining, 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.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) GE Construction Sealants; Momentive Performance Materials Inc.
      - 2) Pecora Corporation.
      - 3) The Dow Chemical Company.
      - 4) Tremco Incorporated. (Basis of Design)

## 2.6 FABRICATION OF STONE

- A. Control depth of stone and back check to maintain minimum clearance of **1 inch (25 mm)** between backs of stone units and surfaces or projections of structural members, fireproofing (if any), backup walls, and other work behind stone.
- B. Dress joints (bed and vertical) straight and at right angle to face unless otherwise indicated. Shape beds to fit supports.
- C. Cut and drill sinkages and holes in stone for anchors, fasteners, supports, and lifting devices as indicated or needed to set stone securely in place.
- D. Finish exposed faces and edges of stone[, **except sawed reveals,**] to comply with requirements indicated for finish and to match approved samples[ **and mockups**].
- E. Cut stone to produce uniform joints **3/8 inch (10 mm)** wide and in locations indicated.
- F. Contiguous Work: Provide chases, reveals, reglets, openings, and similar features as required to accommodate contiguous work.
- G. Fabricate molded work, including washes and drips, to produce stone shapes with a uniform profile throughout entire unit length, with precisely formed arris slightly eased to prevent snipping, and with matching profile at joints between units.

## 2.7 MORTAR MIXES

- A. General: Comply with referenced standards and with manufacturers' written instructions. Do not use admixtures, unless otherwise indicated.

- B. Portland Cement-Lime Setting Mortar: Comply with ASTM C270, Proportion Specification, **Type S**.
  - 1. Set granite with Type S mortar.
- C. Pointing Mortar: Comply with ASTM C270, Proportion Specification, **Type S**. Provide pointing mortar mixed to match Architect's sample and complying with the following:
  - 1. Pigmented Pointing Mortar: Do not exceed pigment-to-cement ratio of 1:10, by weight.
  - 2. Point granite with **Type S** mortar.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION OF STONE CLADDING, GENERAL

- A. Before setting stone, clean surfaces that are dirty or stained by removing soil, stains, and foreign materials. Clean stone by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives.
- B. Execute stone cladding installation by skilled mechanics and employ skilled stone fitters at Project site to do necessary field cutting as stone is set. Use power saws with diamond blades to cut stone.
- C. Set stone to comply with requirements indicated. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure stone cladding in place. Shim and adjust anchors, supports, and accessories to set stone accurately in locations indicated, with uniform joints of widths indicated, and with edges and faces aligned according to established relationships and indicated tolerances.
- D. Provide expansion, control, and pressure-relieving joints of widths and at locations indicated.
  - 1. Sealing expansion and other joints is specified in Section 079200 "Joint Sealants."
  - 2. Keep expansion joints free of mortar and other rigid materials.
- E. Install concealed flashing at continuous shelf angles, lintels, ledges, and similar obstructions to downward flow of water, to divert water to building exterior. Extend flashing **6 inches (150 mm)** at ends and turn up not less than **2 inches (50 mm)** to form end dams.
- F. Keep cavities open where unfilled space is indicated between back of stone units and backup wall; do not fill cavities with mortar or grout.
  - 1. Place weep holes in joints where moisture may accumulate, including at base of cavity walls and above shelf angles and flashing. Locate weep holes at intervals not exceeding **24 inches (600 mm)**.

### 3.2 INSTALLATION OF MECHANICALLY ANCHORED STONE CLADDING

- A. Attach anchors securely to stone and to backup surfaces. Comply with recommendations in ASTM C1242.
- B. Provide compressible filler in ends of dowel holes and bottoms of kerfs to prevent end bearing of dowels and anchor tabs on stone. Fill remainder of anchor holes and kerfs with sealant indicated for filling kerfs.
- C. Set stone supported on clips or continuous angles on resilient setting shims. Use material of thickness required to maintain uniform joint widths and to prevent point loading of stone on anchors. Hold shims back from face of stone a distance at least equal to width of joint.

### 3.3 INSTALLATION OF STONE CLADDING WITH MORTAR

- A. Set stone in full bed of mortar with head joints filled unless otherwise indicated.
  - 1. Provide compressible filler in ends of dowel holes and bottoms of kerfs to prevent end bearing of dowels and anchor tabs on stone. Fill remainder of anchor holes and kerfs with mortar.
- B. Embed ends of sills in mortar; leave remainder of joint open until final pointing.
- C. Rake out joints for pointing with mortar to depths of not less than **1/2 inch (12 mm)**. Rake joints to uniform depths with square bottoms and clean sides.
- D. Point stone joints by placing pointing mortar in layers not more than **3/8 inch (10 mm)**. Compact each layer thoroughly and allow to become thumbprint hard before applying next layer.
- E. Tool joints with a round jointer having a diameter **1/8 inch (3 mm)** larger than width of joint, when pointing mortar is thumbprint hard.
- F. Rake out mortar from sealant-pointed joints to depths required for sealant and sealant backing, but not less than **1/2 inch (12 mm)**. Rake joints to uniform depths with square bottoms and clean sides.

### 3.4 INSTALLATION OF JOINT SEALANTS

- A. Prepare joints and apply sealants of type and at locations indicated to comply with applicable requirements in Section 079200 "Joint Sealants."

### 3.5 INSTALLATION TOLERANCES

- A. Variation from Plumb: For vertical lines and surfaces of walls, do not exceed **1/4 inch in 10 feet (6 mm in 3 m)**, **3/8 inch in 20 feet (10 mm in 6 m)**, or **1/2 inch in 40 feet (12 mm in 12 m)** or more. For external corners, corners and jambs within **20 feet (6 m)** of an entrance, expansion joints, and other conspicuous lines, do not exceed **1/8 inch in 10 feet (3 mm in 3 m)**, **1/4 inch in 20 feet (6 mm in 6 m)**, or **3/8 inch in 40 feet (10 mm in 12 m)** or more.

- B. Variation from Level: For lintels, sills, water tables, parapets, horizontal bands, horizontal grooves, and other conspicuous lines, do not exceed **1/8 inch in 10 feet (3 mm in 3 m)**, **1/4 inch in 20 feet (6 mm in 6 m)**, or **3/8 inch (10 mm)** maximum.
- C. Variation of Linear Building Line: For positions shown in plan and related portions of walls and partitions, do not exceed **1/4 inch in 20 feet (6 mm in 6 m)** or **1/2 inch in 40 feet (12 mm in 12 m)** or more.
- D. Variation in Joint Width: Do not vary from average joint width more than plus or minus **1/8 inch (3 mm)** or a quarter of nominal joint width, whichever is less. For joints within **60 inches (1500 mm)** of each other, do not vary more than **1/8 inch (3 mm)** or a quarter of nominal joint width, whichever is less from one to the other.
- E. Variation in Plane between Adjacent Stone Units (Lipping): Do not exceed **1/16-inch (1.5-mm)** difference between planes of adjacent units.

### 3.6 ADJUSTING AND CLEANING

- A. In-Progress Cleaning: Clean stone cladding as work progresses. [ **Remove mortar fins and smears before tooling joints.** ] Remove excess sealant and smears as sealant is installed.
- B. Final Cleaning: Clean stone cladding no fewer than six days after completion of pointing and sealing, using clean water and stiff-bristle fiber brushes. Do not use wire brushes, acid-type cleaning agents, cleaning agents containing caustic compounds or abrasives, or other materials or methods that could damage stone.

END OF SECTION 044200



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**SECTION 05 12 00 – STRUCTURAL STEEL FRAMING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Structural steel.
  - 2. Shrinkage-resistant grout.
  
- B. Related Requirements:
  - 1. Section 01 33 00 – Submittal Procedures.
  - 2. Section 01 33 30 – Structural Submittal Procedures.
  - 3. Section 01 40 00 – Quality Requirements.
  - 4. Section 01 45 25 – Structural and Special Inspection/Testing Agency Services.
  - 5. Section 04 16 01 – Structural Post-Installed Masonry Anchoring.

**1.2 REFERENCE STANDARDS**

- A. American Institute of Steel Construction (AISC):
  - 1. ANSI/AISC 303 – Code of Standard Practice for Steel Buildings and Bridges.
  - 2. ANSI/AISC 360 – Specification for Structural Steel Buildings.
  - 3. RCSC – Specification for Structural Joints Using High-Strength Bolts.
  
- B. American Welding Society (AWS):
  - 1. AWS D1.1 – Structural Welding Code - Steel.
  
- C. Association for Materials Protection and Performance (AMPP):
  - 1. SSPC-PA 1 – Shop, Field, and Maintenance Coating of Metals.
  - 2. SSPC-SP 2 – Hand Tool Cleaning.
  - 3. SSPC-SP 3 – Power Tool Cleaning.
  
- D. ASTM International (ASTM):
  - 1. ASTM A6 – Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
  - 2. ASTM A36 – Standard Specification for Carbon Structural Steel.
  - 3. ASTM A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
  - 4. ASTM A108 – Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
  - 5. ASTM A123 – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  - 6. ASTM A216 – Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service.
  - 7. ASTM A307 – Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.
  - 8. ASTM A500 – Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
  - 9. ASTM A563 – Standard Specification for Carbon and Alloy Steel Nuts (Inch and Metric).
  - 10. ASTM A668 – Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use.
  - 11. ASTM A992 – Standard Specification for Structural Steel Shapes.
  - 12. ASTM C1107 – Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
  - 13. ASTM E94 – Standard Guide for Radiographic Examination Using Industrial Radiographic Film.
  - 14. ASTM E164 – Standard Practice for Contact Ultrasonic Testing of Weldments.
  - 15. ASTM E165 – Standard Practice for Liquid Penetrant Testing for General Industry.

16. ASTM E709 – Standard Guide for Magnetic Particle Testing.
17. ASTM F436 – Standard Specification for Hardened Steel Washers Inch and Metric Dimensions.
18. ASTM F844 – Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use.
19. ASTM F959 – Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners, Inch and Metric Series.
20. ASTM F1554 – Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
21. ASTM F3125 – Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength.

### 1.3 DEFINITIONS

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

### 1.4 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

### 1.5 ACTION SUBMITTALS

- A. Product Data:
  1. Structural-steel materials.
  2. High-strength, bolt-nut-washer assemblies.
  3. Anchor rods.
  4. Threaded rods.
  5. Shop primer.
  6. Galvanized-steel primer.
  7. Galvanized repair paint.
  8. 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.
  5. Identify members not to be shop primed.
- C. Delegated Design Submittal: For structural-steel connections indicated on Drawings to comply with design loads, include analysis data and design calculations signed and sealed by the qualified professional engineer responsible for their preparation.

## 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data for the following:
  - 1. Installer.
  - 2. Fabricator.
- B. Welding certificates.
- C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide in accordance with AWS D1.1 for each welded joint whether prequalified or qualified by testing, including the following:
  - 1. Power source (constant current or constant voltage).
  - 2. Electrode manufacturer and trade name, for demand-critical welds.
- D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- E. Mill test reports for structural-steel materials, including chemical and physical properties.
- F. 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.
  - 5. Concrete headed anchor connectors.

## 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 (Acceptance Criteria 172).
- B. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
  - 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store and handle welding electrodes in accordance with AWS D1.1.
- C. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
  - 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
  - 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
  - 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125, Grade F1852 bolt assemblies and for retesting bolt assemblies after lubrication.

## PART 2 - PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

- A. Comply with applicable provisions of the following specifications and documents:
  - 1. ANSI/AISC 303.
  - 2. ANSI/AISC 360.
  - 3. RCSC "Specification for Structural Joints Using High-Strength Bolts."
- B. Connection Design Information:
  - 1. Option 3 and 3B: 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.

## 2.2 STRUCTURAL STEEL MATERIALS

- A. W-Shapes: ASTM A992.
- B. Channels: ASTM A36.
- C. Angles: ASTM A36.
- D. Plate and Bar: ASTM A36.
- E. Cold-Formed Hollow Structural Sections:
  - 1. Square and Rectangular: ASTM A500, Grade C structural tubing.
  - 2. Round: ASTM A500, Grade C structural tubing.
- F. Steel Pipe: ASTM A53, Type E or Type S, Grade B.
  - 1. Finish: Black except where indicated to be galvanized.

## 2.3 WELD MATERIALS

- A. Welding Electrodes: E-70xx series low hydrogen; Comply with AWS requirements.

## 2.4 BOLTS AND CONNECTORS

- A. High-Strength A325 Bolts, Nuts, and Washers:
  - 1. Bolt: ASTM F3125, Grade A325, Type 1, heavy-hex steel structural.
  - 2. Nut: ASTM A563, Grade DH, heavy-hex carbon-steel.
  - 3. Washer: ASTM F436, Type 1, hardened carbon-steel.
  - 4. Direct-Tension Indicators: ASTM F959, Type 325-1, compressible-washer type.
  - 5. Finish: Plain
- B. Zinc-Coated High-Strength A325 Bolts, Nuts, and Washers:
  - 1. Bolt: ASTM F3125, Grade A325, Type 1, heavy-hex steel structural.
  - 2. Nut: ASTM A563, Grade DH, heavy-hex carbon-steel.
  - 3. Washer: ASTM F436, Type 1, hardened carbon-steel.
  - 4. Direct-Tension Indicators: ASTM F959, Type 325-1, compressible-washer type with mechanically deposited zinc coating finish.
  - 5. Finish: Hot-dip or mechanically deposited zinc coating.

- C. High-Strength A325 Tension-Control Bolt-Nut-Washer Assemblies: ASTM F3125, Grade F1852 assemblies, consisting of the following:
1. Bolts: ASTM F3125, Grade F1852, Type 1 round head, steel structural bolts with splined ends.
  2. Nuts: ASTM A563, Grade DH, heavy-hex carbon-steel.
  3. Washers: ASTM F436, Type 1, hardened carbon-steel.
  4. Finish: Plain.
- D. Non-High-Strength Bolts, Nuts, and Washers:
1. Bolt: ASTM A307, Grade A, hex carbon-steel.
  2. Nut: ASTM A563, Grade A, hex carbon-steel.
  3. Washer: ASTM F844, unhardened steel.
  4. Finish: Plain, hot-dip zinc coating, or mechanically deposited zinc coating.

## 2.5 RODS

- A. Anchor Rods: ASTM F1554, Grade 36 or Grade 55 as indicated on the drawings.
1. Configuration: Straight, headed or unheaded with nut.
  2. Nuts: ASTM A563, Grade DH, heavy-hex carbon-steel.
  3. Plate Washers: ASTM A36 carbon steel.
  4. Washers: ASTM F436, Type 1, hardened carbon-steel.
  5. Finish: Plain.
- B. Threaded Rods: ASTM A36.
1. Nuts: ASTM A563, Grade DH, heavy-hex carbon-steel.
  2. Washers: ASTM F436, Type 1, hardened carbon-steel.
  3. Finish: Plain.

## 2.6 PRIMER

- A. Steel Primer:
1. Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

## 2.7 SHRINKAGE-RESISTANT GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30 minute working time.

## 2.8 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 and maintain markings until structural-steel framing has been erected.
  4. Mark and match-mark materials for field assembly.
  5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.

- C. Bolt Holes: Cut, drill, or punch bolt holes perpendicular to metal surfaces.
- D. Splicing: Splice members only where indicated unless specifically authorized by the Structural Design Professional.
- E. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- F. Cleaning: Clean and prepare steel surfaces that are to remain unpainted in accordance with SSPC-SP 2. or SSPC-SP 3.
- G. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
  - 1. Cut, drill, or punch holes perpendicular to steel surfaces. 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.

## 2.9 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
  - 1. Provide slip-critical joints subject to tension, including but not limited to braced frame connections, connections transferring drag forces, column splices in tension, and moment connections with bolted flanges
  - 2. Provide snug tightened joints at all other bolted connections unless noted otherwise.
- B. General Weld Connections: Comply with AWS D1.1 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
  - 1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

## 2.10 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel in accordance with ASTM A123.
  - 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 structural steel exposed to weather including lintels and shelf angles supporting exterior building veneer and mechanical equipment support steel.

## 2.11 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.
  - 6. Corrosion-resisting (weathering) steel 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 or 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.

## 2.12 SOURCE QUALITY CONTROL

- A. Special Inspections: The Special Inspection/Testing Agency shall perform shop inspections and tests and prepare test reports as required by the Building Code and Section 01 45 25 – Structural and Special Inspection/Testing Agency Services.
  - 1. Allow testing agency access to places where structural steel work is being fabricated or produced to perform inspections and tests.
  - 2. Shop inspections and tests are not required if the structural steel fabricator is AISC certified and submits an approved “Fabricator’s Certificate of Compliance.”
- B. Inspections:
  - 1. Inspect shop-bolted connections in accordance with RCSC “Specification for Structural Joints Using High-Strength Bolts.”
  - 2. Inspect shop-welded connections in accordance with AWS D1.1.
  - 3. Inspect shop-welded shear connectors in accordance with AWS D1.1 requirements for stud welding.
  - 4. Inspect shop-welded headed concrete anchor connectors in accordance with AWS D1.1 requirements for stud welding.
- C. Tests:
  - 1. Test shop-bolted connections in accordance with RCSC “Specification for Structural Joints Using High-Strength Bolts.”
    - a. Perform testing on 10 percent of bolted connections
  - 2. Test shop-welded connections in accordance with AWS D1.1 and the following test procedures, at the testing agency’s option:
    - a. Liquid Penetrant Testing: ASTM E165.
    - b. Magnetic Particle Testing: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
    - c. Ultrasonic Examination/Testing: ASTM E164.
    - d. Radiographic Examination/Testing: ASTM E94.
    - e. Perform testing on 100 percent of complete penetration shop welds.
  - 3. Test shop-welded shear stud connectors in accordance with AWS D1.1 requirements for stud welding and as follows:
    - a. Perform bend tests if visual inspections reveal either a less-than-continuous 360 degree flash or welding repairs to any shear connector.
    - b. Conduct tests according to requirements in AWS D1.1 on additional shear connectors if weld fracture occurs on shear connectors already tested.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads.



Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated on Drawings.

- B. Notify Design Professional and Special Inspection/Testing Agency at least 48 hours prior to erection activities.

### 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. Baseplates: 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 as indicated in the Structural Drawings.
  - 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.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection unless approved by the Structural Design Professional. Finish thermally cut sections within smoothness limits in AWS D1.1.
- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

### 3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.
  - 1. Provide slip-critical joints subject to tension, including but not limited to braced frame connections, connections transferring drag forces, column splices in tension, and moment connections with bolted flanges
  - 2. Provide snug tightened joints at all other bolted connections unless noted otherwise.
- B. General Weld Connections: Comply with AWS D1.1 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
  - 1. Comply with ANSI/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 REPAIR

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing, and repair galvanizing to comply with ASTM A780.
- B. Touchup Painting:
  - 1. Immediately after erection, clean exposed areas where primer is damaged or missing, and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
    - a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

### 3.6 FIELD QUALITY CONTROL

- A. Special Inspections: The Special Inspection/Testing Agency shall perform inspections and field tests and prepare test reports as required by the Building Code and Section 01 45 25 – Structural and Special Inspection/Testing Agency Services.
- B. Inspections:
  - 1. Verify structural steel materials.
  - 2. Inspect steel frame joint details.
  - 3. Verify connection materials.
  - 4. Inspect field-bolted connections in accordance with RCSC “Specification for Structural Joints Using High-Strength Bolts.”
  - 5. Verify weld materials.
  - 6. Inspect field-welds in accordance with AWS D1.1.
  - 7. Inspect field-welded shear connectors in accordance with AWS D1.1 requirements for stud welding.
- C. Tests:
  - 1. Test field-bolted connections in accordance with RCSC “Specification for Structural Joints Using High-Strength Bolts.”
    - a. Perform testing on 10 percent of bolted connections
  - 2. Test field-welded connections in accordance with AWS D1.1 and the following test procedures, at the testing agency’s option:
    - a. Liquid Penetrant Testing: ASTM E165.
    - b. Magnetic Particle Testing: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
    - c. Ultrasonic Examination/Testing: ASTM E164.
    - d. Radiographic Examination/Testing: ASTM E94.
    - e. Perform testing on 100 percent of complete penetration field welds.

**END OF SECTION 05 12 00**

**SECTION 05 12 00 – STRUCTURAL STEEL FRAMING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Structural steel.
  - 2. Shrinkage-resistant grout.
  
- B. Related Requirements:
  - 1. Section 01 33 00 – Submittal Procedures.
  - 2. Section 01 33 30 – Structural Submittal Procedures.
  - 3. Section 01 40 00 – Quality Requirements.
  - 4. Section 01 45 25 – Structural and Special Inspection/Testing Agency Services.
  - 5. Section 04 16 01 – Structural Post-Installed Masonry Anchoring.

**1.2 REFERENCE STANDARDS**

- A. American Institute of Steel Construction (AISC):
  - 1. ANSI/AISC 303 – Code of Standard Practice for Steel Buildings and Bridges.
  - 2. ANSI/AISC 360 – Specification for Structural Steel Buildings.
  - 3. RCSC – Specification for Structural Joints Using High-Strength Bolts.
  
- B. American Welding Society (AWS):
  - 1. AWS D1.1 – Structural Welding Code - Steel.
  
- C. Association for Materials Protection and Performance (AMPP):
  - 1. SSPC-PA 1 – Shop, Field, and Maintenance Coating of Metals.
  - 2. SSPC-SP 2 – Hand Tool Cleaning.
  - 3. SSPC-SP 3 – Power Tool Cleaning.
  
- D. ASTM International (ASTM):
  - 1. ASTM A6 – Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
  - 2. ASTM A36 – Standard Specification for Carbon Structural Steel.
  - 3. ASTM A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
  - 4. ASTM A108 – Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
  - 5. ASTM A123 – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  - 6. ASTM A216 – Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service.
  - 7. ASTM A307 – Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.
  - 8. ASTM A500 – Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
  - 9. ASTM A563 – Standard Specification for Carbon and Alloy Steel Nuts (Inch and Metric).
  - 10. ASTM A668 – Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use.
  - 11. ASTM A992 – Standard Specification for Structural Steel Shapes.
  - 12. ASTM C1107 – Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
  - 13. ASTM E94 – Standard Guide for Radiographic Examination Using Industrial Radiographic Film.
  - 14. ASTM E164 – Standard Practice for Contact Ultrasonic Testing of Weldments.
  - 15. ASTM E165 – Standard Practice for Liquid Penetrant Testing for General Industry.

16. ASTM E709 – Standard Guide for Magnetic Particle Testing.
17. ASTM F436 – Standard Specification for Hardened Steel Washers Inch and Metric Dimensions.
18. ASTM F844 – Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use.
19. ASTM F959 – Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners, Inch and Metric Series.
20. ASTM F1554 – Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
21. ASTM F3125 – Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength.

### 1.3 DEFINITIONS

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

### 1.4 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

### 1.5 ACTION SUBMITTALS

- A. Product Data:
  1. Structural-steel materials.
  2. High-strength, bolt-nut-washer assemblies.
  3. Anchor rods.
  4. Threaded rods.
  5. Shop primer.
  6. Galvanized-steel primer.
  7. Galvanized repair paint.
  8. 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.
  5. Identify members not to be shop primed.
- C. Delegated Design Submittal: For structural-steel connections indicated on Drawings to comply with design loads, include analysis data and design calculations signed and sealed by the qualified professional engineer responsible for their preparation.

## 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data for the following:
  - 1. Installer.
  - 2. Fabricator.
- B. Welding certificates.
- C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide in accordance with AWS D1.1 for each welded joint whether prequalified or qualified by testing, including the following:
  - 1. Power source (constant current or constant voltage).
  - 2. Electrode manufacturer and trade name, for demand-critical welds.
- D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- E. Mill test reports for structural-steel materials, including chemical and physical properties.
- F. 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.
  - 5. Concrete headed anchor connectors.

## 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 (Acceptance Criteria 172).
- B. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
  - 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store and handle welding electrodes in accordance with AWS D1.1.
- C. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
  - 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
  - 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
  - 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125, Grade F1852 bolt assemblies and for retesting bolt assemblies after lubrication.

## PART 2 - PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

- A. Comply with applicable provisions of the following specifications and documents:
  - 1. ANSI/AISC 303.
  - 2. ANSI/AISC 360.
  - 3. RCSC "Specification for Structural Joints Using High-Strength Bolts."
- B. Connection Design Information:
  - 1. Option 3 and 3B: 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.

## 2.2 STRUCTURAL STEEL MATERIALS

- A. W-Shapes: ASTM A992.
- B. Channels: ASTM A36.
- C. Angles: ASTM A36.
- D. Plate and Bar: ASTM A36.
- E. Cold-Formed Hollow Structural Sections:
  - 1. Square and Rectangular: ASTM A500, Grade C structural tubing.
  - 2. Round: ASTM A500, Grade C structural tubing.
- F. Steel Pipe: ASTM A53, Type E or Type S, Grade B.
  - 1. Finish: Black except where indicated to be galvanized.

## 2.3 WELD MATERIALS

- A. Welding Electrodes: E-70xx series low hydrogen; Comply with AWS requirements.

## 2.4 BOLTS AND CONNECTORS

- A. High-Strength A325 Bolts, Nuts, and Washers:
  - 1. Bolt: ASTM F3125, Grade A325, Type 1, heavy-hex steel structural.
  - 2. Nut: ASTM A563, Grade DH, heavy-hex carbon-steel.
  - 3. Washer: ASTM F436, Type 1, hardened carbon-steel.
  - 4. Direct-Tension Indicators: ASTM F959, Type 325-1, compressible-washer type.
  - 5. Finish: Plain
- B. Zinc-Coated High-Strength A325 Bolts, Nuts, and Washers:
  - 1. Bolt: ASTM F3125, Grade A325, Type 1, heavy-hex steel structural.
  - 2. Nut: ASTM A563, Grade DH, heavy-hex carbon-steel.
  - 3. Washer: ASTM F436, Type 1, hardened carbon-steel.
  - 4. Direct-Tension Indicators: ASTM F959, Type 325-1, compressible-washer type with mechanically deposited zinc coating finish.
  - 5. Finish: Hot-dip or mechanically deposited zinc coating.

- C. High-Strength A325 Tension-Control Bolt-Nut-Washer Assemblies: ASTM F3125, Grade F1852 assemblies, consisting of the following:
1. Bolts: ASTM F3125, Grade F1852, Type 1 round head, steel structural bolts with splined ends.
  2. Nuts: ASTM A563, Grade DH, heavy-hex carbon-steel.
  3. Washers: ASTM F436, Type 1, hardened carbon-steel.
  4. Finish: Plain.
- D. Non-High-Strength Bolts, Nuts, and Washers:
1. Bolt: ASTM A307, Grade A, hex carbon-steel.
  2. Nut: ASTM A563, Grade A, hex carbon-steel.
  3. Washer: ASTM F844, unhardened steel.
  4. Finish: Plain, hot-dip zinc coating, or mechanically deposited zinc coating.

## 2.5 RODS

- A. Anchor Rods: ASTM F1554, Grade 36 or Grade 55 as indicated on the drawings.
1. Configuration: Straight, headed or unheaded with nut.
  2. Nuts: ASTM A563, Grade DH, heavy-hex carbon-steel.
  3. Plate Washers: ASTM A36 carbon steel.
  4. Washers: ASTM F436, Type 1, hardened carbon-steel.
  5. Finish: Plain.
- B. Threaded Rods: ASTM A36.
1. Nuts: ASTM A563, Grade DH, heavy-hex carbon-steel.
  2. Washers: ASTM F436, Type 1, hardened carbon-steel.
  3. Finish: Plain.

## 2.6 PRIMER

- A. Steel Primer:
1. Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

## 2.7 SHRINKAGE-RESISTANT GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30 minute working time.

## 2.8 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 and maintain markings until structural-steel framing has been erected.
  4. Mark and match-mark materials for field assembly.
  5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.

- C. Bolt Holes: Cut, drill, or punch bolt holes perpendicular to metal surfaces.
- D. Splicing: Splice members only where indicated unless specifically authorized by the Structural Design Professional.
- E. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- F. Cleaning: Clean and prepare steel surfaces that are to remain unpainted in accordance with SSPC-SP 2. or SSPC-SP 3.
- G. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
  - 1. Cut, drill, or punch holes perpendicular to steel surfaces. 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.

## 2.9 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
  - 1. Provide slip-critical joints subject to tension, including but not limited to braced frame connections, connections transferring drag forces, column splices in tension, and moment connections with bolted flanges
  - 2. Provide snug tightened joints at all other bolted connections unless noted otherwise.
- B. General Weld Connections: Comply with AWS D1.1 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
  - 1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

## 2.10 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel in accordance with ASTM A123.
  - 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 structural steel exposed to weather including lintels and shelf angles supporting exterior building veneer and mechanical equipment support steel.

## 2.11 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.
  - 6. Corrosion-resisting (weathering) steel 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 or 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.

## 2.12 SOURCE QUALITY CONTROL

- A. Special Inspections: The Special Inspection/Testing Agency shall perform shop inspections and tests and prepare test reports as required by the Building Code and Section 01 45 25 – Structural and Special Inspection/Testing Agency Services.
  - 1. Allow testing agency access to places where structural steel work is being fabricated or produced to perform inspections and tests.
  - 2. Shop inspections and tests are not required if the structural steel fabricator is AISC certified and submits an approved “Fabricator’s Certificate of Compliance.”
- B. Inspections:
  - 1. Inspect shop-bolted connections in accordance with RCSC “Specification for Structural Joints Using High-Strength Bolts.”
  - 2. Inspect shop-welded connections in accordance with AWS D1.1.
  - 3. Inspect shop-welded shear connectors in accordance with AWS D1.1 requirements for stud welding.
  - 4. Inspect shop-welded headed concrete anchor connectors in accordance with AWS D1.1 requirements for stud welding.
- C. Tests:
  - 1. Test shop-bolted connections in accordance with RCSC “Specification for Structural Joints Using High-Strength Bolts.”
    - a. Perform testing on 10 percent of bolted connections
  - 2. Test shop-welded connections in accordance with AWS D1.1 and the following test procedures, at the testing agency’s option:
    - a. Liquid Penetrant Testing: ASTM E165.
    - b. Magnetic Particle Testing: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
    - c. Ultrasonic Examination/Testing: ASTM E164.
    - d. Radiographic Examination/Testing: ASTM E94.
    - e. Perform testing on 100 percent of complete penetration shop welds.
  - 3. Test shop-welded shear stud connectors in accordance with AWS D1.1 requirements for stud welding and as follows:
    - a. Perform bend tests if visual inspections reveal either a less-than-continuous 360 degree flash or welding repairs to any shear connector.
    - b. Conduct tests according to requirements in AWS D1.1 on additional shear connectors if weld fracture occurs on shear connectors already tested.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads.

Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated on Drawings.

- B. Notify Design Professional and Special Inspection/Testing Agency at least 48 hours prior to erection activities.

### 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. Baseplates: 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 as indicated in the Structural Drawings.
  - 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.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection unless approved by the Structural Design Professional. Finish thermally cut sections within smoothness limits in AWS D1.1.
- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

### 3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.
  - 1. Provide slip-critical joints subject to tension, including but not limited to braced frame connections, connections transferring drag forces, column splices in tension, and moment connections with bolted flanges
  - 2. Provide snug tightened joints at all other bolted connections unless noted otherwise.
- B. General Weld Connections: Comply with AWS D1.1 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
  - 1. Comply with ANSI/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 REPAIR

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing, and repair galvanizing to comply with ASTM A780.
- B. Touchup Painting:
  - 1. Immediately after erection, clean exposed areas where primer is damaged or missing, and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
    - a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

### 3.6 FIELD QUALITY CONTROL

- A. Special Inspections: The Special Inspection/Testing Agency shall perform inspections and field tests and prepare test reports as required by the Building Code and Section 01 45 25 – Structural and Special Inspection/Testing Agency Services.
- B. Inspections:
  - 1. Verify structural steel materials.
  - 2. Inspect steel frame joint details.
  - 3. Verify connection materials.
  - 4. Inspect field-bolted connections in accordance with RCSC “Specification for Structural Joints Using High-Strength Bolts.”
  - 5. Verify weld materials.
  - 6. Inspect field-welds in accordance with AWS D1.1.
  - 7. Inspect field-welded shear connectors in accordance with AWS D1.1 requirements for stud welding.
- C. Tests:
  - 1. Test field-bolted connections in accordance with RCSC “Specification for Structural Joints Using High-Strength Bolts.”
    - a. Perform testing on 10 percent of bolted connections
  - 2. Test field-welded connections in accordance with AWS D1.1 and the following test procedures, at the testing agency’s option:
    - a. Liquid Penetrant Testing: ASTM E165.
    - b. Magnetic Particle Testing: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
    - c. Ultrasonic Examination/Testing: ASTM E164.
    - d. Radiographic Examination/Testing: ASTM E94.
    - e. Perform testing on 100 percent of complete penetration field welds.

**END OF SECTION 05 12 00**

## SECTION 05 51 13 - METAL PAN STAIRS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Preassembled steel stairs with concrete-filled treads.
2. Steel tube railings and guards attached to metal stairs.
3. Steel tube handrails attached to walls adjacent to metal stairs.

#### 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.

#### 1.3 ACTION SUBMITTALS

##### A. Product Data: For metal pan stairs and the following:

1. Shop primer products.
2. Nonslip-aggregate concrete finish.
3. Handrail wall brackets.
4. Grout.

##### B. Shop Drawings:

1. Include plans, elevations, sections, details, and attachments to other work. Delegated engineer shall design attachment to the existing building structure for exterior stair.
2. Indicate sizes of metal sections, thickness of metals, profiles, holes, and field joints.
3. Include plan at each level.
4. Indicate locations of anchors, weld plates, and blocking for attachment of wall-mounted handrails.

- C. Delegated Design Submittal: For stairs railings, and guards, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For professional engineer's experience with providing delegated design engineering services of the kind indicated, including documentation that engineer is licensed in the State in which Project is located.
- B. Welding certificates.

## 1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: The contractor shall engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design stairs, railings, and guards including attachment to building construction.
- B. Structural Performance of Stairs: Metal stairs withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
1. Uniform Load: 100 lbf/sq. ft. (4.79 kN/sq. m).
  2. Concentrated Load: 300 lbf (1.33 kN) applied on an area of 4 sq. in. (2580 sq. mm).
  3. Uniform and concentrated loads need not be assumed to act concurrently.
  4. Stair Framing: Capable of withstanding stresses resulting from railing and guard loads in addition to loads specified above.
  5. Limit deflection of treads, platforms, and framing members to L/360 or 1/4 inch (6.4 mm), whichever is less.
- C. Structural Performance of Railings and Guards: Railings and guards, including attachment to building construction, withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
1. Handrails and Top Rails of Guards:
    - a. Uniform load of 50 lbf/ft. (0.73 kN/m) applied in any direction.
    - b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
    - c. Uniform and concentrated loads need not be assumed to act concurrently.
  2. Infill of Guards:
    - a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
    - b. Infill load and other loads need not be assumed to act concurrently.
  3. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
    - a. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

### 2.2 METALS

- A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- B. Steel Tubing for Railings and Guards: ASTM A500/A500M (cold formed).

1. Provide galvanized finish for exterior installations and where indicated.
- C. Steel Pipe for Railings and Guards: ASTM A53/A53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
  1. Provide galvanized finish for exterior installations and where indicated.
- D. Uncoated, Cold-Rolled Steel Sheet: ASTM A1008/A1008M, structural steel, Grade 25 (Grade 170), unless another grade is required by design loads; exposed.

### 2.3 FASTENERS

- A. General: 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 where built into exterior walls.
  1. Select fasteners for type, grade, and class required.
- B. Fasteners for Anchoring Railings and Guards to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings and guards to other types of construction indicated and capable of withstanding design loads.
- C. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors 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 according to ASTM E488/E488M, conducted by a qualified independent testing agency.
  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.

### 2.4 MISCELLANEOUS MATERIALS

- A. Handrail Wall Brackets: Cast stainless steel, center of rail [2-1/2 inches (63.5 mm)] [3-1/8 inches (79.4 mm) from face of wall.
- B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
  1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.
- D. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout; recommended by manufacturer for [interior] [exterior] use; noncorrosive and nonstaining; mixed with water to consistency suitable for application and a 30-minute working time.
  1. Plain Steel Welded-Wire Reinforcement: ASTM A1064/A10645M, steel, ,] 6 by
  2. 6 inches (152 by 152 mm), W1.4 by W1.4, unless otherwise indicated on Drawings.
  3. Reinforcement Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening welded-wire reinforcement in place.

- a. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete.
4. For galvanized reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

## 2.5 FABRICATION, GENERAL

- A. Provide complete stair assemblies, including metal framing, hangers, struts, railings, and guards, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.
  1. Join components by welding unless otherwise indicated.
  2. Use connections that maintain structural value of joined pieces.
- B. Assemble stairs, railings, and guards in shop to greatest extent possible.
  1. Disassemble units only as necessary for shipping and handling limitations.
  2. Clearly mark units for reassembly and coordinated installation.
- C. Cut, drill, and punch metals cleanly and accurately.
  1. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated.
  2. Remove sharp or rough areas on exposed surfaces.
- D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- E. Form exposed work with accurate angles and surfaces and straight edges.
- F. Weld connections 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. Weld exposed corners and seams continuously unless otherwise indicated.
  5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #1 - No evidence of welded joint.
- G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.
  1. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated.
  2. Locate joints where least conspicuous.
  3. Fabricate joints that will be exposed to weather in a manner to exclude water.
  4. Provide weep holes where water may accumulate internally.

## 2.6 FABRICATION OF STEEL-FRAMED STAIRS

- A. NAAMM Stair Standard: Comply with NAAMM AMP 510, "Metal Stairs Manual," for Architectural Class, unless more stringent requirements are indicated.
- B. Stair Framing:
  - 1. Stringers: Fabricate stringers of steel channels.
    - a. Stringer Size: As required to comply with "Performance Requirements" Article.
    - b. Provide closures for exposed ends of channel and rectangular tube stringers.
    - c. Finish: Shop primed.
  - 2. Platforms: Construct of steel channel headers and miscellaneous framing members as required to comply with "Performance Requirements" Article.
    - a. Provide closures for exposed ends of channel and rectangular tube framing.
    - b. Finish: Shop primed.
  - 3. Weld or bolt stringers to headers; weld or bolt framing members to stringers and headers. If using bolts, fabricate and join so bolts are not exposed on finished surfaces.
  - 4. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.
- C. Metal Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements, but not less than 0.067 inch.
  - 1. Fabricate treads and landing subplatforms of exterior stairs so finished walking surfaces slope to drain.
  - 2. Steel Sheet: Uncoated, cold-rolled steel sheet unless otherwise indicated.
  - 3. Directly weld metal pans to stringers; locate welds on top of subtreads where they will be concealed by concrete fill. Do not weld risers to stringers.
    - a. Smooth Soffit Construction: Construct subplatforms with flat metal under surfaces to produce smooth soffits.

## 2.7 FABRICATION OF STAIR RAILINGS AND GUARDS

- A. Comply with applicable requirements in Section 05 52 13 "Pipe and Tube Railings."
- B. Fabricate railings and guards to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of member, post spacings, wall bracket spacing, and anchorage, but not less than that needed to withstand indicated loads.
  - 1. Rails and Posts: 1-1/2-inch- (38-mm-) square] top and bottom rails and 1-1/2-inch- (38-mm-) square posts.
  - 2. Picket Infill: 1/2-inch- (13-mm-) square pickets spaced to prohibit the passage of a 4-inch (100-mm) diameter sphere.
- C. Welded Connections: Fabricate railings and guards with welded connections.
  - 1. Fabricate connections that are exposed to weather in a manner that excludes water.
    - a. Provide weep holes where water may accumulate internally.



2. Cope components at connections to provide close fit, or use fittings designed for this purpose.
  3. Weld all around at connections, including at fittings.
  4. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  5. Obtain fusion without undercut or overlap.
  6. Remove flux immediately.
  7. Finish welds to comply with NOMMA's "Voluntary Joint Finish Standards" for
  8. Finish #1 - No evidence of a welded joint as shown in NAAMM AMP 521.
- D. Form changes in direction of railings and guards as follows:
1. By bending or by inserting prefabricated elbow fittings.
  2. By inserting prefabricated elbow fittings.
- E. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- F. Close exposed ends of railing and guard members with prefabricated end fittings.
- G. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated.
1. Close ends of returns unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.
- H. Connect posts to stair framing by direct welding unless otherwise indicated.
- I. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work.
1. Furnish inserts and other anchorage devices for connecting to concrete or masonry work.
  2. Provide ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors embedded in exterior masonry and concrete construction.
  3. Provide type of bracket with predrilled hole for exposed bolt anchorage and that provides 1-1/2-inch (38-mm) clearance from inside face of handrail to finished wall surface.
- J. Fillers: Provide fillers made from steel plate, or other suitably crush-resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports.
1. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.
- 2.8 FINISHES
- A. Finish metal stairs after assembly.
- B. Preparation for Shop Priming: Prepare uncoated, ferrous-metal surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."

- C. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION OF METAL PAN STAIRS

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction.
  - 1. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.
- C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.
  - 1. Grouted Baseplates: Clean concrete- and masonry-bearing surfaces of bond- reducing materials, and roughen surfaces prior to setting plates.
    - a. Clean bottom surface of plates.
    - b. Set plates for structural members on wedges, shims, or setting nuts.
    - c. Tighten anchor bolts after supported members have been positioned and plumbed.
    - d. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
    - e. Promptly pack grout solidly between bearing surfaces and plates so no voids remain.
      - 1) Neatly finish exposed surfaces; protect grout and allow to cure.
      - 2) Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- E. Fit exposed connections accurately together to form hairline joints.
  - 1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
  - 2. 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.
  - 3. Comply with requirements for welding in "Fabrication, General" Article.
- F. Place and finish concrete fill for treads and platforms to comply with Section 03 30 00 "Cast-in-Place Concrete," or as specified on the drawings.
  - 1. Provide light broom finish..

### 3.2 INSTALLATION OF RAILINGS AND GUARDS

- A. Adjust railing and guard systems before anchoring to ensure matching alignment at abutting joints with tight, hairline joints.
  - 1. Space posts at spacing indicated or, if not indicated, as required by design loads.
  - 2. Plumb posts in each direction, within a tolerance of 1/16 inch in 3 feet.
  - 3. Align rails and guards so variations from level for horizontal members and variations from parallel with rake of stairs for sloping members do not exceed 1/4 inch in 12 feet.
  - 4. Secure posts, rail ends, and guard ends to building construction as follows:
    - a. Anchor posts to steel by [welding] [or] [bolting] to steel supporting members.
    - b. Anchor handrail and guards ends to concrete and masonry with steel round flanges welded to rail and guard ends and anchored with post- installed anchors and bolts.
- A. Attach handrails to wall with wall brackets.
  - 1. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
  - 2. Secure wall brackets to building construction as required to comply with performance requirements.

### 3.2 REPAIR

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
  - 1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint.

END OF SECTION

## SECTION 05 52 13 - PIPE AND TUBE RAILINGS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Steel railings.

#### 1.2 ACTION SUBMITTALS

A. Product Data:

1. Manufacturer's product lines of mechanically connected railings.
2. Handrail brackets.
3. Shop primer.
4. Intermediate coats and topcoats.
5. Bituminous paint.
6. Nonshrink, nonmetallic grout.
7. Anchoring cement.
8. Metal finishes.
9. Paint products.

B. Shop Drawings: Include plans, elevations, sections, project specific details, and attachments to other work.

C. Samples: For each type of exposed finish.

D. Delegated Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

#### 1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For delegated design professional engineer.

B. Welding certificates.

C. Product Test Reports: For tests on railings performed by a qualified testing agency, in accordance with ASTM E894 and ASTM E935.

#### 1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

## PART 2 - PRODUCTS

### 1.5 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.
- B. Structural Performance: Railings, including attachment to building construction, withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  - 1. Handrails and Top Rails of Guards:
    - a. Uniform load of 50 lbf/ ft. applied in any direction.
    - b. Concentrated load of 200 lbf applied in any direction.
    - c. Uniform and concentrated loads need not be assumed to act concurrently.
  - 2. Infill of Guards:
    - a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
    - b. Infill load and other loads need not be assumed to act concurrently.

### 1.6 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 predrilled hole for exposed bolt anchorage and that provides 1-1/2-inch clearance from inside face of handrail to finished wall surface.

### 1.7 STEEL RAILINGS

- A. Tubing: ASTM A500/A500M (cold formed).
- B. Pipe: ASTM A53/A53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
  - 1. Provide galvanized finish for exterior installations and where indicated.
- C. Plates, Shapes, and Bars: ASTM A36/A36M.
- D. Cast Iron Fittings: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.
- E. Extruded Bars and Tubing: ASTM B221, Alloy 6063-T5/T52.
- F. Extruded Structural Pipe and Round Tubing: ASTM B429/B429M, Alloy 6063-T6.
  - 1. Provide Standard Weight (Schedule 40) pipe unless otherwise indicated.
- G. Drawn Seamless Tubing: ASTM B210/B210M, Alloy 6063-T832.
- H. Plate and Sheet: ASTM B209, Alloy 6061-T6.
- I. Die and Hand Forgings: ASTM B247, Alloy 6061-T6.
- J. Castings: ASTM B26/B26M, Alloy A356.0-T6.

## 1.8 FASTENERS

### A. Fastener Materials:

1. Ungalvanized-Steel Railing Components: Plated steel fasteners complying with ASTM F1941/ASTM F1941M, Class Fe/Zn 5 for zinc coating.
2. Hot-Dip Galvanized Railing Components: Type 304 stainless steel or hot-dip zinc-coated steel fasteners complying with ASTM A153/A153M or ASTM F2329/F2329M for zinc coating.

### B. 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.

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.

## 1.9 MISCELLANEOUS MATERIALS

### A. Handrail Brackets: Cast iron 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.

### C. Etching Cleaner for Galvanized Metal: Complying with MPI#25.

### D. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

### E. Intermediate Coats and Topcoats: Provide products that comply with Section 09 91 13 "Exterior Painting." And Section 09 91 23 "Interior Painting."

### F. Bituminous Paint: Cold-applied asphalt emulsion, complying with ASTM D1187/D1187M.

### G. 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.

### H. 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.

1. 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.

## 1.10 FABRICATION

### A. 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.
  - B. Form work true to line and level with accurate angles and surfaces.
  - C. 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.
    5. By bending or by inserting prefabricated elbow fittings.
  - D. 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.
  - E. Close exposed ends of hollow railing members with prefabricated cap and end fittings of same metal and finish as railings.
  - F. 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.
  - G. 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.
  - H. 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.
- 1.11 STEEL AND IRON FINISHES
- A. Galvanized Railings:
    1. Hot-dip galvanize exterior steel railings, including hardware, after fabrication.
    2. Comply with ASTM A123/A123M for hot-dip galvanized railings.
    3. Comply with ASTM A153/A153M for hot-dip galvanized hardware.
  - B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.
  - C. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner and as follows.
    1. Comply with SSPC-SP 16.

- D. For nongalvanized-steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves; however, hot-dip galvanize anchors to be embedded in exterior concrete or masonry.
- E. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with requirements indicated below:
  - 1. Exterior Railings: SSPC-SP 6/NACE No. 3.
  - 2. Other Railings: SSPC-SP 3.
- F. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1 for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.
  - 1. Shop prime uncoated railings with universal shop primer indicated.
  - 2. Do not apply primer to galvanized surfaces.

### PART 3 - EXECUTION

#### 3.1 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.

#### 3.2 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 or anchoring cement, 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 or anchoring cement], mixed and placed to comply with anchoring material manufacturer's written instructions.

### 3.3 ATTACHING RAILINGS

- A. 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.
- B. 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 hollow masonry anchorage, use toggle bolts.
  - 3. For steel-framed partitions, use hanger or lag bolts set into fire-retardant-treated wood backing between studs. Coordinate with stud installation to locate backing members.
  - 4. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

### 3.4 CLEANING

- A. Clean all exposed surfaces prior to substantial completion.

END OF SECTION 055213

Section 06 10 00: ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
  - 1. Pressure treated wood grounds, nailers, and blocking (including plywood).
- B. Related Sections: The following Sections contain requirements that relate to this Section:
  - 1. Division 6 Section "Interior Architectural Woodwork" for nonstructural carpentry items exposed to view and not specified in another Section.

1.3 DEFINITIONS

- A. Rough carpentry includes carpentry work not specified as part of other Sections and generally not exposed, unless otherwise specified. All concealed wood blocking and plywood shall be pressure treated wood.

1.4 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract. Each Manufacturer providing products for this project is required to furnish the Florida Product Approval Number with every component included in the submittal documents. More information is available at the following link: [http://www.pbcgov.com/pzb/building/productappr/rule\\_9B\\_72.pdf](http://www.pbcgov.com/pzb/building/productappr/rule_9B_72.pdf)
- B. Material certificates for dimensional lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use as well as design values approved by the Board of Review of American Lumber Standards Committee.
- C. Wood treatment data as follows including chemical treatment manufacturer's instructions for handling, storing, installation, and finishing of treated material:
  - 1. For each type of preservative treated wood product include certification by treating plant stating type of preservative solution and pressure process used, net amount of preservative retained, and compliance with applicable standards.
  - 2. For water-borne treated products include statement that moisture content of treated materials was reduced to levels indicated prior to shipment to project site.
  - 3. Warranty of chemical treatment manufacturer for each type of treatment.

1.5 QUALITY ASSURANCE

- B. Forest Certification: For the following wood products, provide materials produced from wood obtained

from forests certified by an FSC-accredited certification body to comply with FSC 1.2, "Principles and Criteria".

1. All wood products that are to be a part of the finish project.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Delivery and Storage: Keep materials under cover and dry. Protect against exposure to weather and contact with damp or wet surfaces. Stack lumber as well as plywood and other panels; provide for air circulation within and around stacks and under temporary coverings including polyethylene and similar materials.

1. For lumber and plywood pressure treated with waterborne chemicals, place spacers between each bundle to provide air circulation.

#### PART 2 - PRODUCTS

##### 2.1 LUMBER, GENERAL

- A. Lumber Standards: Furnish lumber manufactured to comply with PS 20 "American Softwood Lumber Standard" and with applicable grading rules of inspection agencies certified by American Lumber Standards Committee's (ALSC) Board of Review.
- B. Inspection Agencies: Inspection agencies and the abbreviations used to reference them with lumber grades and species include the following:
  1. SPIB - Southern Pine Inspection Bureau.
  2. WWPA - Western Wood Products Association.
- C. Grade Stamps: Provide lumber with each piece factory-marked with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content at time of surfacing, and mill.
- D. Nominal sizes are indicated, except as shown by detail dimensions. Provide actual sizes as required by PS 20, for moisture content specified for each use.
  1. Provide dressed lumber, S4S, unless otherwise indicated.
  2. Provide seasoned lumber with 19 percent maximum moisture content at time of dressing and shipment for sizes 2 inches or less in nominal thickness, unless otherwise indicated.

##### 2.2 MISCELLANEOUS LUMBER

- A. General: Provide lumber for support or attachment of other construction including rooftop equipment curbs and support bases, cant strips, bucks, nailers, blocking, furring, grounds, stripping, and similar members.
- B. Fabricate miscellaneous lumber from dimension lumber of sizes indicated and into shapes shown.
- C. Moisture content: 19 percent maximum for lumber items not specified to receive wood preservative treatment.

- D. Grade: "Standard" grade light-framing-size lumber of any species or board-size lumber as required. "No. 3 Common" or "Standard" grade boards per WCLIB or WWPA rules or "No. 2 Boards" per SPIB rules.

### 2.3 CONSTRUCTION PANELS FOR BACKING

- A. Plywood Backing Panels: For mounting electrical or telephone equipment, provide fire-retardant-treated plywood panels with grade designation, APA C-D PLUGGED EXPOSURE 1, in thickness indicated, or, if not otherwise indicated, not less than 15/32 inch.

### 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. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with a hot-dip zinc coating per ASTM A 153 or of AISI Type 304 stainless steel.
- B. Nails, Wire, Brads, and Staples: FS FF-N-105.
- C. Power Driven Fasteners: National Evaluation Report NER-272.
- D. Wood Screws: ANSI B18.6.1.
- E. Lag Bolts: ANSI B18.2.1.
- F. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and where indicated, flat washers.

### 2.5 PRESERVATIVE WOOD TREATMENT BY PRESSURE PROCESS

- A. General: Where lumber or plywood is indicated as preservative-treated wood or is specified herein to be treated, comply with applicable requirements of AWWA Standards C2 (Lumber) and C9 (Plywood). Mark each treated item with the AWPB or SPIB Quality Mark Requirements.
- B. Pressure-treat above-ground items with water-borne preservatives to a minimum retention of 0.25 pcf. For interior uses, after treatment, kiln-dry lumber and plywood to a maximum moisture content, respectively, of 19 percent and 15 percent. Treat indicated items 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. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
  - 3. Wood framing members less than 18 inches above grade.
  - 4. Wood floor plates installed over concrete slabs directly in contact with earth.
- C. Pressure-treat wood members in contact with the ground or fresh water with water-borne preservatives to a minimum retention of 0.40 pcf.
- D. Complete fabrication of treated items prior to treatment, where possible. If cut after treatment, coat cut surfaces to comply with AWWA M4. Inspect each piece of lumber or plywood after drying and discard damaged or defective pieces.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION, GENERAL

- A. Discard units of material with defects that impair quality of rough carpentry construction and that are too small to use in fabricating rough carpentry with minimum joints or optimum joint arrangement.
- B. Set rough carpentry to required levels and lines, with members plumb and true to line and cut and fitted.
- C. Fit rough carpentry to other construction; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds, and similar supports to allow attachment of other construction.
- D. Securely attach rough carpentry work to substrate by anchoring and fastening as required.
- E. Countersink nail heads on exposed carpentry work and fill holes.
- F. Use common wire nails, unless otherwise indicated. Use finishing nails for finish work. Select fasteners of size that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting of wood; predrill as required.

#### 3.2 WOOD GROUNDS, NAILERS, BLOCKING, AND SLEEPERS

- A. Install wood grounds, nailers, blocking, and sleepers where shown and where required for screeding or attachment of other work. Form to shapes as shown and cut as required for true line and level of work to be attached. Coordinate location with other work involved.
- B. Attach to substrates as required to support applied loading. Countersink bolts and nuts flush with surfaces, unless otherwise indicated. Build into masonry during installation of masonry work. Where possible, anchor to formwork before concrete placement.

END OF SECTION 06100

## SECTION 064116 - 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.
3. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-clad architectural cabinets that are not concealed within other construction.

## B. Related Sections

1. 06 10 00 Rough Carpentry.
2. 12 36 61.16 Solid Surface Countertops

## 1.2 PREINSTALLATION MEETINGS

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

## 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
1. Include plans, elevations, sections, and attachment details.
- C. Samples: For each exposed product and for each color and texture specified.

## 1.4 INFORMATIONAL SUBMITTALS

- A. Research reports.
- B. Field quality control reports.

## 1.5 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: 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.

## 1.6 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 (16 and 32 deg C) and relative humidity between **25 and 55** percent during the remainder of the construction period.

## 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.
- B. Architectural Woodwork Standards Grade: **Custom**.
- C. Type of Construction: **Frameless**.
- D. Door and Drawer-Front Style: **Flush** overlay.
- E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by quality standard.
- F. Laminate Cladding for Exposed Surfaces:
  - 1. Vertical Surfaces: **Grade VGS**.
  - 2. Edges: **Grade VGS**
  - 3. Pattern Direction: **Vertically for doors and fixed panels, horizontally for drawer fronts**.
- G. 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**.
- H. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
  - 1. Match Architect's sample. Refer to finish schedule on the drawings.

## 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.
  - 1. Wood Moisture Content: **5 to 10** percent.
  - 2. All base cabinets with sinks shall have plywood bottom and toe kick.
  - 3. Provide backing for all cabinets. Refer to Rough Carpentry section

- 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. Comply with LEED requirements for recycled content and composite wood products.
1. Medium-Density Fiberboard (MDF): ANSI A208.2, **Grade 130**.
  2. Particleboard (Medium Density): ANSI A208.1, **Grade M-2**.
  3. Softwood Plywood: DOC PS 1 , **medium-density overlay**.
  4. Thermally Fused Laminate (TFL) Panels: Particleboard or MDF finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for Test Methods 3.3, 3.4, 3.6, 3.8, and 3.10.

## 2.3 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets **including pulls, hinges, drawer slides, stops and similar items for a fully functional product.**

## 2.4 MISCELLANEOUS 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 and at floors.
- C. Use LEED Compliant adhesives, manufacturer's standard.

## 2.5 FABRICATION

- A. 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.
- B. 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 INSTALLATION

- A. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.
- B. Architectural Woodwork Standards Grade: Install cabinets to comply with quality standard grade of item to be installed.
- 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 (3 mm in 2400 mm) 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. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches (400 mm) o.c. with **No. 10 wafer-head screws sized for not less than 1-1/2-inch (38-mm) penetration into wood framing, blocking, or hanging strips, No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish, toggle bolts through metal backing or metal framing behind wall finish.**

END OF SECTION 064116

## SECTION 070150.19 - PREPARATION FOR REROOFING

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. *Design Intent: The design intent is to remove and replace the existing membrane roofing, flashings, copings, roof edge flashing, gutters and downspouts. It is the Contractor's responsibility to inspect the roof area prior to reroofing, and report any deficiencies to the Architect prior to commencing work. Architect will provide direction for deficiency correction.*
- B. Section Includes:
1. Full tear-off of **entire roof membrane (only)**.
  2. Removal of flashings and counterflashings.
- C. It is intended that the existing tapered roof insulation remain in place. It is not anticipated that wet roof insulation will be encountered. However, if wet roof insulation is uncovered, immediately notify the architect, in writing, of the extent. The architect will evaluate the condition and provide further instructions for removal of existing wet insulation, and replacement with new insulation.

## 1.2 PREINSTALLATION MEETINGS

- A. Preliminary Roofing Conference: Before starting removal Work, conduct conference at **Project site**.

## 1.3 INFORMATIONAL SUBMITTALS

- A. Photographs or Video: Show existing conditions of adjoining construction and site improvements, including exterior and interior finish surfaces, that might be misconstrued as having been damaged by reroofing operations.
1. Submit before Work begins.

## 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Approved by warrantor of existing roofing system to work on existing roofing.

## 1.5 FIELD CONDITIONS

- A. Existing Roofing System: **TPO** roofing.

- B. Owner **will not** occupy portions of building immediately below reroofing area.
  - 1. Conduct reroofing so Owner's operations are not disrupted.
- C. Protect building to be reroofed, adjacent buildings, walkways, site improvements, exterior plantings, and landscaping from damage or soiling from reroofing operations.
- D. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities.
- E. Conditions existing at time of inspection for bidding will be maintained by Owner as far as practical.
- F. Limit construction loads on existing roof areas to remain, and existing roof areas scheduled to be reroofed for equipment wheel loads and for uniformly distributed loads. Do not exceed original building design loads.
- G. Weather Limitations: Proceed with reroofing preparation only when existing and forecasted weather conditions permit Work to proceed without water entering existing roofing system or building.
  - 1. Remove only as much roofing in one day as can be made watertight in the same day.

## PART 2 - PRODUCTS

### 2.1 AUXILIARY REROOFING MATERIALS

- A. General: Use auxiliary reroofing preparation materials recommended by roofing system manufacturer for intended use and compatible with components of new roofing system.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Seal or isolate windows that may be exposed to airborne substances created in removal of existing materials.
- B. Shut off rooftop utilities and service piping before beginning the Work.
- C. Test existing roof drains to verify that they are not blocked or restricted.
  - 1. Immediately notify Architect of any blockages or restrictions.
- D. During removal operations, have sufficient and suitable materials on-site to facilitate rapid installation of temporary protection in the event of unexpected rain.
- E. Maintain roof drains in functioning condition to ensure roof drainage at end of each workday.
  - 1. Prevent debris from entering or blocking roof drains and conductors.

- a. Use roof-drain plugs specifically designed for this purpose.
  - b. Remove roof-drain plugs at end of each workday, when no work is taking place, or when rain is forecast.
2. If roof drains are temporarily blocked or unserviceable due to roofing system removal or partial installation of new roofing system, provide alternative drainage method to remove water and eliminate ponding.
- a. Do not permit water to enter into or under existing roofing system components that are to remain.

### 3.2 ROOF TEAR-OFF

- A. Lower removed roofing materials to ground and onto lower roof levels, using dust-tight chutes or other acceptable means of removing materials from roof areas.
- B. Full Roof Membrane Tear-off: **Remove** existing roofing membrane, other roofing system components including parapet coping, roof edge flashing and trim gutters and downspouts down to the existing insulation.
  1. Remove base flashings and counter flashings.
  2. Remove perimeter edge flashing and gravel stops.
  3. Remove copings.
  4. Remove roof drains indicated on Drawings to be removed.
  5. Remove wood blocking, curbs, and nailers.
6. Notify the architect if wet or damp materials below existing roofing are encountered.
7. Replace wood blocking, curbs, and nailers with preservative treated products of the same dimension.=.

### 3.3 PREPARATION

- A. Inspect surface after tear-off of roofing system.
- B. If broken or loose fasteners that secure deck panels to one another or to structure are observed, or if deck appears or feels inadequately attached, immediately notify Architect.
  1. Do not proceed with installation until directed by Architect.
- C. If deck surface is unsuitable for receiving new roofing or if structural integrity of deck is suspect, immediately notify Architect.
  1. Do not proceed with installation until directed by Architect.

END OF SECTION 070150.19

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**SECTION 072413 - POLYMER-BASED EXTERIOR INSULATION AND FINISH SYSTEM (EIFS)**  
(Repair/Infill of existing exterior stucco system)**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. EIFS-clad barrier-wall assemblies that are field applied over substrate.

**B. Summary:**

1. The work includes repairs of existing stucco finish system.
  - a. Damage due to roof replacement work.
  - b. Infill of recessed areas in stucco band.

**1.2 PREINSTALLATION MEETINGS**

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

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each EIFS component, trim, and accessory.
- B. Samples: For each exposed product and for each color and texture specified.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Manufacturer certificates.
- B. Product certificates.
- C. Product test reports.
- D. Field quality-control reports.
- E. Sample warranty.

**1.5 CLOSEOUT SUBMITTALS**

- A. Maintenance data.

## 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An installer who is certified in writing by AWCI International as qualified to install Class PB EIFS using trained workers.

## 1.7 WARRANTY

- A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace components of EIFS that fail in materials or workmanship within specified warranty period.
1. Warranty Period: **Five** years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Dryvit Systems, Inc.
  2. Parex USA, Inc.
  3. Sto Corp.

### 2.2 PERFORMANCE REQUIREMENTS

- A. EIFS Performance: Comply with ASTM E2568 and with the following:
1. Weathertightness: Resistant to water penetration from exterior.
  2. Impact Performance: ASTM E2568, **Standard** impact resistance[ **unless otherwise indicated**.

### 2.3 EIFS MATERIALS

- A. Flexible-Membrane Flashing: Cold-applied, self-adhering, self-healing, rubberized-asphalt and polyethylene-film composite sheet or tape and primer; EIFS manufacturer's standard or product recommended in writing by EIFS manufacturer.
- B. Insulation Adhesive: EIFS manufacturer's standard formulation designed for indicated use; compatible with substrate.
- C. Molded, (Expanded) Rigid Cellular Polystyrene Board Insulation: Comply with ASTM E2430/E2430M.
1. Foam Buildouts: Provide with profiles and dimensions indicated on Drawings.
- D. Reinforcing Mesh: Balanced, alkali-resistant, open-weave, glass-fiber mesh treated for compatibility with other EIFS materials, made from continuous multi-end strands with retained

mesh tensile strength of not less than **120 lbf/in. (21 dN/cm)** in accordance with ASTM E2098/E2098M.

1. Reinforcing Mesh for EIFS, General: Not less than weight required to comply with impact-performance level specified in "Performance Requirements" Article.
- E. Base Coat: EIFS manufacturer's standard mixture.
- F. Water-Resistant Base Coat: EIFS manufacturer's standard waterproof formulation.
- G. Primer: EIFS manufacturer's standard factory-mixed, elastomeric-polymer primer for preparing base-coat surface for application of finish coat.
- H. Finish Coat: EIFS manufacturer's **standard acrylic-based coating with enhanced mildew resistance**.
  1. Colors: **As selected by Architect from manufacturer's full range**.
  2. Textures: Match existing.
- I. Trim Accessories: Type as designated or required to suit conditions indicated and to comply with EIFS manufacturer's written instructions; manufactured from UV-stabilized PVC; and complying with ASTM D1784 and ASTM C1063.

## PART 3 - EXECUTION

### 3.1 EIFS INSTALLATION

- A. Comply with ASTM C1397, ASTM E2511, and EIFS manufacturer's written instructions for installation of EIFS as applicable to each type of substrate.
- B. Flexible-Membrane Flashing: Apply and lap to shed water; seal at openings, penetrations, and terminations. Prime substrates with flashing primer if required and install flashing.
- C. Trim: Apply trim accessories at perimeter of EIFS, at expansion joints, [**at windowsills,**] and elsewhere as indicated. Coordinate with installation of insulation.
- D. Board Insulation: Adhesively attach insulation to substrate in compliance with ASTM C1397.
  1. Rasp or sand flush entire surface of insulation to remove irregularities projecting more than [**1/32 inch (0.8 mm)**] [**1/16 inch (1.6 mm)**] from surface of insulation and to remove yellowed areas due to sun exposure; do not create depressions deeper than **1/16 inch (1.6 mm)**. Prevent airborne dispersal and immediately collect insulation raspings or sandings.
  2. Coordinate installation of flashing and insulation to produce wall assembly that does not allow water to penetrate behind flashing and EIFS lamina.
- E. Expansion Joints: Install at locations indicated and where required by EIFS manufacturer.
- F. Water-Resistant Base Coat: Apply full-thickness coverage **to exposed insulation parapets foam buildouts** and to other surfaces indicated on Drawings.



- G. Base Coat: Apply full coverage to exposed insulation **and foam buildouts** with not less than **1/16-inch (1.6-mm)** dry-coat thickness.
- H. Reinforcing Mesh: Embed reinforcing mesh in wet base coat to produce wrinkle-free installation with mesh continuous at corners, overlapped not less than **2-1/2 inches (64 mm)** or otherwise treated at joints to comply with ASTM C1397. Do not lap reinforcing mesh within **8 inches (200 mm)** of corners. Completely embed mesh, applying additional base-coat material if necessary, so reinforcing-mesh color and pattern are invisible.
- I. Double-Layer Reinforcing-Mesh Application: Where indicated or required, apply second base coat and second layer of reinforcing mesh, overlapped not less than **2-1/2 inches (64 mm)** or otherwise treated at joints to comply with ASTM C1397 in same manner as first application. Do not apply until first base coat has cured.
- J. Additional Reinforcing Mesh: Apply strip-reinforcing mesh around openings, extending **4 inches (100 mm)** beyond perimeter. Apply additional **9-by-12-inch (230-by-300-mm)** strip-reinforcing mesh diagonally at corners of openings (re-entrant corners). Apply **8-inch- (200-mm-)** wide, strip-reinforcing mesh at both inside and outside corners unless base layer of mesh is lapped not less than **4 inches (100 mm)** on each side of corners.
- K. Foam Buildouts: Fully embed reinforcing mesh in base coat.
- L. Finish Coat: Apply full-thickness coverage over dry **primed** base coat, maintaining a wet edge at all times for uniform appearance, to produce a uniform finish of color and texture matching approved sample and free of cold joints, shadow lines, and texture variations.
- M. Sealer Coat: Apply over dry finish coat, in number of coats and thickness required by EIFS manufacturer.

### 3.2 FIELD QUALITY CONTROL

- A. Special Inspections: Engage a qualified special inspector to perform.
- B. Testing Agency: **Engage** a qualified testing agency to perform tests and inspections.
- C. EIFS Tests and Inspections: In accordance with ASTM E2568.
- D. EIFS will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

END OF SECTION 072413

## SECTION 075423 - THERMOPLASTIC-POLYOLEFIN (TPO) ROOFING

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. *Design Intent: The design intent is to remove and replace the existing membrane roofing, flashings, copings, roof edge flashing, gutters and downspouts. It is the Contractor's responsibility to inspect the roof area prior to reroofing, and report any deficiencies to the Architect prior to commencing work. Architect will provide direction for deficiency correction.*
- B. Section Includes:
1. **Adhered** thermoplastic polyolefin (TPO) roofing system.
  2. Accessory roofing materials.
  3. Substrate board.
  4. Roof insulation and cover boards are included in this specification for reference only. . The Design intent is to leave the existing insulation in place for reuse. It is not anticipated that wet insulation exists. However, if wet insulation is encountered, notify the architect immediately for direction regarding replacement.
  5. Walkways.

## 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. For insulation and roof system component fasteners, include copy of **FM Approvals' RoofNav** listing.
- B. Shop Drawings: Include roof plans, sections, project specific details, and attachments to other work, including the following:
1. Base flashings and membrane termination details.
  2. Flashing details at penetrations.
- C. Samples: For the following products:
1. Roof membrane and flashings, 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.

#### 1.4 INFORMATIONAL SUBMITTALS

##### A. Manufacturer Certificates:

1. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.

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

##### C. Research reports.

##### D. Field Test Reports:

1. Concrete internal relative humidity test reports.
2. Fastener-pullout test results and manufacturer's revised requirements for fastener patterns.

##### E. Field quality-control reports.

##### F. Sample warranties.

#### 1.5 CLOSEOUT SUBMITTALS

##### A. Maintenance data.

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

#### 1.6 QUALITY ASSURANCE

##### A. Qualifications:

1. Manufacturers: A qualified manufacturer that is **UL listed** for roofing system identical to that used for this Project.
2. Installers: 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.

#### 1.7 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. Warranty Period: **20** years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Accelerated Weathering: Roof membrane to withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.
- B. Impact Resistance: Roof membrane to resist impact damage when tested according to ASTM D3746, ASTM D4272, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.
- C. Wind Uplift Resistance: Design roofing system to resist the following wind uplift pressures when tested according to FM Approvals 4474, UL 580, or UL 1897:
  - a. Refer to structural drawings for wind uplift and other loading conditions.
2. Fire/Windstorm Classification: **Class 1A-120**.
3. Hail-Resistance Rating: FM Global Property Loss Prevention Data Sheet 1-34 **SH**.
- D. SPRI's Directory of Roof Assemblies Listing: Roof membrane, base flashings, and component materials comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system, and are listed in SPRI's Directory of Roof Assemblies for roof assembly identical for that specified for this Project.
  1. Wind Uplift Load Capacity: Refer to 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.

### 2.2 THERMOPLASTIC POLYOLEFIN (TPO) ROOFING

- A. TPO Sheet: ASTM D6878/D6878M, internally fabric- or scrim-reinforced, **fabric-backed** TPO sheet.
  1. Manufacturers: Subject to compliance with requirements, **available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**:
    - a. Carlisle Syntec Systems.
    - b. GAF.
    - c. Johns Manville; a Berkshire Hathaway company.
    - d. Mule-Hide Products Co., Inc.
    - e. <Retain one option in "Thickness" Subparagraph below.
  2. Thickness: **60 mils (1.5 mm)**, nominal.
  3. Exposed Face Color: **White** <Insert color>.

## 2.3 ACCESSORY ROOFING MATERIALS

- A. General: Accessory materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.
  - 1. Adhesive and Sealants: Comply with Manufacturer's recommendations.
- B. Sheet Flashing: Manufacturer's standard unreinforced TPO sheet flashing, **60 mils** thick, minimum, of same color as TPO sheet.
- C. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.
- D. Bonding Adhesive: Manufacturer's standard[, **water based**].
- E. Slip Sheet: **Manufacturer's standard, of thickness required for application.**
- F. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.
- G. 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.
- H. 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 BOARD *(If required due to wet insulation and directed by Architect)*

- A. Glass-Mat Gypsum Roof Cover Board: ASTM C1177/C1177M, water-resistant gypsum board.
  - 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. Thickness: **Match existing.**
  - 3. **Unprimed.**

## 2.5 ROOF INSULATION

- A. ***Design Intent: Roof Insulation replacement may be required if wet and unsuitable insulation is found during tearoff. If uncovered, notify the Architect for direction before proceeding.***
- B. Replacement insulation is intended to match existing in type, thickness and 'R' Value.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Kingspan Insulation LLC.
  - b. Owens Corning.
  - c. The Dow Chemical Company.

## 2.6 INSULATION ACCESSORIES AND COVER BOARD

- A. Fasteners: Factory-coated steel fasteners with metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation **and cover boards** to substrate, and acceptable to roofing system manufacturer.
- B. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:
  1. Bead-applied, low-rise, one-component or multicomponent urethane adhesive..
- C. Glass-Mat Gypsum Cover Board: ASTM C1177/C1177M, water-resistant gypsum board. (*When required by Roof Membrane Manufacturer*)
  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. Thickness: **1/4 inch (6 mm)** .
  3. Surface Finish: **Unprimed.**

## 2.7 WALKWAYS

- A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway **pads or rolls**, approximately 3/16 inch (5 mm) thick and acceptable to roofing system manufacturer.
  1. Size: Approximately 36 by 60 inches (914 by 1524 mm).
  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.

### 3.2 INSTALLATION OF ROOFING, GENERAL

- A. Install roofing system according to roofing system manufacturer's written instructions, **FM Approvals' RoofNav** 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.

### 3.3 INSTALLATION OF SUBSTRATE BOARD (*When required, see design intent statement*)

- A. Install substrate board with long joints in continuous straight lines, with end joints staggered not less than 24 inches (610 mm) 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 according to recommendations in [**FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification**] [**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 according to roofing system manufacturers' written instructions.

### 3.4 INSTALLATION OF INSULATION (*When required, see design intent statement*)

- 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 roof 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 (610 mm) in adjacent rows end joints staggered not less than 12 inches (305 mm) in adjacent rows and with long joints continuous at right angle to flutes of decking**.
    - a. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
    - b. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.

- c. Mechanically attach base layer of insulation using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to metal decks.
  - 1) Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.
2. Install upper layers of insulation with joints of each layer offset not less than 12 inches (305 mm) from previous layer of insulation.
  - a. Staggered end joints within each layer not less than 24 inches (610 mm) in adjacent rows.
  - b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
  - c. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
  - d. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
  - e. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.

### 3.5 INSTALLATION OF RECOVERY BOARDS (*When required, see design intent statement*)

- A. Install recovery 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 (150 mm) in each direction.
  1. Trim recovery board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
  2. Cut and fit recovery board tight to nailers, projections, and penetrations.
  3. Adhere recovery board to substrate using adhesive according to **FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification** and FM Global Property Loss Prevention Data Sheet 1-29, as follows:
    - a. Set cover board in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
    - b. Set recovery board in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

### 3.6 INSTALLATION OF ADHERED ROOF MEMBRANE

- A. Adhere roof membrane over area to receive roofing according to roofing 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 roof membrane, 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.

### 3.7 INSTALLATION OF BASE FLASHING

- A. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to roofing system manufacturer's written instructions.
- B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.
- D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.
- E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

### 3.8 INSTALLATION OF WALKWAYS

- A. Flexible Walkways:
  - 1. Install flexible walkways at the following locations:
    - a. Retain one or more subparagraphs below. Revise to suit Project.
    - b. Perimeter of each rooftop unit.
    - c. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.

- d. Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.
  - e. Top and bottom of each roof access ladder.
  - f. Between each roof access ladder and each rooftop unit location or path connecting rooftop unit locations.
  - g. Locations indicated on Drawings.
  - h. As required by roof membrane manufacturer's warranty requirements.
2. Provide 6-inch (76-mm) clearance between adjoining pads.
  3. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

### 3.9 FIELD QUALITY CONTROL

- A. Testing Agency: **Engage** a qualified testing agency to inspect substrate conditions, surface preparation, roof membrane application, flashings, protection, and drainage components, and to furnish reports to Architect.
- B. Perform the following tests:
  1. Infrared Thermography: Testing agency surveys entire roof area using infrared color thermography according to ASTM C1153.
    - a. Perform tests before overlying construction is placed.
    - b. After infrared scan, locate specific areas of leaks by electrical capacitance/impedance testing or nuclear hydrogen detection testing.
    - c. After testing, repair leaks, repeat tests, and make further repairs until roofing and flashing installations are watertight.
      - 1) Cost of retesting is Contractor's responsibility.
    - d. Testing agency to prepare survey report of initial scan indicating locations of entrapped moisture, if any.
  2. Electrical Capacitance/Impedance Testing: Testing agency surveys entire roof area for entrapped water within roof assembly according to ASTM D7954/D7954M.
    - a. Perform tests before overlying construction is placed.
    - b. After testing, repair leaks, repeat tests, and make further repairs until roofing and flashing installations are watertight.
      - 1) Cost of retesting is Contractor's responsibility.
    - c. Testing agency to prepare survey report indicating locations of entrapped moisture, if any.
    - d. Testing agency to prepare survey report indicating locations of initial discontinuities, if any.

- C. 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.
- D. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.

### 3.10 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 system, 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 according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 075423

## SECTION 077100 - ROOF SPECIALTIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Copings.
2. Roof-edge specialties.
3. Roof-edge drainage systems.
4. Reglets and counterflashings.

B. Related Sections:

1. 075423 Thermoplastic Polyolefin (TPO) Roofing.
2. 077233 Roof Hatches.

C. Preinstallation Conference: Conduct conference at **Project site**.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For roof specialties.

1. Include project specific details, plans, elevations, expansion-joint locations, keyed details, and attachments to other work. Distinguish between plant- and field-assembled work.

C. Samples: For each type of roof specialty and for each color and texture specified.

#### 1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For tests performed by a qualified testing agency.

B. Sample warranty.

#### 1.4 CLOSEOUT SUBMITTALS

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

#### 1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer offering products meeting requirements that are **FM Approvals listed for specified class**.

## 1.6 WARRANTY

- A. Roofing-System Warranty: Roof specialties are included in warranty provisions in Section 07 54 23.
- B. Special Warranty on Painted Finishes: Manufacturer agrees to repair finish or replace roof specialties that show evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Delta E units when tested 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. SPRI Wind Design Standard: Manufacture and install **copings** and **roof-edge specialties** tested in accordance with SPRI ES-1 and capable of resisting the following design pressures:
  - 1. Design Pressure: **As indicated on Drawings.**
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  - 1. Temperature Change (Range): **120 deg F (67 deg C), ambient; 180 deg F (100 deg C)**, material surfaces.

### 2.2 COPINGS

- A. Metal Copings: Manufactured coping system consisting of metal coping cap in section lengths not exceeding **12 feet (3.6 m)**, concealed anchorage; with corner units, end cap units, and concealed splice plates with finish matching coping caps.
  - 1. Manufacturers include but are not limited to:
    - a. Exceptional Metals
    - b. Metal Era
    - c. Atas International.

2. Formed Aluminum Sheet Coping Caps: Aluminum sheet, **thickness as required to meet performance requirements.**
  - a. Surface: **Smooth, flat** finish.
  - b. Finish: **Two-coat mica fluoropolymer.**
  - c. Color: **As selected by Architect from manufacturer's full range.**
3. Corners: Factory mitered and **continuously welded.**
4. Coping-Cap Attachment Method: **face leg hooked to continuous cleat with back leg fastener exposed**, fabricated from coping-cap material.
  - a. Face-Leg Cleats: Concealed, continuous **stainless steel.**

### 2.3 ROOF-EDGE SPECIALTIES

- A. Canted Roof-Edge **Fascia and Gravel Stop**: Manufactured, two-piece, roof-edge fascia consisting of **snap-on** metal fascia cover in section lengths not exceeding **12 feet (3.6 m)** and a continuous formed galvanized-steel sheet cant, **0.028 inch (0.71 mm)** thick, minimum, with extended vertical leg terminating in a drip-edge cleat. Provide matching corner units.
  1. Manufacturers include but are not limited to:
    - a. Exceptional Metals
    - b. Metal Era
    - c. Atas International.
    - d. Surface: **Smooth, flat** finish.
    - e. Finish: **Two-coat fluoropolymer.**
    - f. Color: **As selected by Architect from manufacturer's full range.**
  2. Formed Aluminum Sheet Fascia Covers: Aluminum sheet, **thickness as required to meet performance requirements.**
    - a. Surface: **Smooth, flat** finish.
    - b. Finish: **Two-coat fluoropolymer.**
    - c. Color: **As selected by Architect from manufacturer's full range.**
  3. Corners: Factory mitered and **continuously welded.**
  4. Splice Plates: **Concealed**, of same material, finish, and shape as fascia cover.

### 2.4 ROOF-EDGE DRAINAGE SYSTEMS

1. Manufacturers include but are not limited to:
  - a. Exceptional Metals
  - b. Metal Era
  - c. Atas International.
- B. Gutters: Manufactured in uniform section lengths not exceeding **12 feet (3.6 m)**, with matching corner units, ends, outlet tubes, and other accessories. Elevate back edge at least **1 inch (25 mm)** above front edge. Furnish flat-stock gutter straps, gutter brackets, expansion joints, and expansion-joint covers fabricated from same metal as gutters.
  1. Aluminum Sheet: **0.040 inch (1.02 mm)** thick.

2. Gutter Profile: **As indicated** in accordance with SMACNA's "Architectural Sheet Metal Manual."
  3. Corners: Factory mitered and **continuously welded**.
  4. Gutter Supports: **Manufacturer's standard supports as selected by Architect** with finish matching the gutters.
  5. Gutter Accessories: **Continuous screened leaf guard with sheet metal frame**.
- C. Downspouts: **Plain rectangular** complete with **mitered** elbows, manufactured from the following exposed metal. Furnish with metal hangers, from same material as downspouts, and anchors.
1. Formed Aluminum: **0.040 inch (1.02 mm)** thick.
- D. Accessories:

## 2.5 MISCELLANEOUS MATERIALS

- A. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements. Furnish the following unless otherwise indicated:
1. Fasteners for Aluminum: Aluminum or Series 300 stainless steel.
- B. Elastomeric Sealant: ASTM C920, elastomeric **silicone** polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.
- C. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type joints with limited movement.
- D. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.
- E. Asphalt Roofing Cement: ASTM D4586, asbestos free, of consistency required for application.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Install roof specialties in accordance with manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, underlayments, sealants, and other miscellaneous items as required to complete roof-specialty systems.
1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
  2. Provide uniform, neat seams with minimum exposure of solder and sealant.
  3. Install roof specialties to fit substrates and to result in weathertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
  4. Torch cutting of roof specialties is not permitted.
  5. Do not use graphite pencils to mark metal surfaces.

- B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
  - 1. Coat concealed side of **uncoated aluminum** roof specialties with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
  - 2. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof specialties for waterproof performance.
- C. Expansion Provisions: Allow for thermal expansion of exposed roof specialties.
  - 1. Space movement joints at a maximum of **12 feet (3.6 m)** with no joints within **18 inches (450 mm)** of corners or intersections unless otherwise indicated on Drawings.
  - 2. When ambient temperature at time of installation is between **40 and 70 deg F (4 and 21 deg C)**, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.
- D. Fastener Sizes: Use fasteners of sizes that penetrate **wood blocking substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.**
- E. Seal concealed joints with butyl sealant as required by roofing-specialty manufacturer.
- F. Seal joints as required for weathertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below **40 deg F (4 deg C)**.

### 3.2 INSTALLATION OF COPINGS

- A. Install cleats, anchor plates, and other anchoring and attachment accessories and devices with concealed fasteners.
- B. Anchor copings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.
  - 1. Interlock face and back leg drip edges of snap-on coping cap into cleated anchor plates anchored to substrate at **than manufacturer's required spacing that meets performance requirements.**
  - 2. Interlock face-leg drip edge into continuous cleat anchored to substrate at **manufacturer's required spacing that meets performance requirements.** Anchor back leg of coping with screw fasteners and elastomeric washers at **manufacturer's required spacing that meets performance requirements.**

### 3.3 INSTALLATION OF ROOF-EDGE SPECIALITIES

- A. Install cleats, cants, and other anchoring and attachment accessories and devices with concealed fasteners.
- B. Anchor roof edgings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.



### 3.4 INSTALLATION OF ROOF-EDGE DRAINAGE SYSTEMS

- A. Install components to produce a complete roof-edge drainage system in accordance with manufacturer's written instructions. Coordinate installation of roof perimeter flashing with installation of roof-edge drainage system.
- B. Gutters: Join and seal gutter lengths. Allow for thermal expansion. Attach gutters to firmly anchored gutter supports spaced not more than **12 inches (305 mm)** apart. Attach ends with rivets and **seal with sealant** to make watertight. Slope to downspouts.
  - 1. Install gutter with expansion joints at locations indicated but not exceeding **50 feet (15.2 m)** apart. Install expansion-joint caps.
  - 2. Install continuous leaf guards on gutters with noncorrosive fasteners, **removable** for cleaning gutters.
- C. Downspouts: Join sections with manufacturer's standard telescoping joints. Provide hangers with fasteners designed to hold downspouts securely to walls and **1 inch (25 mm)** away from walls; locate fasteners at top and bottom and at approximately [**60 inches (1500 mm)**] **<Insert dimension>** o.c.
  - 1. Provide elbows at base of downspouts at grade to direct water away from building.
  - 2. Connect downspouts to underground drainage system when indicated.

### 3.5 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder and sealants.
- C. Remove temporary protective coverings and strippable films as roof specialties are installed.

END OF SECTION 077100

## SECTION 078413 - PENETRATION FIRESTOPPING

### 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. Penetrations in fire-resistance-rated walls.
  - 2. Penetrations in horizontal assemblies.
  - 3. Penetrations in smoke barriers.

#### 1.3 ACTION SUBMITTALS

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

#### 1.4 CLOSEOUT SUBMITTALS

- A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

#### 1.5 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.

#### 1.6 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 PERFORMANCE REQUIREMENTS

#### A. Fire-Test-Response Characteristics:

1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:
  - a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.
    - 1) UL in its "Fire Resistance Directory."

### 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 shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
- B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
  1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
  1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
  2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
- D. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined per UL 1479, based on testing at a positive pressure differential of 0.30-inch wg (74.7 Pa).
- E. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per 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. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.
- B. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.
- C. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- D. 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.
- E. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
- F. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.

## 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

- 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 (76 mm) high and with minimum 0.375-inch (9.5-mm) strokes.
1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet (4.57 m) from end of wall and at intervals not exceeding 30 feet (9.14 m).

### 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 078413

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## Section 079200: JOINT SEALANTS

## Part 1 - GENERAL

## 1.1 RELATED DOCUMENTS:

- A. Drawings and any general provisions of Contract including General and Supplementary Conditions.

## 1.2 SUMMARY:

- A. This Section includes joint sealants for the following locations:
  - 1. Exterior joints in vertical surfaces and non-traffic horizontal surfaces as indicated below:
    - a. Control and expansion joints in cast-in-place concrete.
    - b. Control and expansion joints in unit masonry.
    - c. Joints between different materials listed above.
    - d. Control and expansion joints in ceiling and overhead surfaces.
    - e. Other joints as indicated.
    - f. These applications shall use silicone sealant specified in 2.1.
  - 2. Exterior joints in horizontal traffic surfaces as indicated below:
    - a. Control, expansion and isolation joints in cast-in-place concrete slabs.
    - b. Joints between different materials listed above.
    - c. Other joints as indicated.
    - d. These applications shall use polyurethane sealant specified in 2.1.
  - 3. Interior joints in vertical surfaces and horizontal non-traffic surfaces as indicated below:
    - a. Control and expansion joints on exposed interior surfaces of exterior walls.
    - b. Perimeter joints of exterior openings where indicated.
    - c. Joints between tops of non-load-bearing unit masonry walls and underside of cast-in-place concrete slabs and beams.
    - d. Vertical control joints on exposed surfaces of interior unit masonry and concrete walls and partitions.
    - e. Perimeter joints between interior wall surfaces and frames of interior doors, windows, and elevator entrances.
    - f. Perimeter joints of toilet fixtures.
    - g. Other joints as indicated.
    - h. These applications shall use silicone sealant specified in 2.1.
  - 4. Interior joints in horizontal traffic surfaces as indicated below:
    - a. Control and expansion joints in cast-in-place concrete slabs.
    - b. Other joints as indicated.
    - c. These applications shall use polyurethane sealant specified in 2.1.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
  - 1. Division 7 Section "Firestopping" for through-penetration firestopping systems.
  - 2. Division 9 Section "Gypsum Board Assemblies" for sealing concealed perimeter joints of



gypsum board partitions to reduce sound transmission.

1.3 SYSTEM PERFORMANCE REQUIREMENTS:

- A. Provide elastomeric joint sealants that have been produced and installed to establish and maintain watertight and airtight continuous seals without causing staining or deterioration of joint substrates.
- B. Provide joint sealants for interior applications that have been produced and installed to establish and maintain airtight continuous seals that are water resistant and cause no staining or deterioration of joint substrates.

1.4 SUBMITTALS:

- A. Product data from manufacturers for each joint sealant product required.
- C. Samples for verification purposes of each type and color of joint sealant required. Install joint sealant samples in 1/2 inch-wide joints formed between two 6-inch long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- D. Certificates from manufacturers of joint sealants attesting that their product comply with specification requirements and are suitable for the use indicated.
- E. Product test reports for each type of joint sealants indicated, evidencing compliance with requirements specified.

1.5 QUALITY ASSURANCE:

- A. Installer Qualifications: Engage an experienced installer who has completed joint sealant applications similar in material, design, and extent to that indicated for Project that have resulted in construction with a record of successful in-service performance.
- B. Single Source Responsibility for Joint Sealant Materials: Obtain joint sealant materials from a single manufacturer for each different product required.

1.6 DELIVERY, STORAGE, AND HANDLING:

- A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.
- B. Store and handle materials in compliance with manufacturer's recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants or other causes.

1.7 PROJECT CONDITIONS:

- A. Environmental Conditions: Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside the limits permitted by joint sealant manufacturer.
2. When joint substrates are wet.
- B. Joint Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than allowed by joint sealant manufacturer for application indicated.
- C. Joint Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with their adhesion are removed from joint substrates.

#### 1.8 SEQUENCING AND SCHEDULING:

- A. Sequence installation of joint sealants to occur not less than 21 nor more than 30 days after completion of waterproofing, unless otherwise indicated.

#### 2.1 PRODUCTS

##### A. MATERIALS, GENERAL:

- 1.VOC Content of Interior Sealants and Sealant Primers: Comply with the following limits when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
  - a. Sealants: Not more than 250 g/L.
  - b. Sealant Primers for Nonporous Substrates: Not more than 250 g/L.
  - c. Sealant Primers for Porous Substrates: Not more than 775 g/L.
- 2.Compatibility: Provide joint sealants, joint fillers, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
3. Colors: Provide color of exposed joint sealants to comply with the following:

Provide selections made by Architect from manufacturer's full range of standard colors for products of type indicated.

##### B. POLYURETHANE AND SILICONE JOINT SEALANTS:

1. Polyurethane Joint Sealant: Manufacturer's standard, multi-component, chemically curing, self-leveling, non-sag, polyurethane sealant specially formulated for use in moving joints ¼" and greater, conforming to ASTM C920, Type M, Grade NS, Class 25.
2. Silicone Joint Sealant: Manufacturer's standard, one-part, neutral-curing, ultra low-modulus silicone sealant.
3. Products: Subject to compliance with requirements, provide one of the following or an approved equal:
  - a. Polyurethane Joint Sealant:
    1. THC 901 by Tremco, Inc.
  - b. Silicone Joint Sealant:
    1. Pecora 890 by Pecora Corporation.

##### C. LATEX JOINT SEALANTS:

1. General: Provide manufacturer's standard one-part, non-sag, mildew-resistant, paintable latex sealant of formulation indicated that is recommended for exposed applications on

interior and protected exterior locations and that accommodates indicated percentage change in joint width existing at time of installation without failing either adhesively or cohesively.

2. Silicone Emulsion Sealant: Provide product complying with ASTM C 834 and, except for weight loss measured per ASTM C 792, with ASTM C 920 that accommodates joint movement of not more than 25 percent in both extension and compression for a total of 50 percent.
3. Available Products: Subject to compliance with requirements, latex joint sealants that may be incorporated in the Work include, but are not limited to, the following:
  - a. Silicone-Emulsion Sealant:
    1. "Trade Mate Paintable Glazing Sealant", Dow Corning Corp.

D. ACOUSTICAL JOINT SEALANTS:

- A.
  1. 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.
  2. Product has flame spread and smoke developed ratings of less than 25 per ASTM E 84.
  3. Acoustical Sealant for Exposed **and Concealed** Joints: Manufacturer's standard nonsag, paintable, nonstaining latex acoustical sealant complying with ASTM C834.
    - i. Manufacturer's include but are not limited to the following.
      1. Hilti Inc. – CP 506
      2. Pecora – Dynatrol II
      3. Tremco – Acoustical Curtainwall sealant
    - ii. Colors of Exposed Acoustical Joint Sealants: As selected by Architect from manufacturer's full range of colors.

E. JOINT SEALANT BACKING:

1. General: Provide sealant backings of material and type that are non-staining; are compatible with joint substrates, sealants, primers and other joint filler, and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
2. Plastic Foam Joint Filler: Preformed, compressible, resilient, non-staining, non-waxing, non-extruding stripes of flexible plastic foam of material indicated below and of size, shape and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

F. MISCELLANEOUS MATERIALS:

1. 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.
2. 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 in any way joint substrates and adjacent nonporous surfaces, and formulated to promote optimum adhesion of sealants with joint substrates.

3. Masking Tape: Non-staining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

### PART 3 -EXECUTION

#### A. EXAMINATION:

1. Examine joints indicated to receive joint sealants with installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint sealant performance. Do not proceed with installation of joint sealants until unsatisfactory conditions have been corrected.

#### B. PREPARATION:

1. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with recommendations of joint sealant manufacturer and the following requirements:
  - a. 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.
  - b. Clean concrete, masonry, unglazed surfaces of ceramic tile, and similar porous joint substrate surfaces by brushing, grinding, blast cleaning, 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 from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air.
  - c. Remove laitance and form release agents from concrete.
  - d. Clean metal, glass, porcelain enamel, glazed surfaces of ceramic tile, and other nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
2. Joint Priming: Prime joint substrates where indicated or where recommended by joint sealant manufacturer based on preconstruction joint sealant-substrate tests or prior experience. Apply primer to comply with joint sealant manufacturer's recommendations. Confine primers to areas of joint sealant bond; do not allow spillage or migration onto adjoining surfaces.
3. Masking Tape: Use masking tape where required to prevent contact of sealant 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.

#### C. INSTALLATION OF JOINT SEALANTS:

1. General: Comply with joint sealant manufacturer's printed installation instructions applicable to products and applications indicated, except where more stringent requirements apply.
2. Sealant Installation Standard: Comply with recommendations of ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
3. Acoustical Sealant Application Standard: Comply with recommendations of ASTM C 919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.
4. Installation of Sealant Backings: Install sealant backings to comply with the following

requirements:

a. Install joint filler of type indicated to provide support of sealants during application and at position required to produce the cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

i. Do not leave gaps between ends of joint fillers.

ii. Do not stretch, twist, puncture, or tear joint fillers.

iii. Remove absorbent joint fillers that have become wet prior to sealant application and replace with dry material.

5. Installation of Sealants: Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability. Install sealants at the same time sealant backings are installed.

6. Tooling of Non-sag Sealants: Immediately after sealant applications and prior to time skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated, to eliminate air pockets, and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

7. Provide concave joint configuration per Figure 5A in ASTM C 962, unless otherwise indicated.

D. CLEANING:

1. Clean off excess sealants or sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

E. PROTECTION:

1. Protect joint sealants during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so that installations with repaired areas are indistinguishable from original work.

END OF SECTION 079200

## SECTION 081213 - HOLLOW METAL FRAMES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
1. Interior standard steel frames.
  2. Interior Stainless Steel hollow-metal frames.

#### 1.2 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include elevations, frame profiles, metal thicknesses, and wall opening conditions.
- C. Schedule: Prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ceco Door; AADG, Inc.; ASSA ABLOY.
  2. Curries, AADG, Inc.; ASSA ABLOY Group.
  3. Steelcraft; Allegion plc. (BASIS OF DESIGN)

## 2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated on Drawings, based on testing at positive pressure according to NFPA 252 or UL 10C.
  - 1. Smoke- and Draft-Control Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.
- B. Fire-Rated, Borrowed-Lite Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

## 2.3 STANDARD STEEL FRAMES

- A. Construct hollow-metal frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Interior Frames: SDI A250.8. **At locations indicated in the Door and Frame Schedule on Drawings.**
  - 1. Materials: **Uncoated** steel sheet, and Type 304 stainless steel minimum thickness of **0.042 inch (1.0 mm)**.
  - 2. Construction: **Full profile welded.**
  - 3. Exposed Finish:
    - a. Standard Steel Frames **Prime.**
    - b. Stainless Steel Frames: Satin Brushed Finish..

## 2.4 FRAME ANCHORS

- A. Jamb Anchors:
  - 1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
  - 2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each **24 inches (610 mm)** of frame height above **7 feet (2.1 m)**.
  - 3. Postinstalled Expansion Anchor: Minimum **3/8-inch- (9.5-mm-)** diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.
- B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.
- C. Floor Anchors for Concrete Slabs with Underlayment: Adjustable-type anchors with extension clips, allowing not less than **2-inch (51-mm)** height adjustment. Terminate bottom of frames at top of underlayment.
- D. Material: ASTM A879/A879M, Commercial Steel (CS), **04Z (12G)** coating designation; mill phosphatized.

## 2.5 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A153/A153M.
- D. Power-Actuated Fasteners in Concrete: Fabricated from corrosion-resistant materials.
- E. Glazing: Comply with requirements in Section 088000 "Glazing."

## 2.6 FABRICATION

- A. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.
  - 1. 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.
- B. Hardware Preparation: Factory prepare hollow-metal frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule on Drawings, and templates.
  - 1. Reinforce frames to receive nontemplated, mortised, and surface-mounted door hardware.
  - 2. Comply with BHMA A156.115 for preparing hollow-metal frames for hardware.

## 2.7 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
  - 1. Shop Primer: SDI A250.10.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. General: Install hollow-metal frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions. Comply with **SDI A250.11**.



- B. 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.
  - 1. 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.
  - 2. Install frames with removable stops located on secure side of opening.
- C. Fire-Rated Openings: Install frames according to NFPA 80.
- D. Floor Anchors: Secure with postinstalled expansion anchors.
  - 1. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
- E. Solidly pack mineral-fiber insulation inside frames.
- F. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:
  - 1. Squareness: Plus or minus **1/16 inch (1.6 mm)**, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
  - 2. Alignment: Plus or minus **1/16 inch (1.6 mm)**, measured at jambs on a horizontal line parallel to plane of wall.
  - 3. Twist: Plus or minus **1/16 inch (1.6 mm)**, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
  - 4. Plumbness: Plus or minus **1/16 inch (1.6 mm)**, measured at jambs at floor.

### 3.2 CLEANING AND TOUCHUP

- 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 081213

## SECTION 081416 - FLUSH WOOD DOORS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Five-ply flush wood veneer-faced doors for transparent finish as specified in the door schedule.
2. Five-ply flush wood doors for opaque finish as specified in the door schedule.

#### 1.2 ACTION SUBMITTALS

##### A. Product Data: For each type of product, including the following:

1. Door core materials and construction.
2. Door edge construction
3. Door face type and characteristics.
4. Factory-machining criteria.
5. Factory-**priming ( for painted doors only)** specifications.

##### B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each type of door; construction details not covered in Product Data; and the following:

1. Door schedule indicating door location, type, size, fire protection rating, and swing.
2. Door elevations, dimension and locations of hardware, lite cutouts, and glazing thicknesses.
3. Dimensions and locations of blocking for hardware attachment.
4. Clearances and undercuts.
5. Requirements for veneer matching.
6. Apply **AWI Quality Certification** Program label to Shop Drawings.

#### 1.3 INFORMATIONAL SUBMITTALS

##### A. Qualification Data: For door inspector.

1. Fire-Rated Door Inspector: Submit documentation of compliance with NFPA 80, Section 5.2.3.1.

##### B. Field quality-control reports.

#### 1.4 CLOSEOUT SUBMITTALS

##### A. Quality Standard Compliance Certificates: **AWI Quality Certification** Program certificates.

- B. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

## 1.5 QUALITY ASSURANCE

- A. Manufacturer's Certification: Licensed participant in **AWI's Quality Certification Program**.
- B. Fire-Rated Door Inspector Qualifications: Inspector for field quality-control inspections of fire-rated door assemblies complies with qualifications set forth in NFPA 80, Section 5.2.3.1 and the following:
  - 1. DHI's Fire and Egress Door Assembly Inspector (FDAI) certification.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Wood Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated on Drawings, based on testing at positive pressure in accordance with **NFPA 252**.

### 2.2 FLUSH WOOD DOORS, GENERAL

- A. Quality Standard: In addition to requirements specified, comply with "**Architectural Woodwork Standards**."
  - 1. Provide **labels from AWI** certification program indicating that doors comply with requirements of grades specified.

### 2.3 SOLID-CORE, FIVE-PLY FLUSH WOOD VENEER-FACED DOORS FOR TRANSPARENT FINISH (where specified on the drawings)

- A. Interior Doors, Solid-Core Five-Ply Veneer-Faced <**Insert drawing designation**>:
  - 1. Acceptable manufacturers:
    - a. Doormerica.
    - b. Eggers Industries, Inc.
    - c. The Maiman Co.
    - d. Marshfield-Algoma, a Masonite Architectural Brand
    - e. Oshkosh Door Co.
    - f. VT Industries, Inc.
  - 2. Performance Grade: ANSI/WDMA I.S. 1A **Standard Duty**.
  - 3. Faces: Single-ply wood veneer not less than **1/50 inch (0.508 mm)** thick.
    - a. **Species: Red oak**
    - b. **Cut: Rift sawn.**
    - c. **Match between Veneer Leaves: Book match.**

- d. Assembly of Veneer Leaves on Door Faces: **Center-balance** match.
  - e. Pair and Set Match: Provide for doors hung in same opening.
  - f. Room Match:
    - 1) Match door faces within each separate room or area of building. Corridor-door faces do not need to match where they are separated by **10 feet (3 m)** or more.
4. Exposed Vertical **and Top Edges: Same species as faces or a compatible species - Architectural Woodwork Standards edge Type A.**
- a. Fire-Rated Single Doors: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed vertical edges.
  - b. Fire-Rated Pairs of Doors:
    - 1) Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.
    - 2) Provide formed-steel edges and astragals with intumescent seals.
      - a) Finish steel edges and astragals with baked enamel[ **same color as doors**].
      - b) Finish steel edges and astragals to match door hardware (locksets or exit devices).
  - c. Mineral-Core Doors: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.
    - 1) Screw-Holding Capability: **550 lbf (2440 N)** in accordance with WDMA T.M. 10.
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.**
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.**

2.4 SOLID-CORE FIVE-PLY FLUSH WOOD DOORS FOR OPAQUE FINISH (where specified on the drawings).

a. .

B. Interior Doors, Solid-Core Five-Ply for Opaque Finish:

1. Acceptable manufacturers:

- a. Doormerica.
- b. Eggers Industries, Inc.
- c. The Maiman Co.
- d. Marshfield-Algoma, a Masonite Architectural Brand
- e. Oshkosh Door Co.
- f. VT industries , Inc.

2. Performance Grade: ANSI/WDMA I.S. 1A **Standard Duty**.

3. Faces: **Any closed-grain hardwood of mill option.**

- a. Apply MDO to **standard-thickness, closed-grain, hardwood face veneers**.
- b. Hardboard Faces: ANSI A135.4, Class 1 (tempered) or Class 2 (standard).
- c. MDF Faces: ANSI A208.2, Grade 150 or Grade 160.

4. Exposed Vertical **and Top** Edges: Any closed-grain hardwood.

- a. Fire-Rated Single Doors: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed vertical edges.
- b. Fire-Rated Pairs of Doors:

- 1) Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.
- 2) Provide formed-steel edges and astragals with intumescent seals.

- a) Finish steel edges and astragals with baked enamel.

- c. Mineral-Core Doors: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.

- 1) Screw-Holding Capability: **550 lbf (2440 N)**.

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**.

2.5 FABRICATION

- A. 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.

## 2.6 FACTORY PRIMING (Interior Doors specified in the door schedule only)

- A. Doors for Opaque Finish: Factory prime faces, all four edges, edges of cutouts, and mortises with one coat of wood primer specified in **Section 099123" Interior Painting."**

## 2.7 FACTORY FINISHING

- A. Comply with referenced quality standard for factory finishing.
  1. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
  2. Finish faces, all four edges, edges of cutouts, and mortises.
  3. Stains and fillers may be omitted on **top and** bottom edges, edges of cutouts, and mortises.
- B. Factory finish doors.
- C. Factory finish doors that are indicated on Drawings to receive transparent finish.
- D. Factory finish doors where indicated in schedules or on Drawings as factory finished.
- E. Transparent Finish:
  1. **Architectural Woodwork Standards**
  2. Grade: **Premium.**
  3. Architectural Woodwork Standards System-11, Polyurethane, Catalyzed.
  4. Staining: **Match Architect's sample.**
  5. Sheen: **Satin.**

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Hardware: For installation, see **Section 087100 "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 (3.2 mm in 2400 mm)**.
  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 (3.2 mm)** at heads, jambs, and between pairs of doors.
    - b. Provide **1/8 inch (3.2 mm)** 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 (6.4 mm)** 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 (3-1/2 degrees)** at lock and hinge edges.
  6. Bevel fire-rated doors **1/8 inch in 2 inches (3-1/2 degrees)** 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.

### 3.2 ADJUSTING

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Fdinishes 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 081416

## SECTION 08 31 00 – ACCESS DOORS AND PANELS

## PART 1 - GENERAL

## 1.1 SUBMITTALS:

- A. Product data: Indicate material types, finishes and sizes, fabrication and installation details and requirements.
- B. Product Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

## 1.2 QUALITY ASSURANCE:

- A. Applicable standards; standards of the following, as referenced herein:
  - 1. American Iron and Steel Institute (AISI).
  - 2. ASTM International (ASTM).
- B. Labeling requirements:
  - 1. Horizontal access doors shall bear a label that includes the wording “FOR HORIZONTAL INSTALLATION”.
  - 2. Permanently attach label to each door, panel and frame.

## 1.3 DELIVERY, STORAGE AND HANDLING:

- A. Deliver access doors in protective packaging.
- B. Store in packaging to prevent soiling and physical damage.
- C. Handle to prevent damage to finished surfaces and operating mechanisms.

## 1.4 PROJECT/SITE CONDITIONS:

- A. Protection: Protect prefinished surfaces from damage or staining. Following installation, provide protective covering for duration of project.

## PART 2 - PRODUCTS

## 2.1 ACCESS DOORS AND PANELS:

- A. Acceptable manufacturers; subject to compliance with specified requirements:
  - 1. Activar Construction Products Group, Inc., J. L. Industries.
  - 2. Acudor Products, Inc.
  - 3. Babcock Davis Hatchways.
  - 4. Karp Associates, Inc.
  - 5. Nystrom.
- B. Characteristics:
  - 1. Size: As indicated on drawings, but not less than 1'-0" by 1'-0".
  - 2. Types:



- a. Typical: As required by substrates.
- b. Access doors in gypsum board work: Flush type with perforated frame flanges for finishing with joint compound.
3. Construction: Minimum 14 ga. steel sheet for doors; 16 ga. for frames; prime painted.
4. Hardware: Manufacturer's standard concealed hinges allowing 175 degree operation and cam lock

### PART 3 - EXECUTION

#### 3.1 PREPARATION:

- A. Coordination:
  1. Coordinate installation of access doors required to be built into building structure. Secure templates or lay out to rough dimensions provided by specialty manufacturer.
  2. Coordinate with mechanical and plumbing sizes and locations of access doors.
  3. Coordinate access door types with final finish of adjacent wall.

#### 3.2 INSTALLATION:

- A. Install access doors in accord with manufacturer's product data, plumb, level and true to line and location.
- B. Install access doors with fasteners of type and spacing recommended by manufacturer's product data.
- C. Protect surfaces from damage or staining. Clean surfaces prior to Date of Substantial Completion.
- D. Test and adjust hardware for ease of operation.

END OF SECTION 083100

## SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Aluminum-framed entrance and storefront systems.

#### 1.2 PREINSTALLATION MEETINGS

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

#### 1.3 ACTION SUBMITTALS

- A. Product data.

B. Shop Drawings:

1. Plans, elevations, sections, full-size details, and attachments to other work.
2. Connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
3. Point-to-point wiring diagrams.

- C. Samples: Manufacturer's standard color sheets, showing full range of available colors for each type of exposed finish.

- D. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams.

- E. Delegated Design Submittals: For aluminum-framed entrance and storefront systems, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Energy Performance Certificates: NFRC-certified energy performance values from manufacturer.

- B. Product test reports.

- C. Source quality-control reports.

- D. Field quality-control reports.

- E. Sample warranties.

## 1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

## 1.6 QUALITY ASSURANCE

- A. Installer Qualifications:

- 1. Fabricator of products.

- B. Delegated Design Engineer Qualifications: A professional engineer who is legally qualified to practice in **state** where Project is located and who is experienced in providing engineering services of the type indicated.

- C. Testing Agency Qualifications: Qualified in accordance with ASTM E699 for testing indicated **and accredited by IAS or ILAC Mutual Recognition Arrangement as complying with ISO/IEC 17025** and acceptable to Owner and Architect.

- D. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

- 1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

## 1.7 WARRANTY

- A. Special Warranty: **Manufacturer agrees** to repair or replace components of aluminum-framed entrance and storefront systems that fail in materials or workmanship within specified warranty period.

- 1. Warranty Period: **Five** years from date of Substantial Completion.

- B. 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. Warranty Period: **10** years from date of Substantial Completion.

- C. 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. Warranty Period: **10** 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 014000 "Quality Requirements," to design aluminum-framed entrance and storefront systems.
- B. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrance and storefront systems representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
1. Aluminum-framed entrance and storefront systems to withstand movements of supporting structure, including, but not limited to, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
  2. Failure also includes the following:
    - a. Thermal stresses transferring to building structure.
    - b. Glass breakage.
    - c. Noise or vibration created by wind and thermal and structural movements.
    - d. Loosening or weakening of fasteners, attachments, and other components.
    - e. Failure of operating units.
- C. Structural Loads:
1. Wind Loads: As indicated on Drawings.
  2. Other Design Loads: **As indicated on Drawings.**
- D. Deflection of Framing Members Supporting Glass: At design wind load, as follows:
1. Deflection Normal to Wall Plane: Limited to **1/175 of clear span for spans of up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 13 feet 6 inches (4.1 m).**
  2. Deflection Parallel to Glazing Plane: Limited to **amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch (3.2 mm).**
    - a. Operable Units: Provide a minimum **1/16-inch (1.6-mm)** clearance between framing members and operable units.
- E. Structural: Test in accordance with ASTM E330/E330M as follows:
1. When tested at positive and negative wind-load design pressures, storefront assemblies, including entrance doors, do not evidence deflection exceeding specified limits.
  2. When tested at **150** percent of positive and negative wind-load design pressures, storefront assemblies, including entrance doors and anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding **0.2** percent of span.

3. Test Durations: As required by design wind velocity, but not less than **10** seconds.
- F. Water Penetration under Static Pressure: Test in accordance with ASTM E331 as follows:
1. No evidence of water penetration through fixed glazing and framing areas, including entrance doors, when tested in accordance with a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than **6.24 lbf/sq. ft. (300 Pa)**.
- G. Energy Performance: Certified and labeled by manufacturer for energy performance as follows:
1. Thermal Transmittance (U-factor):
    - a. Fixed Glazing and Framing Areas: U-factor for the system of not more than **0.41 Btu/sq. ft. x h x deg F (2.33 W/sq. m x K)** as determined in accordance with NFRC 100.
    - b. Entrance Doors: U-factor of not more than **0.68 Btu/sq. ft. x h x deg F (3.86 W/sq. m x K)** as determined in accordance with NFRC 100.
  2. Air Leakage:
    - a. Fixed Glazing and Framing Areas: Air leakage for the system of not more than **0.06 cfm/sq. ft. (0.30 L/s per sq. m)** at a static-air-pressure differential of **1.57 lbf/sq. ft. (75 Pa)** when tested in accordance with ASTM E283.
    - b. Entrance Doors: Air leakage of not more than **1.0 cfm/sq. ft. (5.08 L/s per sq. m)** at a static-air-pressure differential of **1.57 lbf/sq. ft. (75 Pa)**.
  3. Condensation Resistance Factor (CRF):
    - a. Fixed Glazing and Framing Areas: CRF for the system of not less than **35** as determined in accordance with AAMA 1503.
    - b. Entrance Doors: CRF of not less than **57** as determined in accordance with AAMA 1503.
- H. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.
1. Temperature Change: **120 deg F (67 deg C)**, ambient; **180 deg F (100 deg C)**, material surfaces.

## 2.2 ALUMINUM-FRAMED ENTRANCE AND STOREFRONT SYSTEMS

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
1. Coral Architectural Products; Coral Industries, Inc.
  2. Kawneer Company, Inc.; Arconic Corporation. 190 Narrow Stile Entrance (Basis of Design).
  3. U.S. Aluminum; C.R. Laurence Co., Inc.; CRH Americas, Inc.

4. YKK AP America Inc.
  - B. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
    1. Exterior Framing Construction: **Thermally broken.**
    2. Glazing System: Retained mechanically with gaskets on four sides.
    3. Finish: **Color anodic finish.**
    4. Fabrication Method: Field-fabricated stick system.
    5. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
    6. Steel Reinforcement: As required by manufacturer.
  - C. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.
  - D. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
  - E. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing or automatic operation.
    1. Door Construction: **1-3/4-inch (44.5-mm) overall thickness, with minimum 0.125-inch- (3.2-mm-) thick**, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
      - a. Thermal Construction: **High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.**
    2. Door Design: **Narrow stile; 2-1/8-inch (54-mm) nominal width.**
    3. Glazing Stops and Gaskets: **Beveled**, snap-on, extruded-aluminum stops and preformed gaskets.
      - a. Provide nonremovable glazing stops on outside of door.

### 2.3 ENTRANCE DOOR HARDWARE

- A. Entrance Door Hardware: Hardware not specified in this Section is specified in the hardware schedule on the drawings.
- B. General: Provide entrance door hardware and **entrance door hardware indicated in door and frame schedule** for each entrance door, to comply with requirements in this Section.
  1. Entrance Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and **products complying with BHMA standard referenced.**
  2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.

3. Opening-Force Requirements:
  - a. Egress Doors: Not more than **15 lbf (67 N)** to release the latch and not more than **30 lbf (133 N)** to set the door in motion **and not more than 15 lbf (67 N) to open the door to its minimum required width.**
- C. Designations: Requirements for design, grade, function, finish, quantity, size, and other distinctive qualities of each type of entrance door hardware are indicated in "Entrance Door Hardware Sets" Article. Products are identified by using entrance door hardware designations as follows:
  1. References to BHMA Standards: Provide products complying with these standards and requirements for description, quality, and function.
- D. Continuous-Gear Hinges: BHMA A156.26.
- E. Mortise Auxiliary Locks: BHMA A156.5, Grade 1.
- F. Panic Exit Devices: BHMA A156.3, Grade 1, listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing in accordance with UL 305.
- G. Cylinders:
  1. As specified in the hardware Schedule on the drawings.
  2. BHMA A156.5, Grade 1.
    - a. Keying: **Master** key system. Permanently inscribe each key with a visual key control number and include notation "**DO NOT DUPLICATE**".
- H. Strikes: Provide strike with black-plastic dust box for each latch or lock bolt; fabricated for aluminum framing.
- I. Closers: BHMA A156.4, Grade 1, with accessories required for a complete installation, sized as required by door size, exposure to weather, and anticipated frequency of use; adjustable to comply with field conditions and requirements for opening force.
- J. Door Stops: BHMA A156.16, Grade 1, floor mounted, as appropriate for door location indicated, with integral rubber bumper.
- K. Weather Stripping: Manufacturer's standard replaceable components.
  1. Compression Type: Made of ASTM D2000 molded neoprene or ASTM D2287 molded PVC.
  2. Sliding Type: AAMA 701/702, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.
- L. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.

- M. Thresholds: BHMA A156.21 raised thresholds beveled with a slope of not more than 1:2, with maximum height of **1/2 inch (12.7 mm)**.

## 2.4 GLAZING

- A. Glazing: Comply with Section 088000 "Glazing."
- B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.
- C. Glazing Sealants: As recommended by manufacturer.

## 2.5 MATERIALS

- A. Sheet and Plate: **ASTM B209 (ASTM B209M)**.
- B. Extruded Bars, Rods, Profiles, and Tubes: **ASTM B221 (ASTM B221M)**.
- C. Structural Profiles: ASTM B308/B308M.
- D. Steel Reinforcement:
  - 1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
  - 2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
  - 3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.
- E. Steel Reinforcement Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods in accordance with recommendations in SSPC-SP COM, and prepare surfaces in accordance with applicable SSPC standard.

## 2.6 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Fabricate components that, when assembled, have the following characteristics:
  - 1. Profiles that are sharp, straight, and free of defects or deformations.
  - 2. Accurately fitted joints with ends coped or mitered.
  - 3. Physical and thermal isolation of glazing from framing members.
  - 4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
  - 5. Provisions for field replacement of glazing from **interior**.



6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- E. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
- F. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
- G. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.
- H. After fabrication, clearly mark components to identify their locations in Project in accordance with Shop Drawings.

## 2.7 ALUMINUM FINISHES

- A. Color Anodic Finish: AAMA 611, or thicker.
  1. Color: **As selected by Architect from full range of industry colors and color densities.**

## PART 3 - EXECUTION

### 3.1 INSTALLATION OF ALUMINUM-FRAMED ENTRANCE AND STOREFRONT SYSTEMS

- A. Comply with manufacturer's written instructions.
- B. Do not install damaged components.
- C. Fit joints to produce hairline joints free of burrs and distortion.
- D. Rigidly secure nonmovement joints.
- E. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
- F. Seal perimeter and other joints watertight unless otherwise indicated.
- G. Metal Protection:
  1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
  2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

- H. Set continuous sill members and flashing in full sealant bed, as specified in Section 079200 "Joint Sealants," to produce weathertight installation.
- I. Install joint filler behind sealant as recommended by sealant manufacturer.
- J. Install components plumb and true in alignment with established lines and grades.
- K. Install entrance doors to produce smooth operation and tight fit at contact points.
  - 1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
  - 2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware in accordance with entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.
- L. Install glazing as specified in Section 088000 "Glazing."

### 3.2 FIELD QUALITY CONTROL

- A. Tests: Perform the following test, in the presence of the Architect, on **representative areas of aluminum-framed entrance and storefront systems**.
  - 1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect to be tested in accordance with AAMA 501.2 and to not evidence water penetration.
    - a. Perform a minimum of **two** tests in areas as directed by Architect.
- B. Aluminum-framed entrance and storefront systems will be considered defective if they do not pass tests and inspections.

### 3.3 ENTRANCE DOOR HARDWARE SETS

- A. 2 ea Continuous geared hinges
- B. 2 ea Concealed Vertical Rod Exit Device
- C. 2 ea. Lock Cylinder
- D. 2 ea Closers
- E. 2 ea. Floor stops
- F. 1 ea Threshold
- G. 1 ea. Weatherstrip Kit
- H. 2 ea Door Sweeps

END OF SECTION 084113

## SECTION 08 41 13.13: FIRE-RATED ALUMINUM FRAMED ENTRANCES AND STOREFRONTS

## PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Fire resistive framing system.
1. GPX® Architectural Series Framing fire resistive, temperature rise, framing system with aluminum frames for 60 minute applications.
  2. Applications of fire rated framing includes:
    - a. Vision lites in fire rated doors, , sidelites, and transparent walls with fire rating requirement as specified.
- B. Related Sections:
1. Section 01 33 00: Submittals.
  2. Section 08 80 00: Glazing
  3. Section 08 88 13: Fire-Rated Glazing
  4. Section 08 11 13: Hollow Metal Doors and Frames
  5. Section 08 71 00: Door Hardware

1.02 REFERENCES

- A. American Society for Testing and Materials (ASTM):
1. ASTM E119 Methods for Fire Tests of Building Construction and Materials.
  2. ASTM E152 Methods of Fire Tests of Door Assemblies.
  3. ASTM E163 Methods for Fire Tests of Window Assemblies.
  4. ASTM E2074: Standard Test Method for Fire Tests of Door Assemblies, including Positive Pressure Testing of Side-hinged and Pivoted Swinging Door Assemblies.
  5. ASTM E2110-1: Standard Test for Positive Pressure of Fire Tests of Window Assemblies.
  6. ASTM E283-04: Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors.
  7. ASTM 547-00: Test Method for Water Penetration of Exterior Windows, Curtain Walls and Doors by Cyclic Static Air Pressure Difference.
  8. ASTM E331-00: Standard Test Method for Metal Curtain Walls and Doors by Uniform Static Air Pressure Difference.
  9. ASTM E330-02: Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
  10. ASTM F 588-04: Test Method for Resistance of Window Assemblies to Forced Entry Excluding Glazing.
- B. National Fire Protection Association (NFPA):
1. NFPA 80: Fire Doors and Windows.
  2. NFPA 251: Fire Tests of Building Construction and Materials.
  3. NFPA 252: Fire Tests of Door Assemblies.
  4. NFPA 257: Fire Tests of Window Assemblies.
- C. Underwriters Laboratories, Inc. (UL):
1. UL 9: Standard for Safety of Fire Tests of Window Assemblies.
  2. UL 10B: Standard for Safety of Fire Tests of Door Assemblies.
  3. UL 10C: Standard for Safety of Positive Pressure Fire Tests of Door Assemblies.

4. UL 263: Fire Tests of Building Construction and Materials.
  5. UL 752-2005: Standard for Safety for Bullet-Resisting Equipment.
- D. American National Standards Institute (ANSI):
1. ANSI Z97.1: Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test.
- E. Glass Association of North America (GANA)
1. GANA – Glazing Manual.
  2. FGMA – Sealant Manual.
- F. National Fenestration Rating Council (NFRC)
1. NFRC 100: Procedure for Determining Fenestration Product U-Factors.
  2. NFRC 200: Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence.

### 1.03 SYSTEM DESCRIPTION

- A. Performance Requirements:
1. Fire Rating: Shall meet 60 minutes as specified.
  2. Fire Resistive Wall Assembly Certifications: shall meet 60 minute fire resistive wall assemblies tested in accordance with ASTM E119, NFPA 251, UL 263 and ULC-S101.
  3. Fire Resistive, Temperature Rise Door Assembly Certifications: must meet 60-90 minute fire resistive temperature rise door assemblies tested in accordance with NFPA 252, UL 10B, UL 10C I. Must meet 250 degrees F/450 degrees F temperature rise door requirements.
  4. Fire Protective Door Assembly Certifications: must meet 20-45 minute fire protective door assemblies shall be tested in accordance with NFPA 80, NFPA 252, ASTM E152, ASTM E2074, UL 10B, UL 10C and CAN4-S104.
  5. Fire Protective Window Assembly Certifications: must meet 20-45 minute fire protective window assemblies shall be tested in accordance with NFPA 80, NFPA 257, ASTM E163, ASTM E2010, UL 9 and CAN4-S106.
  6. Testing Laboratory: Fire test must be conducted by a nationally recognized independent testing laboratory.
  7. Glazing: Fire protective glazing in 20-45 minute fire protective doors and openings up to the maximum size tested. Fire resistive glazing that meets ASTM E-119/UL 263/ULC- S101 up to the max. size tested. All glazing used in doors, sidelites or any hazardous location must meet CPSC Cat. I or II impact safety.
  8. Max. Door Opening Sizes: must meet up to 4'0" wide x 9'0" high for single doors and 8'0" wide by 9'0" high in pair doors. No intermediate rails required.
- B. Listings and Labels:
1. Fire resistive, temperature rise framing system shall be under current follow-up service by a nationally recognized independent laboratory approved by OSHA and maintain a current listing or certification. Assemblies shall be labeled in accordance with limits of listings.
- C. Appearance:
1. Fire rated wall/door assembly shall have a neat finished appearance with minimum joints at decorative cover intersections.

### 1.04 SUBMITTALS

- A. Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedure Section.
1. Shop Drawings: Submit shop drawings showing layout, profiles and product components.

2. Samples: Submit samples for finishes, colors and textures.
3. Technical Information: Submit latest edition of manufacturer's product data providing product descriptions, technical data and installation instructions.

#### 1.05 DELIVERY, STORAGE AND HANDLING

- A. General: Comply with Division 1 Product Requirements Sections.
- B. Delivery: Deliver materials to specified destinations in manufacturer's or distributor's packaging undamaged, complete with installation instructions.
- C. Storage and Protection: Store off ground, under cover, protected from weather and construction activities and at temperature conditions recommended by manufacturer.

#### 1.06 FABRICATION DIMENSIONS

- A. Field Measurements: Verify actual measurements for openings by field measurements before fabrication. Show recorded measurements on shop drawings. Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.

#### 1.07 WARRANTY

- A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.
- B. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document. Manufacturer's warranty is not intended to limit other rights that the Owner may have under the Contract Documents.
  1. Warranty Period: 5-year limited warranty from date of shipping.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS – FIRE RATED (DOOR) (OPENING) (WALL ASSEMBLY)

- A. Manufacturer of Framing System: GPX Architectural Series Framing as manufactured and distributed by SAFTI *FIRST*® Fire Rated Glazing Solutions.
  1. Contact: 100 N Hill Drive, Suite 12, Brisbane, CA 94005; Telephone 888.653. 3333; email [info@safti.co](mailto:info@safti.co); Web site [www.safti.com](http://www.safti.com)
- B. Manufacturer of Glazing Material: (SuperLiteX 45/60/90 as manufactured and distributed by SAFTI *FIRST*® Fire Rated Glazing Solutions.
  1. Contact: 100 N Hill Drive, Suite 12, Brisbane, CA 94005; Telephone 888.653. 3333; Fax 888.653.4444; email [info@safti.co](mailto:info@safti.co); Web site [www.safti.com](http://www.safti.com)
- C. Fire rated glass and framing must be provided by a single-source, US manufacturer. Distributors of fire rated glass and framing are not to be considered as manufacturers. Materials for the project should be shipped together in the same shipment on the same truck.
- D. Substitutions: No substitutions allowed.

#### 2.02 MATERIALS – FRAMING

A. Fire resistive, temperature rise framing system rated for 20 to 120 minutes.

Properties:

1. Window/Wall Frame thickness: 2-1/2” Standard. 3”, 4-1/8” and 5” also available. Door profile thickness: 5” Standard.
2. Internal framing: Internal tube steel framing shall conform to ASTM A501. Formed steel retainers shall be galvanized conforming to ASTM A527.
3. Insulation: The framing system shall insulate against the effects of fire, smoke and heat transfer from either side. The perimeter of the framing system to the rough opening shall be firmly packed with mineral wool fire stop insulation or appropriately rated intumescent sealant.
4. Fasteners: Type recommended by manufacturer. No exposed fasteners allowed.
5. Glazing accessories: The glazing material perimeter shall be separated from the perimeter framing system with approved flame retardant glazing tape. The SuperLite® glazing panel shall be caulked continuously around the edge to the tube steel frame utilizing neutral cure silicone. Silicone setting blocks recommended.
6. SAFTI FIRST listing allows for doors by others.

2.03 MATERIALS – GLASS

A. Assemblies shall be glazed with SuperLite II XL Starphire® glazing products. Meet ASTM E 119/UL 263/ULC-S101.

B. Properties:

1. Individual Lites shall be permanently identified with a listing mark.
2. Glazing material installed in “Hazardous Locations” (subject to human impact) shall be certified to meet the applicable requirements for fire rated assemblies referenced in ANSI Z97.1 Standard for Safety Glazing Materials Used In Buildings and/or CPSC 16 CFR 1201 Safety Standard for Architectural Glazing Materials.
3. Temperature rise on the unexposed side of glazing material shall be limited to 250 degrees Fahrenheit when required.
4. Visible Transmittance: Varies by glazing type. Must meet:
 

SuperLite® II-XL 60 Starphire®	0.877
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5. STC/OITC rating: Varies by glazing type. Must meet:
 

SuperLite® II-XL 60 & SuperLite® II-XL 60 Starphire®	STC 43/OITC 39
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6. Pressure glazing is acceptable.

C. Logo: Each piece of fire rated glazing shall be labeled with a permanent logo.

2.04 FABRICATION

- A. Assemblies shall be furnished [knocked down for field assembly and will be glazed in the field] [assembled (should configurations and job site conditions allow)][unitized (should configurations and job site conditions allow)] .
- B. Door assemblies shall be factory prepared for field mounting of hardware.
- C. Fabrication Dimensions: Fabricate to approved dimensions. The general contractor shall guarantee dimensions within required tolerance. Obtain approved shop drawings prior to fabrication.

## 2.05 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designing finishes.
- B. Covers shall be chemically cleaned and pretreated; then, finished with (choose one):
  - 1. High Performance Coraflon Fluoropolymer Finish by PPG®. Solid color to be selected from SAFTI's Standard Color Chart. Mica, XL, Gloss & Exotics are available at an additional charge. Color: As selected by Architect from manufacturer's full range.
- C. Protect finishes on exposed surfaces from damage by applying strippable, temporary protective covering before shipping.
- D. Variations in appearance of abutting or adjacent pieces are acceptable. Noticeable variations in the same piece are not acceptable.

## PART 3 EXECUTION

### 3.01 MANUFACTURER'S INSTRUCTIONS

- A. Compliance: Comply with manufacturer's product data including product technical bulletins and installation instructions.

### 3.02 EXAMINATION

- A. Site Verification of Conditions: Verify substrate conditions, have been previously installed under other sections, and are acceptable for product installation in accordance with manufacturer's instructions. Openings shall be plumb, square and within allowable tolerances. The Architect/Engineer shall be notified of any conditions that jeopardize the integrity of the proposed fire wall/door framing system. Do not proceed until such conditions are corrected.

### 3.03 INSTALLATION

- A. Fire wall/door installation shall be by a licensed contractor and in strict accordance with the approved shop drawings.

### 3.04 CLEANING AND PROTECTION

- A. Protect glass from contact with contaminating substances resulting from construction operations. Remove such substances by method approved by manufacturer.
- B. Wash glass on both faces not more than four days prior to date schedule for inspections intended to establish date of Substantial Completion. Wash glass by method recommended by glass manufacturer.
- C. Remove temporary coverings and protection of adjacent work areas.
- D. Remove construction debris from project site and legally dispose of debris.

END OF SECTION 084113.13



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**SECTION 08 71 00 - DOOR HARDWARE****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Hardware for fire-rated doors.
- B. Lock cylinders for doors with balance of hardware specified in other sections.
- C. Thresholds.
- D. Weatherstripping and gasketing.

**1.02 RELATED REQUIREMENTS**

- A. Section 06 20 00 - Finish Carpentry: Wood door frames.
- B. Section 08 11 13 - Hollow Metal Doors and Frames.
- C. Section 08 11 16 - Aluminum Doors and Frames.
- D. Section 08 12 13 - Hollow Metal Frames.
- E. Section 08 14 16 - Flush Wood Doors.
- F. Section 08 14 33 - Stile and Rail Wood Doors.
- G. Section 08 33 23 - Overhead Coiling Doors: Door hardware, except cylinders.
- H. Section 08 43 13 - Aluminum-Framed Storefronts: Door hardware, except as noted in section.

**1.03 REFERENCE STANDARDS**

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.
- B. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen 2019.
- C. BHMA A156.1 - Standard for Butts and Hinges 2021.
- D. BHMA A156.2 - Bored and Preassembled Locks and Latches 2017.
- E. BHMA A156.3 - Exit Devices 2020.
- F. BHMA A156.4 - Door Controls - Closers 2019.
- G. BHMA A156.5 - Cylinders and Input Devices for Locks 2020.
- H. BHMA A156.6 - Standard for Architectural Door Trim 2021.
- I. BHMA A156.7 - Template Hinge Dimensions 2016.
- J. BHMA A156.13 - Mortise Locks & Latches Series 1000 2017.
- K. BHMA A156.18 - Materials and Finishes 2020.
- L. BHMA A156.21 - Thresholds 2019.
- M. BHMA A156.22 - Standard for Gasketing 2021.
- N. BHMA A156.26 - Standard for Continuous Hinges 2021.
- O. BHMA A156.28 - Recommended Practices For Mechanical Keying Systems 2018.
- P. BHMA A156.115 - Hardware Preparation In Steel Doors And Steel Frames 2016.
- Q. BHMA A156.115W - Hardware Preparation in Wood Doors with Wood or Steel Frames 2006.
- R. DHI (H&S) - Sequence and Format for the Hardware Schedule 2019.
- S. DHI (KSN) - Keying Systems and Nomenclature 2019.

- T. DHI (LOCS) - Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames 2004.
- U. DHI WDHS.3 - Recommended Locations for Architectural Hardware for Flush Wood Doors 1993 and in WDHS-1/WDHS-5 Series, 1996.
- V. FLA (FBC-B) - Florida Building Code: Building (6th Edition) 2017.
- W. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.
- X. ITS (DIR) - Directory of Listed Products Current Edition.
- Y. Miami (APD) - Approved Products Directory; Miami-Dade County Current Edition.
- Z. NFPA 80 - Standard for Fire Doors and Other Opening Protectives 2022.
- AA. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives 2022.
- BB. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies 2022.
- CC. UL (DIR) - Online Certifications Directory Current Edition.
- DD. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies Current Edition, Including All Revisions.
- EE. UL 1784 - Standard for Air Leakage Tests of Door Assemblies Current Edition, Including All Revisions.

#### **1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordinate the manufacture, fabrication, and installation of products that door hardware is installed on.
- B. Sequence installation to ensure facility services connections are achieved in an orderly and expeditious manner.
- C. Preinstallation Meeting: Convene a preinstallation meeting one week prior to commencing work of this section; require attendance by affected installers and the following:
  - 1. Architect.
  - 2. Installer's Architectural Hardware Consultant (AHC).
  - 3. Hardware Installer.
  - 4. Owner's Security Consultant.
- D. Furnish templates for door and frame preparation to manufacturers and fabricators of products requiring internal reinforcement for door hardware.
- E. Keying Requirements Meeting:
  - 1. Attendance Required:
  - 2. Agenda:
    - a. Establish keying requirements.
    - b. Verify locksets and locking hardware are functionally correct for project requirements.
    - c. Verify that keying and programming complies with project requirements.
    - d. Establish keying submittal schedule and update requirements.
  - 3. Incorporate "Keying Requirements Meeting" decisions into keying submittal upon review of door hardware keying system including, but not limited to, the following:
  - 4. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.
  - 5. Deliver established keying requirements to manufacturers.

**1.05 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's catalog literature for each type of hardware, marked to clearly show products to be furnished for this project, and includes construction details, material descriptions, finishes, and dimensions and profiles of individual components.
- C. Shop Drawings - Door Hardware Schedule: A detailed listing that includes each item of hardware to be installed on each door.
  - 1. Prepared by or under supervision of Architectural Hardware Consultant (AHC).
  - 2. Comply with DHI (H&S) using door numbering scheme and hardware set numbers as indicated in Contract Documents.
    - a. Submit in vertical format.
  - 3. Include complete description for each door listed.
- D. Shop Drawings - Electrified Door Hardware: Include diagrams for power, signal, and control wiring for electrified door hardware that include details of interface with building safety and security systems. Provide elevations and diagrams for each electrified door opening as follows:
  - 1. Prepared by or under supervision of Architectural Hardware Consultant (AHC) and Electrified Hardware Consultant (EHC).
  - 2. Elevations: Include front and back elevations of each door opening showing electrified devices with connections installed and an operations narrative describing how opening operates from either side at any given time.
  - 3. Diagrams: Include point-to-point wiring diagrams that show each device in door opening system with related colored wire connections to each device.
- E. Samples for Verification:
  - 1. Submit minimum size of 2 by 4 inch for sheet samples, and minimum length of 4 inch for other products.
  - 2. Include product description with samples.
- F. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
- G. Manufacturer's qualification statement.
- H. Installer's qualification statement.
- I. Supplier's qualification statement.
- J. Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.
- K. Keying Schedule:
  - 1. Submit three (3) copies of Keying Schedule in compliance with requirements established during Keying Requirements Meeting unless otherwise indicated.
- L. Warranty: Submit manufacturer's warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- M. Project Record Documents: Record actual locations of concealed equipment, services, and conduit.
- N. Maintenance Materials and Tools: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 01 60 00 - Product Requirements, for additional provisions.

**1.06 QUALITY ASSURANCE**

- A. Standards for Fire-Rated Doors: Maintain one copy of each referenced standard on site, for use by Architect and Contractor.
- B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.
- C. Installer Qualifications: Company specializing in performing work of the type specified for commercial door hardware with at least three years of documented experience.
- D. Supplier Qualifications: Company with certified Architectural Hardware Consultant (AHC) and Electrified Hardware Consultant (EHC) to assist in work of this section.

**1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Package hardware items individually; label and identify each package with door opening code to match door hardware schedule.

**1.08 WARRANTY**

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty: Provide manufacturer warranty against defects in material and workmanship for period indicated, from Date of Substantial Completion. Complete forms in Owner's name and register with manufacturer.
  - 1. Closers: Ten years, minimum.
  - 2. Exit Devices: Five years, minimum.
  - 3. Locksets and Cylinders: Three years, minimum.

**PART 2 PRODUCTS****2.01 GENERAL REQUIREMENTS**

- A. Provide specified door hardware as required to make doors fully functional, compliant with applicable codes, and secure to extent indicated.
- B. Provide individual items of single type, of same model, and by same manufacturer.
- C. Locks: Provide a lock for each door, unless it's indicated that lock is not required.
  - 1. Lock Function: Provide lock and latch function numbers and descriptions of manufacturer's Series. As indicated in hardware sets.
  - 2. Trim: Provide lever handle or pull trim on outside of each lock, unless otherwise indicated.
  - 3. Strikes:
    - a. Finish: To match lock or latch.
    - b. Curved-Lip Strikes: Provide as standard, with extended lip to protect frame, unless otherwise indicated.
    - c. Center Strike At Pairs of Doors: 7/8 inch lip.
- D. Closers:
  - 1. Provide door closer on each fire-rated and smoke-rated door.
  - 2. Spring hinges are not an acceptable self-closing device, unless otherwise indicated.
- E. Drip Guards: Provide at head of out swinging exterior doors unless protected by roof or canopy directly overhead.
- F. Thresholds:
  - 1. Interior Applications: Provide when specified at interior doors for transition between two different floor types, and over building expansion joints, unless otherwise indicated.

2. Exterior Applications: Provide at each exterior door, unless otherwise indicated.

**G. Weatherstripping and Gasketing:**

1. Provide weatherstripping on each exterior door at head, jambs, and meeting stiles of door pairs, unless otherwise indicated.
2. Provide door bottom sweep on each exterior door, unless otherwise indicated.

**H. Fasteners:**

1. Provide fasteners of proper type, size, quantity, and finish that comply with commercially recognized standards for proposed applications.
  - a. Aluminum fasteners are not permitted.
  - b. Provide Phillips flat-head screws with heads finished to match door surface hardware unless otherwise indicated.
2. Provide machine screws for attachment to reinforced hollow metal and aluminum frames.
  - a. Self-drilling (Tek) type screws are not permitted.
3. Provide stainless steel machine screws and lead expansion shields for concrete and masonry substrates.
4. Provide wall grip inserts for hollow wall construction.
5. Fire-Resistance-Rated Applications: Comply with NFPA 80.
  - a. Provide wood or machine screws for hinges mortised to doors or frames, strike plates to frames, and closers to doors and frames.
  - b. Provide steel through bolts for attachment of surface mounted closers, hinges, or exit devices to door panels unless proper door blocking is provided.

**2.02 PERFORMANCE REQUIREMENTS**

**A. Provide door hardware products that comply with the following requirements:**

1. Applicable provisions of federal, state, and local codes.
2. Accessibility: ADA Standards and ICC A117.1.
3. Fire-Resistance-Rated Doors: NFPA 80, listed and labeled by qualified testing agency for fire protection ratings indicated, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.
4. Hardware on Fire-Resistance-Rated Doors: Listed and classified as suitable for application indicated.
5. Hardware for Smoke and Draft Control Doors (Indicated as "S" on Drawings): Provide door hardware that complies with local codes, and requirements of assemblies tested in accordance with UL 1784.
6. Hardware Preparation for Steel Doors and Steel Frames: BHMA A156.115.
7. Hardware Preparation for Wood Doors with Wood or Steel Frames: BHMA A156.115W.
8. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified.

**2.03 HINGES**

**A. Manufacturers: Conventional butt hinges.**

1. BEST; dormakaba Group: [www.bestaccess.com/#sle](http://www.bestaccess.com/#sle).
2. McKinney.
3. PBB.

**B. Properties:**

1. Butt Hinges: As applicable to each item specified.
  - a. Standard Weight Hinges: Minimum of two (2) permanently lubricated non-detachable bearings.

- b. Heavy Weight Hinges: Minimum of four (4) permanently lubricated bearings on heavy weight hinges.
  - c. Template screw hole locations.
  - d. Bearing assembly installed after plating.
  - e. Bearings: Exposed fully hardened bearings.
  - f. Bearing Shells: Shapes consistent with barrels.
  - g. Pins: Easily seated, non-rising pins.
    - 1) Fully plate hinge pins.
    - 2) Non-Removable Pins: Slotted stainless steel screws.
  - h. UL 10C listed for fire-resistance-rated doors.
2. Continuous Hinges: As applicable to each item specified.
- a. Geared Continuous Hinges: As applicable to each item specified.
    - 1) Non-handed.
    - 2) Anti-spinning through-fastener.
    - 3) UL 10C listed for fire-resistance-rated doors.
      - (a) Metal Door Installation: Rated up to 90 minutes.
      - (b) Wood Door Installation: Rated up to 60 minutes.
    - 4) Sufficient size to permit door to swing 180 degrees
- C. Sizes: See Door Hardware Schedule.
1. Hinge Widths: As required to clear surrounding trim.
  2. Sufficient size to allow 180 degree swing of door.
- D. Finishes: See Door Hardware Schedule.
1. Fully polished hinges; front, back, and barrel.
- E. Grades:
1. Butt Hinges: Comply with BHMA A156.1 and BHMA A156.7 for templated hinges.
  2. Comply with BHMA A156.18 Materials and Finishes.
  3. Continuous Hinges: Comply with BHMA A156.26, Grade 1.
- F. Material: Base metal as indicated for each item by BHMA material and finish designation.
- G. Types:
1. Butt Hinges: Include full mortise hinges.
  2. Continuous Hinges: Include geared hinges.
- H. Options: As applicable to each item specified.
- I. Quantities:
1. Butt Hinges: Three (3) hinges per leaves up to 90 inches in height. Add one (1) for each additional 30 inches in height or fraction thereof.
    - a. Hinge weight and size unless otherwise indicated in hardware sets:
      - 1) For doors up to 36 inches wide and up to 1-3/4 inches thick provide hinges with a minimum thickness of 0.134 inch and a minimum of 4-1/2 inches in height.
      - 2) For doors from 36 inches wide up to 42 inches wide and up to 1-3/4 inches thick provide hinges with a minimum thickness of 0.145 inch and a minimum of 4-1/2 inches in height.
      - 3) For doors from 42 inches wide up to 48 inches wide and up to 1-3/4 inches thick provide hinges with a minimum thickness of 0.180 inch and a minimum of 5 inches in height.
      - 4) For doors greater than 1-3/4 inches thick provide hinges with a minimum thickness of 0.180 inch and a minimum of 5 inches in height.
  2. Continuous Hinges: One per door leaf.

**J. Applications:** At swinging doors.

1. Provide non-removable pins at out-swinging doors with locking hardware and all exterior doors.

**K. Products:**

1. Butt Hinges:
  - a. Ball Bearing, Five (5) Knuckle. FBB Series
2. Continuous Hinges:
  - a. Aluminum geared hinges. 660 Series

**2.04 BOLTS****A. Manufacturers:**

1. Trimco: [www.trimcohardware.com/#sle](http://www.trimcohardware.com/#sle).

**B. Properties:**

1. Flush Bolts:
  - a. Pairs of Swing Doors: At inactive leaves, provide flush bolts of type as required to comply with code.
  - b. Manual Flush Bolts: Manually latching upon closing of door leaf.
    - 1) Bolt Throw: 3/4 inch, minimum.
  - c. Automatic Flush Bolts: Automatically latching upon closing of door leaf.
    - 1) Bolt Throw: 3/4 inch, minimum.
2. Dustproof Strikes: For bolting into floor, provide except at metal thresholds.

**C. Options:**

1. Extension Bolts: In leading edge of door, one bolt into floor, one bolt into top of frame.
2. Lever extensions: Provide for top bolt at oversized doors.

**D. Products:**

1. Manual flush bolts. 556WS
2. Automatic flush bolts. 3800

**2.05 EXIT DEVICES****A. Manufacturers:**

1. BEST, dormakaba Group: [www.bestaccess.com/#sle](http://www.bestaccess.com/#sle).
2. Von Duprin.

**B. Properties:**

1. Actuation:
2. Touchpads: "T" style metal touchpads and rail assemblies with matching chassis covers end caps.
3. Latch Bolts: Stainless steel deadlocking with 3/4 inch projection using latch bolt.
4. Lever Design: Match project standard lockset trims.
5. Cylinder: Include where cylinder dogging or locking trim is indicated.
6. Strike as recommended by manufacturer for application indicated.
7. Sound dampening on touch bar.
8. Dogging:
  - a. Non-Fire-Resistance-Rated Devices: Cylinder 1/4 inch hex key dogging.
  - b. Fire-Resistance-Rated Devices: Manual dogging not permitted.
9. Touch bar assembly on wide style exit devices to have a 1/4 inch clearance to allow for vision frames.
10. All exposed exit device components to be of architectural metals and "true" architectural finishes.



11. Handing: Field-reversible.
12. Fasteners on Back Side of Device Channel: Concealed - exposed fasteners not allowed.
13. Vertical Latch Assemblies' Operation: Gravity, without use of springs.

C. Grades: Complying with BHMA A156.3, Grade 1.

1. Provide exit devices tested and certified by UL or by a recognized independent laboratory for mechanical operational testing to 10 million cycles minimum with inspection confirming Grade 1 Loaded Forces have been maintained.

D. Performance Requirements:

1. Exterior Door Exit Devices in Hurricane-Strength Wind Areas:
  - a. Devices included in Miami (APD) (Miami-Dade County Approved Products Directory).
  - b. Complying with FLA (FBC-B) (Florida Building Code).

E. Standards Compliance:

1. Comply with UL 10C.

F. Code Compliance: As required by authorities having jurisdiction in the State in which the Project is located.

G. Options:

1. Exit Device Intruder Function Visual Indicator in conjunction with the ANSI "10" Function,
  - a. Directional Indicator:
    - 1) Actuation: By a rim cylinder equipped with a keyed core or thumb-turn.
    - 2) Embossed into the active case cover.
  - b. Large status window integrated into the housing of the exit device, with directional pointers to indicated key turn direction to lock and unlock outside lever trim.
  - c. Use bright reflective materials capable of being seen in low light condition.
  - d. Labels or stickers are not permitted.
  - e. Impact resistant lens cover.
  - f. A quarter turn (90 degrees) of key or thumb turn to lock down or unlock.
  - g. Locked status indicated by a red indicator with an image of a locked padlock appearing under lens cover.
  - h. Unlocked status indicated by a green indicator with an image of an unlocked padlock appearing under lens cover.

H. Products:

1. 2000.

## 2.06 REMOVABLE MULLIONS

A. Manufacturers:

1. BEST, dormakaba Group: [www.bestaccess.com/#sle](http://www.bestaccess.com/#sle).
2. Von Duprin.

B. Properties:

1. Rectangular shape 3 inches by 2 inches tubes with minimum 1/8 inch wall thickness.
2. Furnished by the same manufacturer as exit devices.
3. Pre-drilled holes for installation of exit device strikes.
4. Spacers: Provide as required for proper installation, based on frame profile and dimensions.

C. Grades: Complying with BHMA A156.3.

D. Materials: Manufacturer's standard for items specified.

1. Top and Bottom Brackets: Investment-cast steel.

E. Options:

F. Applications: As indicated on drawings and in Door Hardware Schedule.

G. Products:

1. 822 Series.

## 2.07 LOCK CYLINDERS

A. Manufacturers:

1. BEST, dormakaba Group: [www.bestaccess.com/#sle](http://www.bestaccess.com/#sle).
2. Substitutions: Not permitted.

B. Properties:

1. Lock Cylinders: Provide key access on outside of each lock, unless otherwise indicated.
  - a. Provide cylinders from same manufacturer as locking device.
  - b. Provide cams and/or tailpieces as required for locking devices.
  - c. Provide cylinders with appropriate format interchangeable cores where indicated.

C. Grades:

1. Standard Security Cylinders: Comply with BHMA A156.5.

D. Material:

1. Manufacturer's standard corrosion-resistant brass alloy.

E. Types: As applicable to each item specified.

F. Applications: At locations indicated in hardware

G. Products:

1. Rim/mortise: 12E / 1E

## 2.08 MORTISE LOCKS

A. Manufacturers:

1. BEST, dormakaba Group: [www.bestaccess.com/#sle](http://www.bestaccess.com/#sle).
2. Substitutions: Not permitted.

B. Properties:

1. Mechanical Locks: Manufacturer's standard.
  - a. Fitting modified ANSI A115.1 door preparation.
  - b. Door Thickness Coordination Fitting 1-3/4 inch to 2-1/4 inch thick doors.
  - c. Latch: Solid, one-piece, anti-friction, self-lubricating stainless steel.
    - 1) Latchbolt Throw: 3/4 inch, minimum.
  - d. Auxiliary Deadlatch: One piece stainless steel, permanently lubricated.
  - e. Backset: 2-3/4 inch.
  - f. Lever Trim:
    - 1) Functionality: Allow the lever handle to move up to 45 degrees from horizontal position prior to engaging the latchbolt assembly.
    - 2) Strength: Locksets outside locked lever designed to withstand minimum 1,400 inch-lbs of torque. In excess of that, a replaceable part will shear. Key from outside and/or inside lever will still operate lockset.
    - 3) Spindle: Designed to prevent forced entry from attacking of lever.
    - 4) Independent spring mechanism for each lever.
      - (a) Trim to be self-aligning and thru-bolted.

- 5) Handles: Made of forged or cast brass, bronze, or stainless steel construction.  
Levers that contain a hollow cavity are not acceptable.

C. Finishes: See Door Hardware Schedule.

1. Core Faces: Match finish of lockset.

D. Grades:

1. Comply with BHMA A156.13, Grade 1, Security; Grade 2.

E. Options:

1. Provide locksets made in a manufacturing facility to compliant with ISO 9001-Quality Management and ISO 14001-Environmental Management.
2. Regulatory Compliance: As required by authorities having jurisdiction the State in which the Project is located.
  - a. Meeting requirements of Florida Building Code and approved for use in Miami-Dade County:

F. Products: Mortise locks, including standard and electrified types.

1. 40H.

## 2.09 CYLINDRICAL LOCKS

A. Manufacturers:

1. BEST, dormakaba Group: [www.bestaccess.com/#sle](http://www.bestaccess.com/#sle).
2. Substitutions: Not permitted.

B. Properties:

1. Mechanical Locks:
  - a. Fitting modified ANSI A115.2 door preparation.
  - b. Door Thickness Fit: 1-3/8 inches to 2-1/4 inches thick doors.
  - c. Construction: Hub, side plate, shrouded rose, locking pin to be a one-piece casting with a shrouded locking lug.
    - 1) Through-bolted anti-rotational studs.
  - d. Cast stainless steel latch retractor with roller bearings for exceptionally smooth operation and superior strength and durability.
  - e. Bored Hole: 2-1/8 inch diameter.
  - f. Backset: 5 inches unless otherwise indicated.
  - g. Latch: Single piece tail-piece construction.
    - 1) Latchbolt Throw: 9/16 inch, minimum.
  - h. Cylinders:
    - 1) Cylinder Core Types: Locks capable of supporting manufacturers' cores, as applicable.
      - (a) Small format interchangeable.
  - i. Lever Trim:
    - 1) Style: See Door Hardware Schedule.
    - 2) Functionality: Allow the lever handle to move up to 45 degrees from horizontal position prior to engaging the latchbolt assembly.
    - 3) Strength: Locksets outside locked lever designed to withstand minimum 1,400 inch-lbs of torque. In excess of that, a replaceable part will shear. Key from outside and/or inside lever will still operate lockset.
    - 4) Independent spring mechanism for each lever.
      - (a) Contain lever springs in the main lock hub.
    - 5) Outside Lever Sleeve: Seamless one-piece construction.
    - 6) Keyed Levers: Removable only after core is removed by authorized control key.

C. Finishes: See Door Hardware Schedule.

1. Core Faces: Match finish of lockset.

D. Grades: Comply with BHMA A156.2, Grade 1, Series 4000, Operational Grade 1, Extra Heavy Duty.

1. Durability: Passing 50 Million cycle tests verified by third party testing agency.

E. Material: Manufacturer's standard for specified lock.

1. Critical Latch and Chassis Components: Brass or corrosion-resistance treated steel.
2. Outside Lever Sleeve: Hardened steel alloy.

F. Options:

1. Regulatory Compliance: As required by authorities having jurisdiction the State in which the Project is located.

G. Products: Cylindrical locks, including mechanical and electrified types.

1. 9K.

## 2.10 COORDINATORS

A. Manufacturers:

1. Trimco: [www.trimcohardware.com/#sle](http://www.trimcohardware.com/#sle).
2. Ives.

B. Properties:

1. General: Non-handed devices, with field-selectable active door leaf.
2. Coordinators: Devices on pairs of doors with closers and self-latching or automatic flush bolts installed.
  - a. Coordinator Operation: Only when inactive door is opened.

C. Code Compliance: As required by authorities having jurisdiction in the State in which the Project is located.

1. Meet UL 10C for Positive Pressure.

D. Types:

1. Coordinators: Bar.

E. Installation:

1. Mounting: Provide necessary mounting brackets and filler bars to ensure proper installation of coordinator and related hardware.
2. Coordination: Properly sequence installation of other door hardware affected by placement of coordinators and carry bars.

F. Products:

1. 3090 Series.

## 2.11 CLOSERS

A. Manufacturers:

1. BEST, dormakaba Group [www.bestaccess.com/#sle](http://www.bestaccess.com/#sle).
2. Sargent.

B. Properties:

1. Surface Mounted Closers: Manufacturer's standard.
  - a. Construction: R14 high silicon aluminum alloy.
  - b. Maximum Projection from Face of Door: 2-7/16 inches.
  - c. Mechanism: Separate tamper-resistant adjusting valves for closing and latching speeds.
    - 1) Include advanced backcheck feature.

- 2) Include delayed action feature.
- d. Pinion: Stainless steel.
- e. Hydraulic Fluid: All-weather type.
- f. Arm Assembly: Standard for product specified.
  - 1) Include hold-open, integral stop, or spring-loaded stop feature, as specified in Door Hardware Schedule.
  - 2) Parallel arm to be a heavy-duty rigid arm.
  - 3) Where "IS" or "S-IS" arms are specified in hardware sets, if manufacturer does not offer this arm provide a regular arm mount closer in conjunction with a heavy-duty overhead stop equal to a dormakaba 900 Series.
- g. Covers:
  - 1) Type: Standard for product selected.
    - (a) Full.
  - 2) Material: Plastic.
  - 3) Finish: Painted.

#### C. Grades:

1. Closers: Comply with BHMA A156.4, Grade 1.
  - a. Underwriters Laboratories Compliance:
    - 1) Product Listing: UL (DIR) and ULC for use on fire-resistance-rated doors.
      - (a) UL 228 - Door Closers-Holders, With or Without Integral Smoke Detectors.

#### D. Types:

1. Rack-and-pinion, surface-mounted. 1-1/2 inches minimum bore.

#### E. Options:

1. Delayed action, adjustable with an independent valve.
2. Advanced backcheck.
3. Cushion limit stay.

#### F. Installation:

1. Mounting: Includes surface mounted installations.
2. Mount closers on non-public side of door and stair side of stair doors unless otherwise noted in hardware sets.
3. At out swinging exterior doors, mount closer on interior side of door.
4. Provide adapter plates, shim spacers, and blade stop spacers as required by frame and door conditions.
5. Where an overlapping astragal is included on pairs of swinging doors, provide coordinator to ensure door leaves close in proper order.

#### G. Products:

1. Surface Mounted:
  - a. HD8000.

## 2.12 PROTECTION PLATES

#### A. Manufacturers:

1. Trimco: [www.trimcohardware.com/#sle](http://www.trimcohardware.com/#sle).
2. Rockwood.
3. Burns.

#### B. Properties:

1. Plates:

- a. Kick Plates: Provide along bottom edge of push side of every wood door with closer, except aluminum storefront and glass entry doors, unless otherwise indicated.
- b. Mop Plates: Provide along bottom edge of pull side of doors to provide protection from cleaning liquids and equipment damage to door surface.
  - 1) Size: 6 inch high by 1 inch less door width (LDW) on pull side and 2 inch LDW on push side of door.
- c. Edges: Beveled, on four (4) unless otherwise indicated.

C. Grades: Comply with BHMA A156.6.

D. Material: As indicated for each item by BHMA material and finish designation.

1. Metal Properties: Stainless steel.
  - a. Metal, Standard Duty: Thickness 0.050 inch, minimum.

E. Installation:

1. Fasteners: Countersunk screw fasteners

F. Products:

1. K0050 / KM050.

## 2.13 STOPS AND HOLDERS

A. Manufacturers:

1. Trimco: [www.trimcohardware.com/#sle](http://www.trimcohardware.com/#sle).
2. Don-Jo.
3. Rockwood.

B. Grades:

1. Door Holders, Wall Bumpers, and Floor Stops: Comply with BHMA A156.16 and Resilient Material Retention Test as described in this standard.

C. Material: Base metal as indicated for each item by BHMA material and finish designation.

D. Types:

1. Wall Bumpers: Bumper, concave, wall stop.

E. Installation:

1. Non-Masonry Walls: Confirm adequate wall reinforcement has been installed to allow lasting installation of wall bumpers.

F. Products:

1. Wall Bumpers: 1270CVSV

## 2.14 THRESHOLDS

A. Manufacturers:

1. National Guard Products, Inc: [www.ngpinc.com/#sle](http://www.ngpinc.com/#sle).
2. Burns.

B. Properties:

1. Threshold Surface: Fluted horizontal grooves across full width.

C. Grades: Thresholds: Comply with BHMA A156.21.

D. Material: Base metal as indicated for each item by BHMA material and finish designation.

E. Types: As applicable to project conditions. Provide barrier-free type at every location where specified.

F. Products:

**2.15 WEATHERSTRIPPING AND GASKETING****A. Manufacturers:**

1. National Guard Products, Inc: [www.ngpinc.com/#sle](http://www.ngpinc.com/#sle).
2. Reese.
3. Zero.

**B. Properties:**

1. Weatherstripping Air Leakage Performance: Not exceeding 0.3 cfm/sq ft of door opening at 0.3 inches of water pressure differential for single doors, and 0.5 cfm/sq ft of door area at 0.3 inches of water pressure differential for double doors for gasketing other than smoke control, as tested according to ASTM E283/E283M; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.
2. Rigid, Housed, Perimeter Gasketing: Sponge silicone gasket material held in place by aluminum housing; fastened to frame stop with screws.
3. Door Sweeps: Neoprene or silicone gasket material held in place by flat aluminum housing or flange; surface mounted to face of door with screws.
4. Door Shoes: Thermoplastic elastomer gasket material held in place by metal retainer; mounted to bottom edge of door with screws.
  - a. Mounting: Surface mounted on bottom edge of door.
  - b. Extended Housing: One side of door.

**C. Grades: Comply with BHMA A156.22.****D. Products:**

1. Weatherstripping: See Door Hardware Schedule.
2. Smoke Seals: See Door Hardware Schedule.
3. Meeting Stile Seals: See Door Hardware Schedule.
4. Door Bottom Seals:
  - a. Door Sweeps: See Door Hardware Schedule.
  - b. Door Shoes: See Door Hardware Schedule.

**2.16 MISCELLANEOUS ITEMS****A. Manufacturers:**

1. Trimco.
2. Ives
3. Rockwood

**B. Properties:**

1. Silencers: Provide at equal locations on door frame to mute sound of door's impact upon closing.
  - a. Single Door: Provide three on strike jamb of frame.
  - b. Pair of Doors: Provide two on head of frame, one for each door at latch side.
  - c. Material: Rubber, gray color.

**C. Products:**

1. Silencers.

**2.17 KEYS AND CORES****A. Manufacturers:**

1. BEST, dormakaba Group: [www.bestaccess.com/#sle](http://www.bestaccess.com/#sle).
2. Substitutions: Not permitted.

**B. Properties: Complying with guidelines of BHMA A156.28.**

1. Provide small format interchangeable core.
2. Provide Patented CORMAX keys and cores.
3. Provide keying information in compliance with DHI (KSN) standards.
4. Keying Schedule: Arrange for a keying meeting, with Architect, Owner and hardware supplier, and other involved parties to ensure locksets and locking hardware, are functionally correct and keying complies with project requirements.
5. Keying: Master keyed.
6. Include construction keying and control keying with removable core cylinders.
7. Supply keys in following quantities:
  - a. Grand Master Keys: 1 each.
  - b. Master Keys: 4 each.
  - c. Construction Master Keys: 6 each.
  - d. Construction Keys: 15 each.
  - e. Construction Control Keys: 2 each.
  - f. Control Keys if New System: 2 each.
8. Provide key collection envelopes, receipt cards, and index cards in quantity suitable to manage number of keys.
9. Deliver keys with identifying tags to Owner by security shipment direct from manufacturer.
10. Permanent Keys and Cores: Stamped with applicable key marking for identification. Do not include actual key cuts within visual key control marks or codes. Stamp permanent keys "Do Not Duplicate."
11. Include installation of permanent cores and return construction cores to hardware supplier. Construction cores and keys to remain property of hardware supplier.

C. Products:

1. Patented:
  - a. CORMAX.

## 2.18 FINISHES

A. Finishes: Identified in Hardware Sets.

B. Finishes: Provide door hardware of same finish, unless otherwise indicated.

1. Finish: 630; satin stainless steel, with stainless steel 3000 series base material (former US equivalent 32D), 652; satin chromium plated over nickel, with steel base material (former US equivalent 26D), and 689; aluminum painted, with any base material (former US equivalent US28); BHMA A156.18.

C. Exceptions:

1. Where base material metal is specified to be different, provide finish that is an equivalent appearance in accordance with BHMA A156.18.
2. Hinges for Fire-Rated Doors: Steel base material with painted finish, in compliance with NFPA 80.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that doors and frames are ready to receive this work; labeled, fire-rated doors and frames are properly installed, and dimensions are as indicated on shop drawings.
- B. Correct all defects prior to proceeding with installation.
- C. Verify that electric power is available to power operated devices and of correct characteristics.



**3.02 INSTALLATION**

- A. Install hardware in accordance with manufacturer's instructions and applicable codes.
- B. Install hardware using the manufacturer's fasteners provided. Drill and tap all screw holes located in metallic materials. Do not use "Riv-Nuts" or similar products.
- C. Install hardware on fire-rated doors and frames in accordance with applicable codes and NFPA 80.
- D. Install hardware for smoke and draft control doors in accordance with NFPA 105.
- E. Use templates provided by hardware item manufacturer.
- F. Do not install surface mounted items until application of finishes to substrate are fully completed.
- G. Wash down masonry walls and complete painting or staining of doors and frames.
- H. Complete finish flooring prior to installation of thresholds.
- I. Door Hardware Mounting Heights: Distance from finished floor to center line of hardware item. As indicated in following list; unless noted otherwise in Door Hardware Schedule or on drawings.
  - 1. For Steel Doors and Frames: Install in compliance with DHI (LOCS) recommendations.
  - 2. For Steel Doors and Frames: See Section 6549.
  - 3. For Steel Door Frames: See Section 08 12 13.
  - 4. For Aluminum-Framed Storefront Doors and Frames: See Section 08 43 13.
  - 5. For Wood Doors: Install in compliance with DHI WDHS.3 recommendations.
  - 6. Flush Wood Doors: See Section 08 14 16.
  - 7. Stile and Rail Wood Doors: See Section 08 14 33.
  - 8. Mounting heights in compliance with ADA Standards:
    - a. Locksets: 40-5/16 inch.
    - b. Push Plates/Pull Bars: 42 inch.
    - c. Deadlocks (Deadbolts): 48 inch.
    - d. Exit Devices: 40-5/16 inch.
    - e. Door Viewer: 43 inch; standard height 60 inch.
- J. Set exterior door thresholds with full-width bead of elastomeric sealant at each point of contact with floor providing a continuous weather seal. Anchor thresholds with stainless steel countersunk screws.
- K. Include in installation for existing doors and frames any necessary field modification and field preparation of doors and frames for new hardware. Provide necessary fillers, reinforcements, and fasteners for mounting new hardware and to cover existing door and frame preparations.

**3.03 FIELD QUALITY CONTROL**

- A. Perform field inspection and testing under provisions of Section 01 40 00 - Quality Requirements.

**3.04 ADJUSTING**

- A. Adjust work under provisions of Section 01 70 00 - Execution and Closeout Requirements.
- B. Adjust hardware for smooth operation.
- C. Adjust gasketing for complete, continuous seal; replace if unable to make complete seal.

**3.05 CLEANING**

- A. Clean finished hardware in accordance with manufacturer's written instructions after final adjustments have been made.
- B. Clean adjacent surfaces soiled by hardware installation activities.

C. Replace items that cannot be cleaned to manufacturer's level of finish quality at no additional cost.

**3.06 PROTECTION**

A. Protect finished Work under provisions of Section 01 70 00 - Execution and Closeout Requirements.

B. Do not permit adjacent work to damage hardware or finish.

**3.07 HARDWARE SETS –THE CONTRACTOR SHALL PROVIDE A HARDWARE SCHEDULE BASED ON THE SCHEDULE APPEARING ON THE DRAWINGS AND THIS SPECIFICATION.**

END OF SECTION 08 71 00

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## SECTION 088000 - GLAZING

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Glass products.
2. Insulating glass.
3. Glazing sealants.
4. Glazing tapes.
5. Miscellaneous glazing materials.

#### 1.2 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.

#### 1.3 PREINSTALLATION MEETINGS

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

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Glass Samples: For each type of glass product other than clear monolithic vision glass; **12 inches (300 mm)** square.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For glass.
- B. Product test reports.
- C. Preconstruction adhesion and compatibility test report.
- D. Sample warranties.

## 1.6 QUALITY ASSURANCE

- A. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.

## 1.7 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

1. Warranty Period: **10** years from date of Substantial Completion.

- B. 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 PERFORMANCE REQUIREMENTS

- A. 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: As indicated on Drawings.
2. 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.

- B. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

- C. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. U-Factors: Center-of-glazing values, in accordance with NFRC 100 and based on most current non-beta version of LBL's WINDOW computer program, expressed as **Btu/sq. ft. x h x deg F (W/sq. m x K)**.

2. SHGC and Visible Transmittance: Center-of-glazing values, in accordance with NFRC 200 and based on most current non-beta version of LBL's WINDOW computer program.
3. Visible Reflectance: Center-of-glazing values, in accordance with NFRC 300.

D. Acoustic Performance:

1. Exterior Glazing: **33** OITC.

## 2.2 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. 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 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.**
- 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.

## 2.3 GLASS PRODUCTS

- A. Clear Annealed Float Glass: ASTM C1036, Type I, Class 1 (clear), Quality-Q3.
  1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - a. [AGC Glass Company North America, Inc.](#)
    - b. [Cardinal Glass Industries, Inc.](#)
    - c. Pilkington North America; NSG Group.
    - d. Saint-Gobain Glass Corp.
    - e. [Vitro Architectural Glass.](#)

- B. Tinted Annealed Float Glass: ASTM C1036, Type I, Class 2 (tinted), Quality-Q3.
1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - a. [AGC Glass Company North America, Inc.](#)
    - b. Pilkington North America; NSG Group.
    - c. Saint-Gobain Glass Corp.
    - d. [Vitro Architectural Glass.](#)
    - e. Guardian Glass LLC.
- C. 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.

## 2.4 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.**
    - a. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
      - 1) Saint-Gobain Glass Corp.
      - 2) [Technoform Glass Insulation North America.](#)
      - 3) [Thermix; a brand of Ensinger USA.](#)
  3. Desiccant: Molecular sieve or silica gel, or a blend of both.

## 2.5 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.
2. Applications: **<Describe types of glazing applications where sealant is required>.**

## 2.6 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C1281 and AAMA 800 for products indicated below:
  1. AAMA 804.3 tape, where indicated.
  2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
  3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
  1. AAMA 810.1, Type 1, for glazing applications in which tape acts as primary sealant.
  2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

## 2.7 MISCELLANEOUS GLAZING MATERIALS

- A. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- B. Setting Blocks:
  1. **EPDM** with Shore A durometer hardness of 85, plus or minus 5.
  2. Type recommended in writing by sealant or glass manufacturer.
- C. Spacers:
  1. **Neoprene** blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
  2. Type recommended in writing by sealant or glass manufacturer.
- D. Edge Blocks:
  1. **EPDM** with Shore A durometer hardness per manufacturer's written instructions.
  2. Type recommended in writing by sealant or glass manufacturer.



- E. 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.

## PART 3 - EXECUTION

### 3.1 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 (1270 mm).
- 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.

### 3.2 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Apply heel bead of elastomeric sealant.

- F. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- G. Apply cap bead of elastomeric sealant over exposed edge of tape.

### 3.3 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.

### 3.4 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.

### 3.5 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.

### 3.6 INSULATING GLASS SCHEDULE

1. Overall Unit Thickness: **As required** by Storefront Door and sidelite and transom requirements.
2. Minimum Thickness of Each Glass Lite: **3 mm**.
3. Outdoor Lite: **Fully tempered** float glass.
4. Interspace Content: **Air**.
5. Indoor Lite: **Fully tempered** float glass.
6. Safety glazing required.

END OF SECTION 088000

## SECTION 08 88 13 - FIRE-RATED GLAZING

### PART 1 GENERAL

#### 1.01 SUMMARY

##### A. Section Includes: Fire rated glazing

1. SuperLite<sup>®</sup> II-XL 60 safety rated, fire protective glazing with fire resistive qualities for interior and exterior applications.
2. Applications of fire rated glazing includes:
  - a. Fire rated glazing as vision lites in door assemblies.
  - b. Fire rated glazing as sidelites, in fire rated frames.

##### B. Related sections:

1. Section 01 33 23: Shop Drawings, Product Data and Samples
2. Section 08 80 00: Glazing
3. Section 08 41 13.13: Fire-Rated Aluminum Framed Entrances and Storefronts

#### 1.02 REFERENCES

##### A. American Society for Testing and Materials (ASTM):

1. ASTM E119: Methods for Fire Tests of Building Construction and Materials.
2. ASTM E152: Methods for Fire Tests of Door Assemblies.
3. ASTM E163: Methods for Fire Tests of Window Assemblies.
4. ASTM E2074: Standard Test Method for Fire Tests of Door Assemblies, including Positive Pressure Testing of Side-hinged and Pivoted Swinging Door Assemblies.
5. ASTM E2010-1: Standard Test for Positive Pressure of Fire Tests of Window Assemblies.

##### B. National fire Protection Association (NFPA):

1. NFPA 80: Fire Doors and Windows.
2. NFPA 251: Fire Tests of Building Construction and Materials.
3. NFPA 252: Fire Tests of Door Assemblies.
4. NFPA 257: Fire Tests of Window Assemblies.

##### C. Underwriters Laboratories, Inc. (UL):

1. UL 9: Standard for Safety of Fire Tests of Window Assemblies.
2. UL 10 B: Standard for Safety of Fire Tests of Door Assemblies.
3. UL 10 C: Standard for Safety of Positive Pressure Tests of Door Assemblies.
4. UL 263: Fire Tests of Building Construction and Materials.

##### D. Glass Association of North America (GANA)

1. GANA – Glazing Manual.
2. FGMA – Sealant Manual.

### 1.03 SYSTEM DESCRIPTION

A. Performance Requirements: Provide a fire rated glazing manufactured, fabricated and installed to maintain performance criteria stated by manufacturer without defects, damage, or failure.

1. Fire Rating: 60 minutes with hose stream.
2. Safety rated, fire protective glazing with fire resistive qualities tested in accordance with ASTM E119, NFPA 80, NFPA 251, NFPA 252, NFPA 257, UL 9, UL 10B, UL 10C and UL 263.
3. Testing Laboratory: Fire test shall be conducted by a nationally recognized independent testing laboratory.

A. Listings and Labels:

1. Fire rated glazing shall be under current follow-up services by nationally recognized independent testing laboratory approved by OSHA and maintain a current listing or certification. Assemblies shall be labeled in accordance with limits of listings.

### 1.04 SUBMITTALS

A. Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedure Section.

1. Shop Drawings: Submit shop drawings showing layouts, profiles and product components.
2. Samples: Submit 12x12 glass samples.
3. Technical Information: Submit latest edition of manufacturer's product data.

### 1.05 DELIVERY, STORAGE AND HANDLING

A. General: Comply with Division 1 Product Requirements Sections.

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

C. Delivery: Deliver materials to specified destinations in manufacturer or distributor's packaging.

D. Storage and Protection: Store off ground, under cover, protected from weather and construction activities and at temperature conditions recommended by manufacturer.

### 1.06 PROJECT CONDITIONS

A. Field Measurements: Verify actual measurements for openings by field measurements before fabrication. Show recorded measurements on shop drawings. Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.

### 1.07 WARRANTY

A. Manufacturer's Warranty: Submit manufacturer's standard warranty document.

Manufacturer's warranty is not intended to limit other rights that the Owner may have under the Contract Documents.

1. Warranty Period: 5-year limited warranty from date of shipping.

## PART 2 PRODUCTS

### 2.01 FIRE RATED GLAZING

- A. Material: SuperLite<sup>®</sup> II-XL 60 minute fire protective glazing with fire resistive qualities.
- B. Manufacturer: SuperLite<sup>®</sup> II-XL as manufactured and distributed by SAFTIFIRST<sup>®</sup>.
1. Contact: 100 N Hill Drive, Suite 12, Brisbane, CA 94005; Telephone 888.653.3333; email [info@safti.com](mailto:info@safti.com); Web site [www.safti.com](http://www.safti.com).
  2. Fire rated glass and framing must be provided by a single-source, US manufacturer. Distributors of fire rated glass and framing are not to be considered as manufacturers.
- C. Design Requirements:
1. Make-up: Must be comprised of an inboard and outboard lite of [clear tempered] [Starphire Ultra-Clear<sup>®</sup> glass by Vitro] protecting a clear, fire resistive, intumescent interlayer.
  2. Thickness: 1-3/8" (35 mm) standard profile.
  3. Weight: 14-lbs/sq. for standard 1-3/8" (35 mm) standard profile.
  4. Sound Transmission Rating: Must meet 43 STC/39 OITC in 1-3/8" standard profile; Must meet 43 STC/ 37 OITC insulated with 1/4" Low-E.
  5. Dimensions: Must meet max. clear view area of 4,952 sq. in., measuring at least 124 in. on the long side.
  6. Appearance: Must be tint-free, optically clear fire resistive glazing.
  7. Visible Transmittance: Must meet 0.786 with clear standard; 0.877 with clear low-iron.
  8. Fire Rating: Must be fire rated to 60 minutes with hose stream and meet ASTM E-119.
  9. Impact Safety Resistance: CPSC 16 CFR 1201 Cat. I & II.
  10. Hard Body Impact Classification: Must meet ASTM C1629/C1629M Level 3.
  11. Soft Body Impact Classification: Must meet ASTM E695 Level 3.
  12. Surface Abrasion Resistance: Must meet ASTM D4977 Level 3.
  13. Customization: Available in insulated, energy performance, bullet-resistant, blast-resistant, hurricane-resistant, laminated, tinted, patterned, frosted, mirrored, reflective, segmented, decorative and more.
- D. Manufacturer's Fire Rated Glazing Material:
1. Each piece of fire-rated glazing material shall be labeled with a permanent logo including name of product, manufacturer, testing laboratory, fire rating period and safety glazing standards.
  2. Glazing materials installed in Hazardous Locations, subject to human impact, shall be certified and permanently labeled as meeting applicable requirements reference in NFPA 80:
    - a) CPSC 16 CFR 1201 Cat. I & II
- E. Substitutions: No substitutions allowed.

### 2.02 MATERIALS

- A. Glazing Accessories: Manufacturer recommended fire rated glazing accessory as follows:
- a. Glazing with EPDM tape or other listed flame resistant gasket material and calcium silicate setting blocks.

### 2.03 RELATED PRODUCTS

- A. Glazing shall be installed in an equally rated framing system.
- B. Pressure glazing is allowed.

### 2.04 SOURCE QUALITY

- A. Obtain fire rated glazing products from a single manufacturer.
- B. Fabrication Dimensions: Fabricate to approved dimensions. The general contractor shall guarantee dimensions where practicable within required tolerances.

## PART 3 EXECUTION

### 3.01 MANUFACTURER'S INSTRUCTIONS

- A. Compliance: Comply with manufacturer's product data including product technical bulletins and installation instructions.

### 3.02 EXAMINATION

- A. Site Verification of Conditions: Verify substrate conditions, have been previously installed under other sections, and are acceptable for product installation in accordance with manufacturer's instructions.

### 3.03 INSTALLATION

- A. Installation shall be in strict accordance with the fire glazing material manufacturer's specifications. Field cutting or tampering is strictly prohibited.

### 3.04 CLEANING AND PROTECTION

- A. Protect glass from contact with contaminating substances resulting from construction operations. Remove such substances by method approved by manufacturer.
- B. Wash glass on both faces not more than four days prior to date schedule for inspections intended to establish date of Substantial Completion. Wash glass by method recommended by glass manufacturer.
- C. Remove temporary coverings and protection of adjacent work areas.
- D. Remove construction debris from project site and legally dispose of debris.

END OF SECTION 08813

## SECTION 092216 - NON-STRUCTURAL METAL FRAMING

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section Includes:
1. Non-load-bearing steel framing systems for interior gypsum board assemblies.
  2. Suspension systems for interior gypsum ceilings and soffits.

## 1.2 ACTION SUBMITTALS

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

## PART 2 - PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: Provide materials and construction identical to those tested according to ASTM E 119.
- B. STC-Rated Assemblies: Provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413.

## 2.2 FRAMING SYSTEMS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of prec-onsumer recycled content is not less than 25 percent.
- B. Steel Studs and Runners: ASTM C 645. Use either steel studs and runners or dimpled steel studs and runners of equivalent minimum base-metal thickness.
1. Minimum Base-Metal Thickness: 22GA
  2. Depth: As indicated on Drawings.
- C. Slip-Type Head Joints: Where indicated, provide one of the following in thickness not less than indicated for studs and in width to accommodate depth of studs:
1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch- (51-mm-) deep flanges, installed with studs friction fit into top runner and with continuous bridging located within 12 inches (305 mm) of the top of studs to provide lateral bracing.
  2. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch- (51-mm-) deep flanges and fastened to studs, and outer runner sized to friction fit inside runner.
  3. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes due to deflection of structure above.
    - a. Products: Subject to compliance with requirements, provide one of the following:



- 1) Dietrich Metal Framing; SLP-TRK Slotted Deflection Track.
- 2) MBA Building Supplies;
- 3) Steel Network Inc. (The);
- 4) Superior Metal Trim; Superior Flex Track System (SFT).
- 5) Telling Industries; [

D. Firestop Tracks: 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.

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

- a. Fire Trak Corp.; Fire Trak System
- b. Grace Construction Products; FlameSafe FlowTrak System.
- c. Metal-Lite, Inc.; The System.

E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Minimum Base-Metal Thickness: 0.018 inch (0.45 mm).

F. Cold-Rolled Channel Bridging: Steel, 0.053-inch (1.34-mm) minimum base-metal thickness, with minimum 1/2-inch- (13-mm-) wide flanges.

1. Depth: 1-1/2 inches (38 mm).
2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38 by 38 mm), 0.068-inch- (1.72-mm-) thick, galvanized steel.

G. Hat-Shaped, Rigid Furring Channels: ASTM C 645.

1. Minimum Base-Metal Thickness: 0.018 inch (0.45 mm).
2. Depth: 7/8 inch (22.2 mm).

H. Resilient Furring Channels: 1/2-inch- (13-mm-) deep, steel sheet members designed to reduce sound transmission.

1. Configuration: Asymmetrical.

I. Cold-Rolled Furring Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges.

1. Depth: As indicated on Drawings 3/4 inch (19 mm).
2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum uncoated-steel thickness of 0.033 inch (0.8 mm).
3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.

J. Z-Shaped Furring: With slotted or non-slotted web, face flange of 1-1/4 inches (31.8 mm) , wall attachment flange of 7/8 inch (22 mm), minimum uncoated-metal thickness of 0.018 inch (0.45 mm), and depth required to fit insulation thickness indicated.

## 2.3 SUSPENSION SYSTEMS

A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.

- B. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch (4.12 mm) in diameter.
- C. Flat Hangers: Steel sheet, 1 by 3/16 inch (25 by 5 mm) by length indicated.
- D. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.053 inch (1.34 mm) and minimum 1/2-inch- (13-mm-) wide flanges.
  - 1. Depth: 1-1/2 inches (38 mm).
- E. Furring Channels (Furring Members):
  - 1. Cold-Rolled Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges, 3/4 inch (19 mm) deep.
  - 2. Steel Studs and Runners: ASTM C 645. Use either steel studs and runners or dimpled steel studs and runners of equivalent minimum base-metal thickness.
    - a. Minimum Base-Metal Thickness: 0.018 inch (0.45 mm).
    - b. Depth: [As indicated on Drawings] [1-5/8 inches (41 mm)] [2-1/2 inches (64 mm)] [3-5/8 inches (92 mm)].
  - 3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch (22 mm) deep.
    - a. Minimum Base-Metal Thickness: 0.018 inch (0.45 mm).
  - 4. Resilient Furring Channels: 1/2-inch- (13-mm-) deep members designed to reduce sound transmission.
    - a. Configuration: Asymmetrical or hat shaped.

## 2.4 AUXILIARY MATERIALS

- A. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide [asphalt saturated organic felt] [or] [foam gasket].

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754.
  - 1. Gypsum Plaster Assemblies: Also comply with requirements in ASTM C 841 that apply to framing installation.
  - 2. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C 1063 that apply to framing installation.
  - 3. Gypsum Veneer Plaster Assemblies: Also comply with requirements in ASTM C 844 that apply to framing installation.
  - 4. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

- B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- C. Install bracing at terminations in assemblies.
- D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

### 3.2 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks (runners) 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 penetrating 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 runner track section (for cripple studs) at head and secure to jamb studs.
    - a. Install two studs at each jamb unless otherwise indicated.
  - 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
    - b. Curved Partitions:
      - 1) Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
      - 2) Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 6 inches (150 mm) o.c.
- E. Direct Furring:
  - 1. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.

### 3.3 INSTALLING SUSPENSION SYSTEMS

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

- C. Suspend hangers from building structure as follows:
1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
    - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, counter-splaying, or other equally effective means.
  2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
  3. Do not attach hangers to steel roof deck.
  4. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
  5. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
  6. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- E. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

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## SECTION 092900 - 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.
- B. Shop Drawings: Show locations and installation of control and expansion joints, including plans, elevations, sections, details of components, and attachments to other work.
- C. Samples: For each texture finish indicated on same backing indicated for Work.

## 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 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 according to ASTM E90 and classified according to 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 Wallboard: ASTM C1396/C1396M.
- B. Manufacturer's include, but are not limited to the following:
  - 1. American Gypsum.
  - 2. Certainteed.
  - 3. USG.
  - 4.

- C. Gypsum Board, Type X: ASTM C1396/C1396M.
  - 1. Thickness: **5/8 inch (15.9 mm)**.
  - 2. Long Edges: **Tapered**.
  
- D. Gypsum Ceiling Board: ASTM C1396/C1396M.
  - 1. Thickness: **5/8 inch (15.9 mm)**.
  - 2. Long Edges: Tapered.
  
- E. Mold/ Moisture-Resistant Gypsum Board: ASTM C1396/C1396M. With moisture- and mold-resistant core and paper surfaces.
  - 1. Core: **5/8 inch (15.9 mm), Type X**.
  - 2. Long Edges: Tapered.
  - 3. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

#### 2.4 SPECIALTY GYPSUM BOARD

- A. Gypsum Board, Type C: ASTM C1396/C1396M. Manufactured to have increased fire-resistive capability.
  
- B. Manufacturer's include, but are not limited to the following:
  - 1. American Gypsum.
  - 2. Certainteed.
  - 3. USG.
  - 4. Thickness: As required by fire-resistance-rated assembly indicated on Drawings.
  - 5. Long Edges: Tapered.

#### 2.5 TILE BACKING PANELS

- A. Glass-Mat, Water-Resistant Backing Board: ASTM C1178/C1178M, with manufacturer's standard edges.
  
- B. Manufacturer's include, but are not limited to the following:
  - 1. American Gypsum.
  - 2. Certainteed.
  - 3. USG.
  - 4. Core: **5/8 inch (15.9 mm), Type X**.
  - 5. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.
  
- C. Cementitious Backer Units: ANSI A118.9 and ASTM C1288 or ASTM C1325, with manufacturer's standard edges.
  
- D. Manufacturer's include, but are not limited to the following:
  - 1. Certainteed. Fiber Cement
  - 2. USG.
  - 3. Thickness: **5/8 inch (15.9 mm)**.
  - 4. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

#### 2.6 TRIM ACCESSORIES

- A. Interior Trim: ASTM C1047.
  - 1. Material: **Galvanized or aluminum-coated steel sheet or rolled zinc**.
  - 2. Shapes:

- a. Cornerbead.
- b. LC-Bead: J-shaped; exposed long flange receives joint compound.
- c. L-Bead: L-shaped; exposed long flange receives joint compound.
- d. U-Bead: J-shaped; exposed short flange does not receive joint compound.
- e. Expansion (control) joint.

## 2.7 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C475/C475M.
- B. Joint Tape:
  1. Interior Gypsum Board: Paper.
  2. Tile Backing Panels: As recommended by panel manufacturer.
- 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 **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 **drying-type, all-purpose** compound.
    - a. Use setting-type compound for installing paper-faced metal trim accessories.
  3. Fill Coat: For second coat, use **drying-type, all-purpose** 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.

## 2.8 AUXILIARY MATERIALS

- A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- B. Steel Drill Screws: ASTM C1002 unless otherwise indicated.
  1. Use screws complying with ASTM C954 for fastening panels to steel members from **0.033 to 0.112 inch (0.84 to 2.84 mm)** thick.
  2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- C. 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.
- D. Acoustical Sealant: As specified in Section 079219 "Acoustical Joint Sealants."
- E. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."



- F. Vapor Retarder: As specified in Section 072600 "Vapor Retarders."

### PART 3 - EXECUTION

#### 3.1 INSTALLATION OF PANELS

- A. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- B. Comply with ASTM C840.
- C. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide **1/4- to 1/2-inch- (6.4- to 12.7-mm-)** 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.
- D. 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.

#### 3.2 FINISHING OF GYPSUM BOARD

- A. Prefill open joints , **beveled edges**, and damaged surface areas.
- B. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- C. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C840:
1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
  2. Level 2: **Panels that are substrate for tile.**
  3. 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 099123 "Interior Painting."
    - b. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."
- D. Cementitious Backer Units: Finish according to manufacturer's written instructions.

#### 3.3 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, and mold damaged.

END OF SECTION 092900

## SECTION 093050 – WALL TILING

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section Includes:
  - 1. Tile.
  - 2. Tile Accessories

## 1.2 ACTION SUBMITTALS

- A. Shop drawings: Submit for tile pattern work indicated. Indicate control and expansion joint locations. Include tile layout, setting bed thicknesses, joint widths, control and expansion joint sizes and sections.
- B. Product data: Submit manufacturer's printed product description and installation instructions for each type of tile and for use of manufactured mortars, grouts, adhesives, sealants, and accessory products. Include mortar and grout proportioning and mixing instructions for latex/polymer additives.
- C. Samples; submit the following:
  - 1. 1'-0" by 1'-0" panel of each type and color tile selected, grouted as specified.
  - 2. Samples of each trim shape required.
  - 3. Samples of each accessory required.
  - 4. Submit color samples of sealant materials for Architect's approval.

- 1.3 Master grade certificates: Indicate that materials conform to ANSI A137.1, ANSI A137.2, and ANSI A137.3. Certificates shall indicate grade, kind of tile, identification for tile packages and name and location of project. Tile manufacturer shall issue certificates at time of shipping.

## 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

## 1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Tile and Trim Units: **Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.**

## 1.6 QUALITY ASSURANCE

- A. Applicable standards:
  - 1. Standards of the following, as referenced herein:
    - a. American National Standards Institute (ANSI).
    - b. ASTM International (ASTM).
    - c. Marble Institute of America, Version VII (MIA).
  - 2. Tile Council of North America (TCNA), "Handbook for Ceramic, Glass, and Stone Tile Installation," 2017 Edition.
- B. Sole source: For each type of setting material and grouting material specified, only one brand shall be used throughout project.

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

- A. Build mockup of **each type of** wall tile installation.
- B. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

### 1.7.1 DELIVERY, STORAGE AND HANDLING:

- A..Deliver materials in original containers with labels legible and intact, identifying brand name and contents.
- B..Manufactured mortars, adhesives and grouts shall bear hallmarks certifying compliance with specified standards.

### 1.7 JOB CONDITIONS:

- A.. Environmental requirements:  
For manufactured mortar, adhesive and grout, comply with minimum temperature recommendations of manufacturer's product data

### 1.8 WARRANTY:

- A. Setting/grouting system warranty: Provide setting/grouting manufacturer's system warranty against bond failure, cracking and installation/material defects. Warranty period shall be 10 years, beginning at Date of Substantial Completion. Form of warranty shall be as included in Division 00.

### 1.09. MAINTENANCE:

- A. Extra materials:
  - 1. Provide 5% of installed total of each type, size and color of tile specified and 5% of each type, size and color of accessory, for Owner's maintenance.
  - 2. Store tile and accessory units where indicated by Owner.

## PART 2 - PRODUCTS

### 2.1 Tile

- A. Manufacturer: Refer to Finish Schedule.
- B. Face Size As specified on the drawings.
- C. Finish: As specified on the drawings.
- D. Tile Color and Pattern: As specified on the drawings.
- E. Grout Color: As specified on the drawings.
- F. Trim Units: As specified on the drawings.

### 2.2 TILE BACKING PANELS

#### A. Cementitious Backer Units: ANSI A118.9 or ASTM C1325, Type A.

- 1. Manufacturer's include but are not limited to:
  - a. James Hardie
  - b. USG
- 2. Thickness: **5/8 inch (15.9 mm)**.

#### A. GROUTING MATERIALS:

- A. Premium rapid-setting high performance grout for joints from 1/16" to 1/2" wide:
  - 1. Acceptable products: As specified on the drawings.
  - 2. Characteristics:
    - a. Type: Cementitious grout meeting ANSI A118.7; sanded or unsanded as required by joint size.
    - b. Applications: Suitable for interior and exterior applications.
    - c. Compressive strength: Minimum 3,000 psi at 28 days.
    - d. Water absorption: Less than 5%.
    - e. Colors: Standard colors selected by Architect;

#### B. CONTROL AND EXPANSION JOINT MATERIALS:

- A. Acceptable products:
  - 1. BASF Building Systems, MasterSeal NP-2.
  - 2. Custom Building Products, 100% Silicone Sealant.
  - 3. Mapei Corp., MapeSil T.
  - 4. Pecora Corp., Dynatrol II
  - 5. Tremco, Inc.,
  - 6. Dymeri Improved Modified Dry-Set Mortar (Thinset): ANSI A118.15.
- B. Manufacturer's include but are not limited to the following:
  - 1. Laticrete International, Inc.– (Basis of Design).
  - 2. Ardex
  - 3. Custom Tile Installation Systems
- C. Provide prepackaged, dry-mortar mix to which only water must be added at Project site.
- D. Provide prepackaged, dry-mortar mix combined with liquid-latex additive at Project site.
- E. For wall applications, provide nonsagging mortar.
- F. Characteristics:
  - 1. Type; Contractor's option:
    - a. Urethane: Two-part, polyurethane-based sealant with separate pre-packaged color agent; meeting ASTM C920-14a, Type M, Grade NS, Class 25,

for use NT. VOC Content of not more than 250 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

- b. Silicone: One-part 100% silicone sealant meeting ASTM C920- 14a, Shore A Hardness of 35+, Type S, Grade NS, Class 25, Use T, I, M, NT and G and ASTM C794-15a properties.
- 2. Colors: Standard colors selected by Architect;
- G. Primer: Types recommended by sealant manufacturer's product data:
  - 1. Sealant primers for nonporous substrates: 250 g/L.
  - 2. Sealant primers for porous substrates: 775 g/L.
- H. Backup material: Flexible, non-compressive foam type as recommended by sealant manufacturer's product data.

C. Water-Cleanable, Tile-Setting Epoxy: ANSI A118.3.

### PART 3 - EXECUTION

#### 3.2 EXAMINATION:

- A. Suitable substrates:
  - 3.2.1.1 Concrete shall be fully cured and tested for moisture vapor emissions, humidity levels, and pH level as specified herein.
  - 3.2.1.2 Gypsum board products shall be properly installed and receive a Level 2 Finish as specified in Gypsum Board section.
- B. Conditions of surfaces to receive tile:
  - 3.2.1.3 Surfaces shall be firm, dry, smooth, clean, free of oily or waxy films, and suitable for tile installation.
  - 3.2.1.4 Grounds, anchors, plugs, hangers, bucks, electrical and mechanical work in or behind tile shall be installed prior to proceeding with tile work.
- C. Correction of conditions: Prior to installation, correct conditions that do not meet specified requirements and tile manufacture's requirements, or that may be detrimental to tile installation.

#### 3.3 GENERAL TILE INSTALLATION:

- A. Install tile in accord with ANSI A108.1 through A108.17 and as specified herein.
- B. Layout:
  - 1. Center tile within areas to avoid tiles of unequal widths at opposite walls and tiles of less than 1/2 tile width.
  - 2. Align tile joints straight and parallel to walls.
  - 3. Align joints in base and wall tile.
  - 4. Locate accessories, control joints and expansion joints before installing tile.
- C.. Cutting and fitting:
  - 1. Cut and drill tiles without damaging exposed tile face. Rub cut edges smooth with Carborundum stone.

2. Grind and fit tile at intersections, against trim and at built-in fixtures and accessories.
3. Fit tile around outlets, pipes, fixtures and fittings so that tile edges are concealed under applied escutcheons, collars or plates.
- 4.. Miter coved and bullnose tile in corners or use special trim shapes to maintain uniform joint widths.

D.. Joints:

- 1..Provide joint widths as indicated on drawings.
- 2..In internal vertical corners of wall tile and base, and where tile abuts dissimilar materials, form joints using control joint filled with sealant in lieu of groutWhere indicated, prepare substrates to receive waterproof membrane by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot (1:50) toward drains.
- 3..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.

### 3.4 INSTALLATION

- A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
  - i. Install tile in accord with ANSI A108.1 through A108.17 and as specified herein.
  - ii. Layout:
    1. Center tile within areas to avoid tiles of unequal widths at opposite walls and tiles of less than 1/2 tile width.
    2. Align tile joints straight and parallel to walls.
    3. Align joints in base and wall tile.
    4. Locate accessories, control joints and expansion joints before installing tile.
  - iii. Cutting and fitting:
    1. Cut and drill tiles without damaging exposed tile face. Rub cut edges smooth with Carborundum stone.
    2. Grind and fit tile at intersections, against trim and at built-in fixtures and accessories.
    3. Fit tile around outlets, pipes, fixtures and fittings so that tile edges are concealed under applied escutcheons, collars or plates.
    4. Miter coved and bullnose tile in corners or use special trim shapes to maintain uniform joint widths.

## iv. Joints:

1. Provide joint widths as indicated on drawings.
2. In internal vertical corners of wall tile and base, and where tile abuts dissimilar materials, form joints using control joint filled with sealant in lieu of grout.

## A. I Movement joints:

1. Ascertain that control joints, expansion joints and other movement joints are located in accord with approved shop drawings, TCNA EJ171-16, and as approved in advance by Architect.
2. Provide movement joints through tile and setting bed.
  - a. Provide movement joints at all perimeters.
  - b. Width of joints shall match width of grout joints, except control joint shall be not less than 1/8" wide.
3. Following tile work completion, seal joints in accord with TCNA EJ171-16, using specified sealant. Prime joints in accord with sealant manufacturer's product data.

## B. Tolerances:

1. Concrete substrate tolerances: Refer to the Cast-In-Place Concrete section and the Concrete Finishes section.
2. Allowable lippage: Comply with ANSI A108.02 as follows:
  - a. Glazed wall tile/mosaic tile: 1/32".
3. Allowable tile installation tolerances: Plumb, level and true to line, meeting ANSI A108.02 as follows:
  - a. For tile with all dimensions less than 15": Maximum 1/16" in 1'-0" and maximum 1/4" in 10'-0".
  - b. For tile with any dimension greater than 15": Maximum 1/16" in 2'-0" and maximum 1/8" in 10'-0".

## 3.5 TILE INSTALLATION:

## A. Wall tile and base, thinset over gypsum board and studs, interior:

1. Setting method: Premium polymer-modified thinset mortar.
2. Standard installation method: TCNA W243-16.
3. Grout types: Premium rapid-setting high performance grout.

## 3.6.. CLEANING AND PROTECTION:

- A.. Clean tile as work progresses, preventing accumulation of setting and grouting materials or debris on tile faces.
- B. Immediately remove stains, grout release agent, excess mortar, grout and sealant from faces of tile; comply with manufacturer's product data.
- C. Thresholds and glazed tile: Clean thresholds and glazed tile using

a solution of detergent and water only. Do not use acids or harsh cleaning agents to clean thresholds or glazed tile.

- D. Clean grout smears and haze from tile in accord with tile and grout manufacturer's product data.
  - 1. 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.
  - 2. Protect metal surfaces and plumbing fixtures from effects of cleaning.
  - 3. Flush surfaces with clean water before and after cleaning.
- E. Remove temporary protective coating by method recommended by coating manufacturer's product data and as acceptable to tile and grout manufacturer. Trap and remove coating to prevent drain clogging.
- F. Protection: Protect installed tile work until Date of Substantial Completion by covering with kraft paper.
- G.

END OF SECTION 093050



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## SECTION 095113 - ACOUSTICAL PANEL CEILINGS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes acoustical panels and exposed suspension systems for interior ceilings.

#### 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at [**Project site**] <**Insert location**>.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, and coordinated with each other, using input from installers of the items involved.
- B. Product test reports.
- C. Research reports.
- D. Field quality-control reports.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.

### PART 2 - PRODUCTS

- A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: Class **A** according to ASTM E1264.
  - 2. Smoke-Developed Index: **450** or less.

## 2.2 ACOUSTICAL PANELS

- A. Manufacturer's: Refer to finish schedule.
- B. Acoustical Panel Standard: Manufacturer's standard panels according to ASTM E1264.
- C. Classification: Per manufacturer's designation based on product specified on the drawings.
- D. Color: **As indicated in a schedule.**
- E. Light Reflectance (LR): Classification: Per manufacturer's designation based on product specified on the drawings.
- F. Ceiling Attenuation Class (CAC): Classification: Per manufacturer's designation based on product specified on the drawings.
- G. Noise Reduction Coefficient (NRC): Classification: Per manufacturer's designation based on product specified on the drawings.
- H. Articulation Class (AC): Classification: Per manufacturer's designation based on product specified on the drawings.
- I. Edge/Joint Detail: Classification: Per manufacturer's designation based on product specified on the drawings.
- J. Thickness: Classification: Per manufacturer's designation based on product specified on the drawings.
- K. Modular Size: Classification: Per manufacturer's designation based on product specified on the drawings.

## 2.3 METAL SUSPENSION SYSTEM

- A. Manufacturer: Per manufacturer's recommendation based on ceiling panel product specified on the drawings.
- B. Metal Suspension-System Standard: Manufacturer's standard, direct-hung, metal suspension system and accessories according to ASTM C635/C635M.
- C. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized, **G30 (Z90)** coating designation; with prefinished **15/16-inch- (24-mm-)** wide metal caps on flanges.
  - 1. Structural Classification: **Intermediate** duty system.
  - 2. End Condition of Cross Runners: **butt-edge**] type.
  - 3. Face Design: Flat, flush.
  - 4. Cap Material: **Cold-rolled steel.**
  - 5. Cap Finish: **Painted in color as selected from manufacturer's full range**

## 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.

## 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.

## PART 3 - EXECUTION

### 3.1 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.
- B. Layout openings for penetrations centered on the penetrating items.

### 3.2 INSTALLATION

- A. Install acoustical panel ceilings according to ASTM C636/C636M and manufacturer's written instructions.
- B. 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. Do not use exposed fasteners, including pop rivets, on moldings and trim.
  - 3. Arrange directionally patterned acoustical panels as follows:
    - a. As indicated on reflected ceiling plans.

END OF SECTION 095113

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## SECTION 096340 – NATURAL STONE FLOORING

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Section Includes:
  - 1. Dimension stone interior flooring.

## 1.3 PREINSTALLATION MEETINGS

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

## 1.4 ACTION SUBMITTALS

- A. Product Data: For each **variety of stone**, stone accessory, and manufactured product.
- B. Shop Drawings: Include plans, sections, details, and attachments to other work.
  - 1. Show locations and details of joints both within stone flooring and between stone flooring and other finish materials.
  - 2. Show direction of veining, grain, or other directional patterns.
- C. Samples for Initial Selection: For joint materials involving color selection.
- D. Samples for Verification:
  - 1. For each stone type indicated, in sets of Samples not less than **12 inches (300 mm)** square. Include at least **two** or more Samples in each set and show the full range of color and other visual characteristics in completed Work.
  - 2. For each color of **grout** or **pointing mortar** required.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.
- B. Material Test Reports:

1. Stone Test Reports: For **each** stone variety proposed for use on Project, by a qualified testing agency, indicating compliance with required physical properties, according to referenced ASTM standards. Base reports on testing within previous **five** years.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For stone flooring to include in maintenance manuals. Include product data for stone-care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

#### 1.7 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate stone flooring.
- B. Installer Qualifications: Fabricator of stone flooring.
- C. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for fabrication and execution.
  1. Build mockup of typical interior floor area **about 96 inches (2400 mm) square**..
  2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

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

## 1.9 FIELD CONDITIONS

- A. Maintain air and material temperatures to comply with requirements of installation material manufacturers, but not less than **50 deg F (10 deg C)** during installation and for seven days after completion.
- B. Cold-Weather Requirements for Exterior Stone Flooring: 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 ACI 530.1/ASCE 6/TMS 602.
- C. Hot-Weather Requirements for Stone Flooring: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602 and with the following:
  - 1. Maintain temperature of materials below **100 deg F (38 deg C)**.
  - 2. Do not apply mortar to substrates with temperatures of **100 deg F (38 deg C)** and above.
  - 3. When the ambient temperature exceeds **90 deg F (32 deg C)**, fog spray installed stone flooring until damp at least three times a day until flooring is three days old.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Source Limitations for Stone: Obtain **each variety of** stone, **regardless of finish**, from single quarry with resources to provide materials of consistent quality in appearance and physical properties.
  - 1. For stone types that include same list of varieties and sources, provide same variety from same source for each.
- B. STONE:
  - 1. Refer to Finish schedule.
- C. Material Standards:
  - 1. Maximum Absorption according to ASTM C97/C97M.
  - 2. Minimum Compressive Strength according to ASTM C170/C170M.
  - 3. Minimum Flexural Strength according to ASTM C880/C880M.
  - 4. Minimum Modulus of Rupture according to ASTM C99/C99M.
  - 5. Stone Abrasion Resistance: Minimum value of **10**, based on testing according to ASTM C241/C241M or ASTM C1353.
- D. Match Architect's samples for color, finish, and other stone characteristics relating to aesthetic effects.

### 2.2 MORTAR MATERIALS

- A. Medium bed Mortar for floors:



1. Medium-Bed Modified Dry-Set Mortar: ANSI A118.4. Provide product that is approved by manufacturer for application thickness of
2. Water: Potable.

B. GROUT

1. Grout Colors: Refer to finish schedule.
  1. Unsanded grout mix for joints 1/8" and narrower.

C. Sanded grout mix for joints wider than 1/8".

2.3 ACCESSORIES

A. Water-Cleanable Epoxy Adhesive: ANSI A118.3.

- 1.

B. Joint Sealants: Manufacturer's standard sealants that comply with applicable requirements in Section 079200 "Joint Sealants" and will not stain the stone they are applied to.

1. Use mildew-resistant joint sealant at plumbing fixtures and for control and expansion joints in toilet rooms.
2. Colors: Provide colors of exposed sealants to match other joints in stone adjoining sealed joints unless otherwise indicated.

C. Cleaner: Stone cleaner specifically formulated for stone types, finishes, and applications indicated, as recommended by stone producer **and by sealer manufacturer**. Do not use cleaning compounds containing acids, caustics, harsh fillers, or abrasives.

D. Sealer: Colorless, slip- and stain-resistant sealer that does not affect color or physical properties of stone surfaces, as recommended by stone producer for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to receive stone flooring and conditions under which stone flooring will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of stone flooring.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of stone flooring.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. **Vacuum** concrete substrates to remove dirt, dust, debris, and loose particles.
- B. Remove substances from concrete substrates that could impair mortar bond, including curing and sealing compounds, form oil, and laitance.
- C. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped **1/4 inch per foot (1:50)** toward drains.
- D. Before setting stone, clean dirty or stained stone surfaces by removing soil, stains, and foreign materials. Clean stone by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives.

### 3.3 INSTALLATION, GENERAL

- A. Do necessary field cutting as stone is set. Cut lines straight and true, and finish field-cut edges to match shop-cut edges.
  - 1. Use power saws with diamond blades to cut stone.
- B. Scribe and field cut stone as necessary to fit at obstructions. Produce neat joints of size specified or indicated.
- C. Provide control and expansion joints of widths and at locations indicated. Keep control and expansion joints free of mortar, grout, and other rigid materials.

### 3.4 INSTALLATION TOLERANCES

- A. Variation in Joint Width: Do not vary from average joint width more than plus or minus one-fourth of nominal joint width.
- B. Variation in Surface Plane: Do not exceed maximum from level or slope indicated.
- C. Variation in Plane between Adjacent Units (Lipping): Do not exceed difference between planes of adjacent units..

### 3.5 INSTALLATION OF STONE BONDED TO CONCRETE

- A.. Install stone tile medium bed mortar in accord with mortar manufacturer's product data.

### 3.6 I

### 3.7 GROUTING

- A. Grout stone joints to comply with ANSI A108.10 and with manufacturer's written instructions.

1. Do not use sanded grout for polished stone.
2. Grout joints as soon as possible after initial set of setting bed. Force grout into joints, taking care not to smear grout on adjoining stone and other surfaces. After initial set of grout, finish joints by tooling to produce a slightly concave polished joint, free of drying cracks.

### 3.8 ADJUSTING AND CLEANING

- A. Remove and replace stonework of the following description:
  1. Broken, chipped, stained, or otherwise damaged stone. Stone may be repaired if methods and results are approved by Architect.
  2. Defective joints.
  3. Stone flooring and joints not matching approved Samples and mockups.
  4. Stonework not complying with other requirements indicated.
- B. Replace in a manner that results in stonework matching approved Samples and mockups, complying with other requirements, and showing no evidence of replacement.
- C. In-Progress Cleaning: Clean stonework as work progresses. Remove **mortar fins and smears** before tooling joints.
- D. Clean stonework after setting and **pointing** and **grouting** are complete. Use procedures recommended by stone fabricator for application types.
- E. Apply sealer to cleaned stonework according to sealer manufacturer's written instructions.

### 3.9 PROTECTION

- A. Prohibit traffic from installed stone for a minimum of 72 hours.
- B. Protect installed stonework during construction with nonstaining kraft paper. Where adjoining areas require construction work access, cover stonework with a minimum of **3/4-inch (20-mm)** untreated plywood over nonstaining kraft paper.

END OF SECTION 096340

## SECTION 096500 – VINYL LUXURY TILE

## LUXURY VINYL TILE 096500

## Part 1 – General

- 1.1 RELATED DOCUMENTS: Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to work of this section.
- 1.2 DESCRIPTION OF WORK: Extent of luxury vinyl tile flooring and accessories is shown on drawings and in Room Finish Schedules.
- 1.3 QUALITY ASSURANCE: Manufacturer: Provide each type of luxury vinyl tile and accessories as produced by a single manufacturer, including recommended primers, adhesives, sealants and leveling compounds.
- 1.4 Product shall have a 20 year commercial wear warranty.
- 1.5. Fire Test Performance: Provide luxury vinyl tile flooring which complies with the flooring fire test performance criteria as determined by an independent testing laboratory acceptable to authorities having jurisdiction.
- 1.6. Flame Spread: > 0.45 watts/cm<sup>2</sup> Class I – ASTM E-648 Smoke Density: < 450 per ASTM E 662
- 1.7 SUBMITTALS:
  - A. Product Data: Submit manufacturer's technical data for each type of luxury vinyl tile and accessory. Samples for initial Selection Purposes:
  - B. Submit manufacturer's standard color charts in form of actual sections of luxury vinyl tile, including accessories, showing full range of colors and patterns available, for each type of luxury vinyl tile required.
  - C. Samples for Verification Purposes: Submit the following samples of each type, color and pattern of luxury vinyl tile required, showing full range of color and pattern variations.
  - D. Full size tile samples. 6" long samples of resilient bases, including preformed corners. 6" long samples of resilient edge strips. 2 ½" long samples of luxury vinyl tile accessories.
  - E. Other materials, such as stair tread units, etc., as required.
  - F. Bond and Moisture Tests: Submit location diagrams and results. It is essential that moisture tests be taken on all concrete floors regardless of the age or grade level. Check moisture content does not exceed 2.5% by weight (calcium carbide test method) or moisture emissions do not exceed 5 lbs. Water/24 hours/1000 sq. ft. (calcium chloride test method) by conducting moisture tests, around the perimeter of the room, at columns and where moisture may be evident. Calcium chloride tests and/or calcium carbide tests must be done in accordance with ASTM F-1869 and to instructions. It is the responsibility of the contractor to provide adequate moisture testing by an independent agency acceptable to the floor covering manufacturer for products specified within this document
  - G. Maintenance Instructions: Submit two copies of manufacturer recommended maintenance practices for each type of luxury vinyl tile flooring and accessory required.
- 1.8 PROJECT CONDITIONS: Maintain minimum temperature as instructed by material manufacturers but not less than 65 ° F (18 ° C) in spaces to receive luxury vinyl tile for at least 48 hours prior to installation, during installation and for not less than 48 hours after installation. Store luxury vinyl tile materials in spaces where they

will be installed for at least 48 hours before beginning installation. Subsequently, maintain minimum temperature of 55 °F (13 ° C) in areas where work is completed. Install luxury vinyl tile and accessories after other finishing operations, including painting, have been completed. Do not install luxury vinyl tile over concrete slabs until the latter have been cured and are sufficiently dry to achieve bond with adhesive as determined by the luxury vinyl tile manufacturer's recommended bond and moisture test. Do not take tests later than ten days prior to scheduled installation. Notify Architect immediately of unsatisfactory conditions.

## PART 2 – PRODUCTS:

2.1 Manufacturer: Refer to the finish schedule for manufacturer.

- A. LUXURY VINYL TILE COLORS AND PATTERNS: Provide color and patterns as indicated on the finish schedule, or if not indicated as selected by Architect from manufacturer's standards.

## PART 3 – EXECUTION

3.1 INSPECTION: Installer shall inspect subfloor surfaces to determine that they are satisfactory. A satisfactory subfloor surface is defined as one that is smooth and free from cracks, holes, ridges, or coatings preventing adhesive bond and other defects impairing performance or appearance. Report unsatisfactory subfloor surfaces to the General Contractor, in writing, prior to commencing work.

- A. Concrete subfloors: Verify that concrete slabs comply with ASTM F710 and the following: Slab substrates are dry and free of curing compounds, sealers, hardeners and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by flooring manufacturer. Do not allow luxury vinyl tile work to proceed until subfloor surfaces are satisfactory. Report unsatisfactory concrete surfaces to the General Contractor, in writing, prior to commencing work.

### 3.2 PREPARATION:

- A. Prepare subfloor surface as follows: Inspection of existing sub—floor: A solid, dry, clean sub-floor is required for the installation of all materials. All wax and finishes shall be removed prior installation of material. Use cementitious leveling and patching compounds as recommended by luxury vinyl tile manufacturer for filling small cracks, holes and depressions and leveling subfloors. The flooring contractor shall be responsible for leveling new or existing floors whose surface varies up to 5/16". Notify , in writing, General Contractor in writing where substrate varies more than above before proceeding with the work. Gypsum based leveling compounds will not be accepted, Synthetic based gypsum such as Schonox is an acceptable product. Use cementitious leveling and patching compounds as recommended by luxury vinyl tile manufacturer for filling small cracks, holes and depression in subfloors. All loose and cracked existing tile shall be removed and filled smooth with leveling compounds.
- B. Remove coatings from subfloor surfaces that would prevent adhesive bond, including curing compounds incompatible with luxury vinyl tile adhesives, paints, oils, waxes and sealers. Floors shall be rinsed at least twice and allowed to dry for a minimum of 48 hours. Broom clean or vacuum surfaces to be covered, and inspect subfloor.

### 3.3 INSTALLATION

- A. GENERAL: Installer verification: All materials should be installed by a professional flooring mechanic, preferably one who has attended an installation clinic or a Master Mechanic Training Seminar. Field verification: Field verify, prior to installation, exact layout dimensions of all seams, floor patterns, grain directions and insets with Architect. Start of work without Architect acceptance of field verification shall be not permitted and unauthorized installations shall be replaced at Contractors expense. Where moveable partitions are shown, install luxury vinyl tile before partitions are erected. Install flooring using method indicated in strict compliance with manufacturer's printed instructions. Extend flooring into toe spaces, door reveals and into closets and similar openings. Scribe, cut and fit luxury vinyl tile to permanent fixtures built

in furniture and cabinets, pipes, outlets and permanent columns, walls and partitions. Maintain reference markers, holes or openings that are in place or plainly marked for future cutting by repeating on finish flooring as marked on subfloor. Use chalk or other non-permanent marking device. Install flooring on covers for telephone and electrical ducts, and other such items as occur within finished floor areas. Maintain overall continuity of color and pattern with pieces of flooring installed on these covers. Tightly cement edges to perimeter of floor around covers and to covers. Tightly adhere flooring to subbase without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks or other surface imperfections. Hand roll flooring at perimeter of each covered area to assure adhesion.

**B. INSTALLATION OF TILE FLOORS:** Lay tile from center marks established with principal walls, discounting minor offsets, so that tile at opposite edges of room are of equal width. Adjust as necessary to avoid use of cut widths less than 1/2 tile at room perimeters. Lay tile square to room axis, unless otherwise shown. Confirm with Custom direction of tile prior to installation. Match tiles for color and pattern by using tile from cartons in same sequence as manufactured and packaged if so numbered. Cut tile neatly around all fixtures. Broken, cracked, chipped or deformed tiles are not acceptable. Lay tile with grain running in one direction unless shown or directed otherwise. Verify grain directions with Architect prior to installation. Adhere tile flooring to substrates using full spread of adhesive applied in compliance with flooring manufacturer's directions. On all floor penetrations cutouts and edge conditions, such as door frames, fill voids between tile floor and other surfaces with sealant recommended by tile manufacturer. Transition section at paving junction: Visedge VR by Howie Green is designed to securely anchor the perimeter of tile flooring to prevent ingress of water at the interface with the screed and to protect the ceramic floor edge profile.

Bond as indicated on the drawings on the finish schedule,

Failure to install and maintain products in accordance with recommended procedures can affect the performance of the product. Comply with manufacturer's installation instructions..

**3.4 INSTALLATION OF ACCESSORIES:** Apply wall base to walls, columns, pilasters, casework and other permanent fixtures in rooms or areas where base is required. Install base in lengths as long as practicable, with preformed corner units. Tightly bond base to substrate throughout length of each piece, with continuous contact at horizontal and vertical surfaces. On masonry surfaces, or other similar irregular substrates, fill voids along top edge of resilient wall base with manufacturer's recommended adhesive filler material. Place resilient edge strips tightly butted to flooring and secure with adhesive. Install edging strips at edges of flooring which would otherwise be exposed. Apply resilient accessories to stairs in strict accordance with manufacturer's installation instructions.

**3.5 CLEANING AND PROTECTION:** Perform following operations immediately upon completion of luxury vinyl tile: Sweep or vacuum floor thoroughly. Do not wash floor until time period recommended by luxury vinyl tile manufacturer has elapsed to allow luxury vinyl tile to become well adhered. Spray budding using a white or lamb's wool pad is also a very effective and economical method of maintaining a high standard of appearance. Damp mop floor being careful to remove black marks and excessive soil. Remove any excess adhesive or other surface blemishes, using appropriate cleaner recommended by flooring manufacturers. Protect flooring against damage during construction period to comply with luxury vinyl tile manufacturer's directions. If required by owner, apply protective floor polish to luxury vinyl tile surfaces free from soil, excess adhesive or surface blemishes. Use commercially available metal cross-linked acrylic product acceptable to luxury vinyl tile manufacturer. Protect flooring against damage from rolling loads for initial period following installation by covering with plywood or hardboard. Use dollies to move stationary equipment or furnishings across floors. Cover luxury vinyl tile with undyed, untreated building paper until inspection for Substantial Completion. Clean luxury vinyl tile not more than four days prior to date scheduled for inspections intended to establish date of Substantial Completion in each area of project. Clean resilient flooring by method recommended by luxury vinyl tile manufacturer.

**3.6 EXTRA MATERIALS:** Furnish extra maintenance materials to Owner. Furnish extra materials from same manufactured lot as materials installed. Deliver to Owner enclosed in protective packaging with appropriate identifying labels. Tile Flooring: Furnish not less than one box for 50 boxes or fraction thereof, for each type,

color, pattern and size installed. Resilient Accessories: Furnish not less than ten linear feet for each 500 linear feet or fraction thereof, of each type, size, color and pattern installed.

END OF SECTION 096500

## SECTION 096513 - RESILIENT BASE AND ACCESSORIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Rubber base.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

### PART 2 - PRODUCTS

#### 2.1 -RUBBER BASE :

A. Refer to the finish schedule.

B. Product Standard: ASTM F1861, Type TS (rubber, (solid, homogeneous).

1. Style and Location: Refer to the finish plan.

C. Thickness: **0.125 inch (3.2 mm)**.

D. Height: Refer to the finish schedule

E. Lengths: **Cut lengths 48 inches (1219 mm) long or coils in manufacturer's standard length.**

F. Outside Corners: **Preformed.**

G. Inside Corners: **Job formed.**

H. Colors: Refer to the finish schedule

#### 2.2 MOLDING ACCESSORIES

A. Refer to the finish schedule for products, manufacturer's and descriptions.

B. Profile and Dimensions: **As indicated** on the drawings.

C. Locations: **Provide molding accessories in areas indicated on the finish schedule.**



- D. Colors and Patterns: **As indicated on the finish schedule.**

## 2.3 INSTALLATION MATERIALS

- A. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

## 2.4 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- C. Do not install resilient products until materials are the same temperature as space where they are to be installed.
- D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

## 2.5 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Preformed Corners: Install preformed corners before installing straight pieces.
- H. Job-Formed Corners:
  - 1. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than **3 inches (76 mm)** in length.
    - a. **Miter** corners to minimize open joints.

2.6 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

2.7 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 096513

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## SECTION 096519 - RESILIENT TILE FLOORING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Vinyl composition floor tile.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and pattern specified.

#### 1.3 CLOSEOUT SUBMITTALS

- A. Maintenance data.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for floor tile installation.

### 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 E648 or NFPA 253 by a qualified testing agency.
  - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

#### 2.2 SOLID VINYL FLOOR TILE

- A. Manufacturer: Refer to the finish schedule.
- B. Tile Standard: ASTM F1700.
  - 1. Class: Type and Size: **As indicated by product designations.**
- C. Colors and Patterns: **As indicated by manufacturer's designations.**

## 2.3 VINYL COMPOSITION FLOOR TILE

- A. : Refer to the finish schedule.Manufacturer”
- B. Tile Standard: ASTM F1066,
- C. Wearing Surface: **As indicated by manufacturer's designations for product specified.**
- D. Thickness: As indicated by manufacturer's designations for product specified.
- E. Size: **12 by 12 inches (305 by 305 mm).**
- F. Colors and Patterns: As indicated by manufacturer's designations for product specified..

## 2.4 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.
- C. Floor Polish: Provide protective, liquid floor-polish products recommended by floor tile manufacturer.

## PART 3 - EXECUTION

### 3.1 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 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 adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
  - 3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than **9** pH.
  - 4. Moisture Testing: Perform tests so that each test area does not exceed [**200 sq. ft. (18.6 sq. m)**] [**1000 sq. ft. (304.8 sq. m)**] <Insert area>, 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. (1.36 kg of water/92.9 sq. m)** in 24 hours.

- b. **Relative Humidity Test:** Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum **75** percent relative humidity level measurement.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install 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.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

### 3.2 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.
  - 1. Lay tiles **in pattern indicated**.
- 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.
  - 1. Lay tiles **in pattern of colors and sizes indicated**.
- 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.
- G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.
- H. Adhere floor tiles 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. Floor Polish: Remove soil, adhesive, and blemishes from floor tile surfaces before applying liquid floor polish.
  1. Apply **two** coat(s).

END OF SECTION 096519

## SECTION 096813 - 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**.

## 1.3 ACTION SUBMITTALS

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

- B. Sustainable Design Submittals:

- C. 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.

- D. Samples: For each exposed product and for each color and texture required.

## 1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.

- B. Sample warranty.

## 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.



## 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Certified by the International Certified Floorcovering Installers Association at the **Commercial** certification level.

## 1.7 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 Period: **10** years from date of Substantial Completion.

## PART 2 - PRODUCTS

## 2.1 CARPET TILE

- A. Product: Match Architect's product specification appearing on the drawings.
- B. The following product components shall be in conformance with the product specified on the drawings.
1. Color Match Architect's product specification appearing on the drawings.
  2. Pattern: In accordance with the product specified on the drawings.
  3. Fiber Content: Meet the requirements of the product specified on the drawings.
  4. Fiber Type: In accordance with the product specified on the drawings.
  5. Pile Characteristic: In accordance with the product specified on the drawings.
  6. Yarn Twist: In accordance with the product specified on the drawings.
  7. Yarn Count: In accordance with the product specified on the drawings.
  8. Density: In accordance with the product specified on the drawings
  9. Pile Thickness: In accordance with the product specified on the drawings **according to ASTM D6859.**
  10. Stitches: In accordance with the product specified on the drawings.
  11. Gage: < In accordance with the product specified on the drawings.
  12. Surface Pile Weight: Per requirements of manufacturer's product specified on the drawings.
  13. Total Weight: Per requirements of manufacturer specified on the drawings.
- C. Primary Backing/Backcoating: **Manufacturer's standard composite materials**
- D. Secondary Backing: **Manufacturer's standard material.**
- E. Size: In accordance with the product specified on the drawings.
- F. Critical Radiant Flux Classification: Not less than **0.22 W/sq. cm** according to NFPA 253.
- G. Dry Breaking Strength: Not less than **100 lbf (445 N)** according to ASTM D2646.
- 2.2 INSTALLATION ACCESSORIES
- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

- B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

##### A. Concrete Slabs:

1. Moisture Testing: Perform tests so that each test area does not exceed **1000 sq. ft. (304.8 sq. m)**, and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
  - a. Relative Humidity Test: Using in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum **75** percent relative humidity level measurement.
  - b. Perform additional moisture tests recommended in writing by adhesive and carpet tile manufacturers. Proceed with installation only after substrates pass testing.

#### 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 (3 mm)** wide or wider, and protrusions more than **1/32 inch (0.8 mm)** unless more stringent requirements are required by manufacturer's written instructions.
- C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.
- D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

#### 3.3 INSTALLATION

- A. General: Comply with the Carpet and Rug Institute's CRI 104, Section 10, "Carpet Tile," and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: **As recommended in writing by carpet tile manufacturer.**
- C. Maintain dye-lot integrity. Do not mix dye lots in same area.
- D. Maintain pile-direction patterns **indicated on Drawings.**
- 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.
- I. 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 096813

## SECTION 099000 – PAINTING AND COATING

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes surface preparation and the application of paint systems on **the following**:
1. Work of this section includes:
  2. Touching up of shop-applied prime coats.
  3. Preparation of surfaces to receive finishes.
  4. Painting, staining or otherwise finishing of surfaces, except as otherwise indicated.
  5. Priming, back priming and finishing of exterior and interior finish carpentry.
- B. Related work specified elsewhere:
1. Shop-applied primer coats.
  2. Joint sealants.
  3. Wall coverings.
  4. Special finishes.
  5. Piping identification.
  6. Prefinished items.
  7. Elastomeric coatings.

## 1.2 DEFINITIONS:

- A. Properly painted surface: The painting contractor shall produce properly painted surfaces as herein defined, and shall obtain Architect's approval of all surfaces.
1. A "properly painted surface" is defined as uniform in appearance, color, texture, hiding and sheen.
  2. Surfaces shall be free of foreign material, lumps, skins, runs, sags, holidays, misses, or insufficient coverage.
  3. Surfaces shall be free of drips, spatters, spills or overspray caused by the painting contractor's workforce.
  4. To determine whether a surface has been "properly painted", the surface shall be examined without magnification at a distance of thirty-nine (39) inches or one (1) meter, or more, under finished lighting conditions and from a normal viewing position.
- B. Standard coating terms: As defined in ASTM D16-14.
- C. Commercial: Painter grade products.
- D. DFT: Dry film thickness of the coating.
- E. Premium: Best quality product (top of the line)ACTION SUBMITTALS
- F. VOC: Volatile Organic Compounds found in primers, paints, sealers and stains. VOC levels are designated in grams per liter (g/L).

## 1.3 PERFORMANCE REQUIREMENTS:

- A. DFT for each primer, paint, sealer and stain shall be as recommended by product manufacturer's product data.
- B. VOC Content: For field applications that are inside the weather-proofing system, paints and coatings shall comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:

## 1.2 SUBMITTALS:

- A. Product data:
  - 1. Submit complete list of products proposed for use at least 30 days prior to commencement of painting work.
  - 2. Indicate manufacturer, brand name, quality, type, and sheen for each type of paint and for each surface to be finished. Indicate VOC rating and compliance with applicable regulations.
  - 3. Indicate manufacturer's instructions regarding mixing, surface preparation and application. Include application rates, film thickness and required primers.
  - 4. Intent of Contractor to use products specified does not relieve him from responsibility of submitting product list.
- B. Card stock brush-outs: Prepare two sets of color coat brush-outs for each paint and stain color and sheen scheduled, applying actual finish color coat to standard sample card stock, minimum 80 sq. in. size.
- C. Substrate brush-outs:
  - 1. In addition to color coat brush-outs, submit one actual brush-out sample application for each paint and stain type, color and sheen as applicable to the following substrates.
  - 2. Apply complete finish system in the number of coats specified, to the actual substrate material or simulated material indicated; allow 1" offset of each successive coat along one edge to illustrate successive applications.
    - a. Concrete unit masonry: One face of a concrete block of type and texture used on the project.
    - b. Gypsum board, concrete and smooth finish stucco: Apply over gypsum board, 1'-0" by 1'-0" size, edges taped and sanded.
    - c. Metals: Apply over hardboard, 1'-0" by 1'-0" size.
    - d. Painted wood: Wood stock typical of type, color and cut used on the project, minimum 6" wide by 1'-0" long.
    - e. Stained or transparent finished wood: Wood stock typical of type, species, grade, color and cut used on project, minimum 6" wide by 1'-0" long.

### 1.3 QUALITY ASSURANCE:

- A. Applicable standards:
1. American Coatings Association (ACA), Gloss Standard.
  2. ASTM International (ASTM), as referenced herein.
  3. American National Standards Institute (ANSI) Performance Standards.
  4. Environmental Protection Agency (EPA), volatile organic compounds (VOC) standards as required by local codes and regulations.
  5. Master Paint Institute (MPI) established paint categories and standards.
  6. Occupational Safety & Health Act (OSHA) Safety Standards.
  7. Ozone Transmission Commission (OTC) established levels of Volatile Organic Compounds.
  8. Paint Decorating Contractors of America (PDCA) Application Standard, P1 Standard and P5 Standard.

### 1.4 DELIVERY, STORAGE AND HANDLING:

- A. Delivery: Deliver materials to project site ready-mixed in original containers with labels intact; labels bearing manufacturer's name, paint type, color and recommended installation and reducing procedures.
- B. Storage and handling:
1. Store materials in location acceptable to Architect.
  2. Coating materials and thinners stored on site shall be kept in a clean, secure and climate controlled area.
  3. Labels shall remain on containers used to hold primers, paints or stains while on site. Containers without labels shall be disposed of.
  4. Product name, number, health and safety information, and precautions shall be legible at all times during storage and use.
  5. Close containers at end of day's work. Leave no materials open.
- C. Waste management and disposal:
1. Disposal containers for recycled materials must be established on site.
  2. Dispose of rags containing solvent, daily.
  3. Dispose of hazardous coatings in accord with state, county and local regulations for hazardous waste disposal.

### 1.5 PROJECT/SITE CONDITIONS:

- A. Environmental requirements:
1. Comply with manufacturer's product data as to environmental conditions under which materials may be applied.
  2. Apply no materials in spaces where dust is being generated.
  3. Comply with applicable VOC regulations.
- B. Protection: Cover finished work of other trades and surfaces not

being painted concurrently and prefinished items.

- C. Safety precautions:
1. Provide temporary fire protection equipment in materials storage area.
  2. Prohibit smoking in storage area.

#### 1.6 MAINTENANCE:

- A. Extra materials:
1. Provide one gallon of each type and color of paint and stain in full unused cans.
  2. Cans shall be marked with color name, number and type of paint and stain.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS:

- A. Acceptable manufacturers: Except as otherwise noted, products specified as a standard of quality are manufactured by PPG Paints. Products of the following manufacturers similar in type and quality are acceptable for use, subject to approval of product list:
1. PPG Paints.
  2. Benjamin Moore Co.
  3. Sherwin-Williams Co. (Basis of Design)
- B. Where products other than those of the manufacturer listed as the standard of quality are specified in Painting Schedule, such products have been selected to achieve specific results and substitutions will be allowed only in accord with Product Substitution Procedures section.

### 2.2 PAINTING MATERIALS:

#### A.. Miscellaneous materials:

1. Paint thinners and tints shall be products of same manufacturer as paints or approved by him for use with his products.
  - a. Shellac, turpentine, patching compounds and similar materials required for execution of work shall be pure, best quality products.

- B.. Paint and stain colors shall be as indicated on Color Schedule with final approval based on brush-out submittal

## PART 3 - EXECUTION

### 3.1 PREPARATION:

- A. Surfaces to receive finishes shall be dry and free of debris, oils, dust or other deleterious materials.

- B. Where finish materials abut or are abutted by dissimilar materials, caulk joints in accord with Joint Sealants section.
- C. Lumber, plywood and veneered wood surfaces:
1. Apply shellac, maximum two pounds cut to knots, pitch and resinous sapwood prior to application of first paint or stain coat.
  2. For surfaces to receive opaque finish, fill nail holes, cracks, joints and defects with spackling compound. Apply after first coat of paint.
  3. For surfaces to receive transparent finish, fill nail holes, cracks and defects with wood filler matching finish color.
  4. Sand surfaces smooth except where rough sawn surfaces are indicated. Final step shall remove scuffs, handling marks and effects of moisture exposure. Dust to remove debris.
    - a. Sand plane surfaces using sanding block; touch sand moldings in manner preventing removal of sharp edges or obscuring profile.
    - b. Moldings cut with machine finish or minimum 16 knife cuts per inch shall not require further sanding except to correct irregularities.
    - c. Sand surfaces within normal visual range, including surfaces within 10'-0" of floor level, using not less than 80 grit abrasive exterior or 100 grit abrasive interior, except increase to 120 to 180 grit abrasive for transparent finished interior surfaces.
    - d. Install prefinished or presurfaced items following finishing or sanding of adjacent surfaces. Replace prefinished items damaged by finishing of adjacent work.
- D. Gypsum board:
1. Fill narrow, shallow cracks and small holes with patching compound. Allow to dry and sand smooth without raising nap of gypsum board paper.
  2. Gypsum board shall be finished as specified in Gypsum Board section prior to painting.
  3. Portland cement plaster (Stucco):
  4. Allow surfaces to cure a minimum of 30 days before applying first coat of paint.
  5. Surfaces shall be dry prior to applying first paint coat. Moisture level shall be acceptable to paint manufacturer when tested by a moisture meter.
  6. Perform pH testing to determine alkalinity of substrates prior to painting application; comply with paint manufacturer's product data.
  7. Fill narrow, shallow cracks and small holes with patching plaster. Allow to dry and sand smooth.
  8. Cut out map cracks and repair to same plane and finish as original work.
- E. Concrete:
1. Fill cracks, holes and irregularities with cement grout.
  2. Remove laitance, oil, grease, dirt and debris from surfaces. Allow concrete to cure prior to paint application.
- F. Concrete unit masonry: Rub to remove loose mortar and debris. Fill irregularities with cement grout.
- G. Galvanized metals:
1. Test for passivator or stabilizer using copper sulfate solution (20 grams of copper sulfate in one liter of water). If passivator or stabilizer is present, remove by brush blasting, sanding or chemical etching.
  2. Wash with xylol to remove grease, oil and contaminants. Wipe dry with clean cloth.



- H. Aluminum:
  - 1. Sand or scrape to remove oxides.
  - 2. Wash with xylol to remove grease, oil and contaminants. Wipe dry with clean cloth.
- I. Ferrous Metals:
  - 1. Wire-brush or sandpaper to remove rust and mill scale.
  - 2. Solvent-clean with xylol to remove grease, oil and contaminants. Wipe dry with clean cloth.

### 3.2 APPLICATION:

- A. Apply paint only when moisture content of surfaces is within limits recommended in product data. Apply paint materials using clean brushes, rollers or spraying equipment.
- B. Apply materials at rate not exceeding that recommended in product data for surface being painted, less ten percent for losses.
- C. Comply with product data for drying time between coats.
- D. Sand and dust between coats to remove defects visible from a distance of 5'-0".
- E. Finish coats shall be smooth, free of brush marks, streaks, laps or pile-up of paint, skipped or missed areas. Do not apply additional coats until completed coat has been observed by Architect. Only these coats of paint will be considered in determining number of coats applied.
- F. Make edges of paint adjoining other materials or colors clean and sharp without overlapping.
- G. Primer coats may be omitted for surfaces specified to receive factory-applied primer, if primer is compatible with finish coats. If primer coats are not compatible, substitute a bond coat as recommended by paint manufacturer for specified primer coat.
- H. Where two-coat finish is specified, prime coat shall be tinted to approximate finish color.
- I. Where portion of finish on gypsum board partition is damaged or unacceptable, refinish entire surface of partition.
- J. Seal tops and bottoms of interior doors with prime coat only; side edges same as faces.
- K. Finish top, bottom and side edges of exterior doors same as faces.
- L. Paint inside of ductwork flat black for entire area visible through ceiling openings. Paint underside of ductwork and other above-ceiling items flat black for entire area visible through ceiling openings.
- M. Paint exposed piping and ductwork in painted spaces same as adjacent wall surfaces.
- N. Paint exposed grilles and registers in public spaces.
- O. Paint walls, exposed structure, handrails and exposed ductwork and piping in stairwells.

- P. Remove and protect hardware, accessories, device plates, lighting fixtures, factory-finished work and similar items, or provide in-place protection. Upon completion of each space, replace removed items.
- Q. Back prime finish carpentry with material specified for prime coat, without runs on face. Finish cut edges prior to installation.
- R. Unless otherwise indicated, paint ground mounted mechanical, plumbing and electrical equipment, including prefinished equipment.
- S. The following surfaces do not require painting:
  - 1. Prefinished and factory-finished surfaces and items, except where indicated otherwise.
  - 2. Concealed ductwork, conduit and piping.

### 3.3 EXTERIOR PAINT SCHEDULE:

- A. Concrete (Other Than Concrete Unit Masonry): Provide the following finish systems over exterior concrete substrates.
  - 1. Low-luster acrylic finish:
    - a. First coat: PPG; 4-603 Perma-Crete Int/ Ext Alkali Resistant Primer (88 g/L VOC); 1.2 to 1.5 Dry Mills.
    - b. Second coat: PPG; 6-2045XI Series SpeedHide Exterior Satin Acrylic Latex (<50 g/L VOC); 1.4 Dry Mills.
    - c. Third coat: PPG; 6-2045XI Series SpeedHide Exterior Satin Acrylic Latex (<50 g/L VOC); 1.4 Dry Mills. Portland cement plaster (Stucco)
- B. Masonry; CMU: Concrete, Split Face, Scored, Smooth, High Density, Low Density, Fluted, and Stucco.
  - 1. Urethane Systems; Waterbased:
    - a. 1st Coat: S-W Heavy Duty Block Filler, B42W46 (18.0-34.0 mils wet, 10.0-18.0 mils dry).
    - b. 2nd Coat: S-W Pro Industrial Waterbased Acrolon 100 Gloss, B65-720 Series.
    - c. 3rd Coat: S-W Pro Industrial Waterbased Acrolon 100 Gloss, B65-720 Series (4.0-8.0 mils wet, 1.8-3.6 mils dry per coat).
  - 2. Note: 1<sup>st</sup> Coat may be omitted on previously painted surfaces.
  - 3. Note: Sheen as selected by architect.
- C. Ferrous metal: Provide the following finish systems over exterior ferrous metal. Primer is not required on shop-primed items.
  - 1. Semi-gloss acrylic-enamel finish:
    - a. First coat: PPG; 90-712 Series Pitt-Tech Int/Ext Industrial DTM Primer/Finish Enamel (123 g/L VOC compliant as anti-corrosive product); 2.0 to 3.0 Dry Mills.
    - b. Second coat: PPG; 90-1210 Series Pitt-Tech Plus Int/Ext Semi- Gloss DTM Industrial Enamels (90 g/L VOC compliant as anti- corrosive product); 2.0 to 4.0 Dry Mills.
    - c. Third coat: PPG; 90-1210 Series Pitt-Tech Plus Int/Ext Semi- Gloss DTM Industrial Enamels (90 g/L VOC compliant as anti- corrosive product); 2.0 to 4.0 Dry Mills.

- D. Zinc-coated metal: Provide the following finish systems over exterior zinc-coated metal surfaces:
1. Semi-gloss acrylic-enamel finish:
    - a. First coat: PPG; 90-712 Series Pitt-Tech Int/Ext Industrial DTM Primer/Finish Enamel (123 g/L VOC compliant as anti-corrosive product); 2.0 to 3.0 Dry Mils.
    - b. Second coat: PPG; 90-1210 Series Pitt-Tech Plus Int/Ext Semi- Gloss DTM Industrial Enamels (90 g/L VOC compliant as anti- corrosive product); 2.0 to 4.0 Dry Mils.
    - c. Third coat: PPG; 90-1210 Series Pitt-Tech Plus Int/Ext Semi- Gloss DTM Industrial Enamels (90 g/L VOC compliant as anti- corrosive product); 2.0 to 4.0 Dry Mils.

### 3.4 INTERIOR PAINT SCHEDULE:

- A. Concrete and masonry (Other Than Concrete Unit Masonry): Provide the following paint systems over interior concrete and brick masonry substrates:
1. Flat acrylic finish (ceilings):
    - a. First coat: PPG; 4-603 Perma-Crete Int/ Ext Alkali Resistant Primer (88 g/L VOC); 1.2 to 1.5 Dry Mils.
    - b. Second coat: PPG; 6-70 Series SpeedHide Interior Wall Flat Latex (<50 g/L VOC); 1.3 Dry Mils.
    - c. Third coat: PPG; 6-70 Series SpeedHide Interior Wall Flat Latex (<50 g/L VOC); 1.3 Dry Mils.
  2. Low-luster acrylic finish:
    - a. First coat: PPG; 4-603 Perma-Crete Int/ Ext Alkali Resistant Primer (88 g/L VOC); 1.2 to 1.5 Dry Mils.
    - b. Second coat: PPG; 6-411 Series SpeedHide Interior Enamel Eggshell Latex (<50 g/L VOC); 1.5 Dry Mils.
    - c. Third coat: PPG; 6-411 Series SpeedHide Interior Enamel Eggshell Latex (<50 g/L VOC); 1.5 Dry Mils.
  3. Semi-gloss waterborne acrylic epoxy finish:
    - a. First coat: PPG; 4-603 Perma-Crete Int/ Ext Alkali Resistant Primer (88 g/L VOC); 1.2 to 1.5 Dry Mils.
    - b. Second coat: PPG; 16-510 Series Pitt-Glaze WB-1 PreCatalyzed Acrylic Semi-Gloss Epoxy (95 g/L VOC); 1.5 Dry Mils.
    - c. Third coat: PPG; 16-510 Series Pitt-Glaze WB-1 PreCatalyzed Acrylic Semi-Gloss Epoxy (95 g/L VOC); 1.5 Dry Mils.
- B. Concrete masonry unit: Provide the following finish systems over interior concrete masonry:
1. Low-luster acrylic finish:
    - a. First coat: PPG; 6-7 SpeedHide Int/Ext Masonry Block Filler Latex (<50 g/L VOC); 7.1 Dry Mils.
    - b. Second coat: PPG; 6-411 Series SpeedHide Interior Enamel Eggshell Latex (<50 g/L VOC); 1.5 Dry Mils.
    - c. Third coat: PPG; 6-411 Series SpeedHide Interior Enamel Eggshell Latex (<50 g/L VOC); 1.5 Dry Mils.
  2. Semi-gloss waterborne acrylic epoxy finish:
    - a. First coat: PPG; 6-7 SpeedHide Int/Ext Masonry Block Filler Latex (<50 g/L VOC); 7.1 Dry Mils.

- b. Second coat: PPG; 16-510 Series Pitt-Glaze WB-1 PreCatalyzed Acrylic Semi-Gloss Epoxy(95 g/L VOC); 1.5 Dry Mils.
  - c. Third coat: PPG; 16-510 Series Pitt-Glaze WB-1 PreCatalyzed Acrylic Semi-Gloss Epoxy(95 g/L VOC); 1.5 Dry Mils
3. Thin film epoxy floor system:
- a. Surface Preparation: Clean to remove dirt, dust, chalk, grease, oil, wax, mildew and other residue or contamination from the existing tile surface. It is imperative that the surface is clean and free from contamination. After cleaning dull the tile surface by sanding or best available means. The surface shall be rendered dull and free of any sheen on the surface. Sanding dust and any residual contamination must be completely removed from the surface before coating. Follow additional surface preparation guidelines on technical data sheets.
  - b. First Coat- PPG Industries, Inc.: Apply one coat of: Amerlock 2 VOC High Solida Epoxy Coating @ 4.0 –8.0 mils DFT.
  - c. Topcoat - PPG Industries, Inc.: Apply one coat of: Amerlock 2 VOC High Solida Epoxy Coating @ 4.0 –8.0 mils DFT.
- C. Gypsum board: Provide the following finish systems over interior gypsum board surfaces:
1. Flat acrylic finish (ceilings):
    - a. First coat: PPG; 6-2 SPEEDHIDE Interior Latex Sealer Quick- Drying (<50 g/L VOC); 1.0 Dry Mils.
    - b. Second coat: PPG; 6-70 Series SpeedHide Interior Wall Flat Latex (<50 g/L VOC); 1.3 Dry Mils.
    - c. Third coat: PPG; 6-70 Series SpeedHide Interior Wall Flat Latex (<50 g/L VOC); 1.3 Dry Mils.
  2. Low-luster acrylic finish:
    - a. First coat: PPG; 6-2 SPEEDHIDE Interior Latex Sealer Quick- Drying (<50 g/L VOC); 1.0 Dry Mils.
    - b. Second coat: PPG; 6-411 Series SpeedHide Interior Enamel Eggshell Latex (<50 g/L VOC); 1.5 Dry Mils.
    - c. Third coat: PPG; 6-411 Series SpeedHide Interior Enamel Eggshell Latex (<50 g/L VOC); 1.5 Dry Mils.
  3. Semi-gloss acrylic-enamel finish:
    - a. First coat: PPG; 6-2 SPEEDHIDE Interior Latex Sealer Quick- Drying (<50 g/L VOC); 1.0 Dry Mils.
    - b. Second coat: PPG; 6-500 Series SpeedHide Interior Semi-gloss Acrylic Latex (<50 g/L VOC); 1.4 Dry Mils.
    - c. Third coat: PPG; 6-500 Series SpeedHide Interior Semi-gloss Acrylic Latex (<50 g/L VOC); 1.4 Dry Mils.
- D. Ferrous metal: Provide the following finish systems over ferrous metal:
1. Semi-gloss waterborne acrylic epoxy finish:
    - a. First coat: PPG; 90-712 Series Pitt-Tech Int/Ext Industrial DTM Primer/Finish Enamel (123 g/L VOC compliant as anti-corrosive product); 2.0 to 3.0 Dry Mils.
    - b. Second coat: PPG; 16-510 Series Pitt-Glaze WB-1 PreCatalyzed Acrylic Sem-Gloss Epoxy (95 g/L VOC); 1.5 Dry Mils.
    - c. Third coat: PPG; 16-510 Series Pitt-Glaze WB-1 PreCatalyzed Acrylic Sem-Gloss Epoxy (95 g/L VOC); 1.5 Dry Mils.

### 3.5 CLEANING AND PROTECTION

- A. 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.
- B. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

END OF SECTION 099000

**SECTION 10 14 00 - INTERIOR SIGNAGE****PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. informational, personnel, directory, directional and regulatory signage.

**1.2 RELATED SECTIONS**

- A. Section 10 14 26 – Exterior Post and Panel / or Pylon Signage. (McAfee Team: If the Exterior Specifications are in your scope, APCO can provide Specifications once the internal design review is completed/ or please advise if not in the architect’s scope).

**1.3 REFERENCES**

- A. ANSI A117.1: Providing Accessibility and Usability for Physically Handicap People, 1986 edition.
- B. Department of Justice, Office of the Attorney General, "Americans with Disabilities Act", Public Law 101-336, (ADA).
- C. 2010 Standards for Accessible Design (SAD): The updated ADAAG (ADA Accessibility Guidelines), effective on March 15, 2011 and made mandatory on March 16, 2012.

**1.4 GENERAL INFORMATION**

- A. Signage under this section is intended to include items for identification, direction, control, and information within a building where installed as a complete integrated system from a single manufacturer.
- B. ADA Design Requirements:
  - 1. Provide signage that conforms to the requirements of all regulatory agencies holding jurisdiction.
  - 2. Comply with all applicable provisions of the 2010 Standards for Accessible Design (the updated ADA Accessibility Guidelines, ADAAG - <http://www.ada.gov/regs2010/2010ADASTandards/2010ADAstandards.htm>), effective in March 2011. Requirements include, but are not limited to the following:
    - a. Tactile copy must be all upper case and raised at least 1/32". Tactile characters must be sans serif, not italic, not oblique, script or highly decorative.
    - b. The stroke width of the upper case "I" has to be 15% of the letter height or less. The character width of the uppercase "O" must be between 55% and 100% of the height of the corresponding uppercase "I".
    - c. The copy height for tactile information must be between 5/8" and 2". If separate visual characters are provided, raised characters can be 1/2" and need not contrast with the background.

- d. The distance between characters on tactile copy must be a minimum of 1/8” and a maximum of 4 times the character stroke width. These distances are measured between the closest points of adjacent characters.
- e. Spacing between lines of tactile copy needs to be a minimum of 135% and a maximum of 170% of the corresponding upper case “I” height (measured from baseline to baseline).
- f. Braille must be Grade II and positioned directly below the corresponding raised characters. If text is multi-lined, Braille is placed below the entire body of text and separated 3/8” from any other tactile characters and 3/8” minimum from raised borders and decorative elements.
- g. Visual characters and symbols, and their background, are to have a non-glare finish. The color of raised characters must contrast as much as possible with their background to make sure signs are more legible for persons with low vision.
- h. Pictograms, selected from International Standards, are to be located within a 6” vertical void and accompanying text descriptions are to be located directly below the pictogram.

#### 1.5 **SUBMITTALS**

- A. Submit under provisions of Section 01300.
- B. Product Data:  
Manufacturer's data sheets on each product to be used, including:
  - 1. Manufacturer's product literature indicating units and designs selected.
  - 2. Evidence of manufacturer's computerized data retrieval program for tracking of project for sign typography, message strip requirements and other pertinent data from schedule input to final computerized typography on finished product.
  - 3. Preparation instructions and recommendations.
  - 4. Storage and handling requirements and recommendations.
  - 5. Installation methods.
- C. Samples: One full size sign sample illustrating the design, construction, colors, typestyles, mounting method and other details as specified. Provide sample in small size sign.
  - 1. Samples will be returned for use in Project.
  - 2. Samples will not be returned for use in Project.
- D. Shop Drawings:
  - 1. Indicate materials, sizes, configurations, and applicable mountings.
  - 2. Typography sample for typical inserts.
  - 3. Artwork for special graphics.
  - 4. Artwork for special headers.
- E. Signage Schedule:  
Complete with location of each sign and the required copy/text.
- F. Sign Program Maintenance Plan:

1. Manufacturer shall provide details of software and system of pre-perforated paper sign inserts allowing client to update and maintain signage graphics in-house.
- G. Contract close out:
1. Furnish appropriate checklist for aiding in reordering after Date of Substantial Completion. Maintain computer schedule program for five years for ordering new signage required by Owner.
  2. Maintenance data and cleaning requirements for sign surfaces.
  3. Furnish one complete SignWord Pro software package compatible with Windows XP or newer.

## **1.6 QUALITY ASSURANCE**

- A. Manufacturer Qualifications:
1. Work required under this section from manufacturer regularly engaged in work of this type and scope for a minimum of 5 years.
  2. Maintain computer link between schedule input and computerized typography production.
- B. Installer Qualifications: Trained and authorized by manufacturer for installations of required scope and product.

## **1.7 DELIVERY, STORAGE & HANDLING**

- A. Package signs to prevent damage during shipment, handling, storage and installation. Products are to remain in their original packaging (unless otherwise specified) until removal is necessary for installation.
- B. If installation site is not ready for signage upon delivery, store signs in a dry, air-conditioned environment.
- C. Handle signage in accordance with manufacturer's instructions.
- D. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

## **1.8 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.

## **1.9 SEQUENCING AND SCHEDULING**

- A. Schedule system installation after room finishes and fixtures have been completed.

## **1.10 WARRANTY**



- A. Product Warranty: Provide manufacturer's warranty against defects in materials and workmanship for a minimum period of one year.

## **PART 2 PRODUCTS**

### **2.1 ACCEPTABLE MANUFACTURERS**

- A. Signage shall be manufactured by APCO Graphics, Inc. (a.k.a. APCO Signs or APCO USA), at 388 Grant Street SE, Atlanta, GA 30312.

### **2.2 ACCEPTABLE PRODUCT**

- A. Elevate Frameless Modular Sign System (NR – No Reveal Series)
- B. Substitutions not permitted.
- C. Requests for substitutions will be considered in accordance with provisions of Section 01600.

### **2.3 SYSTEM REQUIREMENTS**

- A. General:
  - 1. Sign system shall be frameless and shall feature solutions for all required sign types, including but not limited to wall mounted personnel signs, work station personnel signs, primary room identification, directories, directionals, overhead signs, projection wall signs, restroom signs, regulatory and information signs, stair signs and changeable slide conference room signs. All signs within the system must convey a uniform look throughout.
- B. Features:
  - 1. Sign Assembly:  
Sign shall feature a fully recessed chassis to which modular display panels securely engage, creating a frameless look with the appearance that display panels are floating off of the mounting surface.
  - 2. Display Panels / Inserts:  
Primary display panels shall be 1/8" thick painted acrylic plaques. Display panels engage with the concealed chassis in a precise manner to ensure a no reveal between all panels.
  - 3. Tamper Resistance:  
System must offer an option for a concealed locking method to increase level of tamper resistance.
  - 4. Mounting:  
Signs must be able to accommodate installation via fully concealed mechanical fasteners.
  - 5. Modularity:

All display panels shall be securely engaged within a concealed chassis but must be easily updatable to accommodate change. Display panels must be removable without the use of a special, proprietary tool.

6. User Letter Paper Inserts:  
System must offer solutions for user updatable paper inserts, including a range of perforated, coated paper and free software with templates for easy creation of graphics.
  
- C. Graphics and Typography:  
As selected from manufacturer's standards. Reference sign drawings.
  
- D. Colors and Finishes:  
As selected from manufacturer's standards. Reference sign drawings.
  
- E. ADA Compliance:  
Sign system shall comply with all applicable provisions of the 2010 Standards for Accessible Design (the updated ADA Accessibility Guidelines, ADAAG), effective in March 2011. This includes requirements regarding which sign types require Braille/tactile features, character heights, raised character spacing, raised character stroke width, color contrast and installation locations and mounting heights within the facility.
  
- F. Materials and Construction:
  1. Sign shall feature a fully recessed black anodized aluminum chassis to which modular display panels securely engage. Chassis shall be no more than 3/8" in depth and shall be recessed sufficiently behind the panels to give the appearance the panels/inserts are floating off of the mounting surface.
  2. Primary display panels shall be 1/8" thick painted acrylic. Display panels securely engage with the recessed chassis via a concealed attachment method but should be 100% modular to accommodate changes.
  3. System shall offer a range of aluminum bands to house user-updatable, perforated paper inserts. Inserts shall be retained on the left and right sides of the aluminum band by .020" clear, flexible end caps.
  4. Standard ADA inserts/plaques are acrylic with APCO's DP-Tactile process direct-print, UV-cured 1/32" thick tactile characters and fully domed Braille.
  5. Standard graphics are UV-cured, direct-print with true 600dpi resolution.
  6. Attachment: Signs shall be able to accommodate fully concealed mechanical fasteners.

## 2.4 Sign Types and Graphics

Reference drawings for colors, finishes, sizes and details. Reference signage schedule for graphics/copy specifications.

- A. **SignType A – Office ID:** 7.25"h x 6"w wall-mounted sign featuring arc shape acrylic header with DP-Tactile raised characters and Braille, one .25"h decorative aluminum divider bar, a 3"h extruded aluminum insert slot with a non-glare lens to accommodate a removable paper insert and a 1.5"h decorative acrylic bottom insert with a flatbed printed woodgrain image.

- B. **SignType B – Back-of-House Room ID:** 7.5”h x 8.5”w wall-mounted sign featuring arc shape acrylic header with DP-Tactile raised characters and Braille and a 1.5”h decorative acrylic bottom insert with a flatbed printed woodgrain image.
- C. **SignType C – Conference Room ID:** 7.25”h x 6”w wall-mounted sign featuring arc shape acrylic header with DP-Tactile raised characters and Braille, one .25”h decorative aluminum divider bar, a 3”h acrylic insert with flatbed print graphics and a 1.5”h decorative acrylic bottom insert with a flatbed printed woodgrain image.
- D. **SignType D – Restroom and Stair ID:** 10.75”h x 6”w wall-mounted sign featuring arc shape acrylic header, one .25”h decorative aluminum divider bar, a 6”h acrylic insert with flatbed print symbol and a 2”h acrylic bottom insert with DP-Tactile raised characters and Braille.
- E. **SignType E – Workstation ID:** 2”h x 6”w extruded aluminum insert slot with a non-glare lens and subsurface paper insert. Insert slot is pin-mounted to fabric office partition and features a discreet, clear plastic end cap on the left side, with the right side open for easy changeability of the paper insert.
- F. **SignType F – Max Occupancy:** 6”h x 6”w non-modular, wall-mounted sign featuring an acrylic plaque with flatbed print graphics and a sub-surface, recessed .25” thick backer.
- G. **Graphics**
1. Type Sizes:  
Selected from manufacturer's standard sizes indicated in SCHEDULE for particular units; meet ADA requirements for letter proportions and sizes.
  2. Typography:  
Reference signage schedule and drawings for details. Font(s) selected from manufacturer's standards unless otherwise specified. All text and graphics shall be a true representation of the typeface(s) and/or graphics specified. Letter spacing and interline spacing shall be set by the manufacturer.
    - a. HelveticaNeue-Roman (HR)
    - b. Futura Book (FUB)
    - c. Arial (AR)
    - d. Frutiger-Normal (F55)
    - e. Myriad Pro (MP)
    - f. Typeface(s) as indicated in SCHEDULES Article and Drawings.
  3. Type Code(s): Uppercase.
  4. Type Code(s): Initial caps.
  5. Type Code(s): Combination.
  6. Type Code(s): Indicated in SCHEDULES Article.
  7. Imprint Colors:  
Selected by Architect from manufacturer's standard or PMS colors and indicated in SCHEDULE; color contrast background colors in accord with ADA requirements.
  8. Copy/Message List: Indicated in SCHEDULE.
  9. Reference drawings and Signage Schedule for details.

10. All text and graphics shall be a true representation of typeface(s) and/or graphics specified.

## **2.5 FABRICATION**

- A. Fabricate units as per specifications and details indicated on reviewed drawings.
- B. All fabrication must take place in the USA.
- C. Include product instructions sheets for installation and removal/replacement of insert components.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

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

### **3.2 PREPARATION**

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

### **3.3 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions, in locations and with mounting methods as specified in sign and location drawings.
- B. Square, plumb and level all installed products.
- C. Install all signage in accordance with the 2010 Standard for Accessible Design (SAD) effective in March 2011, and any applicable local regulations and/or codes.
- D. Upon completion of the work, sign installer shall remove any unused products, materials, packaging and debris from the installation site.

### **3.4 CLEANING**

- A. Clean all exposed surface not more than 48 hours prior to Date of Substantial Completion in accordance with manufacturer's written cleaning instructions.

**3.5 PROTECTION**

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

**3.6 SIGN SCHEDULES**

- A. Refer to Signage Schedule and Drawings for sizes, locations, sign types, layouts, typestyle specifications, sign text/copy and sign graphics.

**END OF SECTION 101400**

## SECTION 102113.16 - PLASTIC-LAMINATE-CLAD TOILET COMPARTMENTS

## PART 1 - GENERAL

## 1.1 SUMMARY

## A. Section Includes:

1. Plastic-laminate-clad toilet compartments.

## B. Related Requirements:

1. Section 061000 "Rough Carpentry" for **blocking**.
2. Section 102800 "Toilet, Bath, and Laundry Accessories" for accessories mounted on toilet compartments.

## 1.2 ACTION SUBMITTALS

## A. Product data.

## B. Shop Drawings: Plans, elevations, sections, details, and attachment details.

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

## 1.3 CLOSEOUT SUBMITTALS

## A. Operation and maintenance data.

## 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 (1112 N) 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 PLASTIC-LAMINATE-CLAD TOILET COMPARTMENTS <Insert drawing designation>

- A. Manufacturer's include but are not limited to:
1. ASI
  2. Bobrick
  3. Metpar
- B. Toilet-Enclosure Style: **Overhead braced, Floor anchored**].
- C. Urinal-Screen Style: **Wall hung**.
- D. Door, Panel, and Pilaster Construction: One-piece, plastic-laminate facing sheets pressure laminated to core material without splices or joints in facings or cores; with **lamine** applied to edges before faces to seal edges and prevent laminate from being pried loose. Seal exposed core material at cutouts to protect core from moisture. **Provide with no-sightline system consisting of a full-height continuous stop on latch side of door and full-height continuous filler strip on hinge side of door (unless continuous hinge is used).**
1. Core Material:
    - a. Door and Panel: **Particleboard**.
    - b. Pilaster: **Manufacturer's standard**.
  2. Thickness:
    - a. Doors and Panels: Finished to not less than 1 inch (25 mm) thick.
    - b. Pilasters: Finished to not less than 1-1/4 inches (32 mm) thick **and with internal, nominal 0.134-inch- (3.42-mm-) thick, steel sheet reinforcement**.
- E. Urinal-Screen Construction: Matching panel construction.
- F. Pilaster Shoes: Formed from stainless steel sheet, not less than 0.031-inch (0.79-mm) nominal thickness and 3 inches (76 mm) high, finished to match hardware.
- G. Pilaster Sleeves (Caps): Formed from stainless steel sheet, not less than 0.031-inch (0.79-mm) nominal thickness and 3 inches (76 mm) high, finished to match hardware.
- H. Brackets (Fittings):
1. Full-Height (Continuous) Type: Manufacturer's standard design; **aluminum**.
- I. Plastic-Laminate Finish: **One color** in each room.
1. Color: **As selected by Architect from manufacturer's full range**.

## 2.3 HARDWARE AND ACCESSORIES

- A. Door Hardware and Accessories: Manufacturer's operating hardware and accessories. **Mount with through bolts.**
1. Hinges:
    - a. Manufacturer's continuous, cam type that swings to a closed or partially open position, allowing emergency access by lifting door.
      - 1) Material, Continuous, Cam-Type Hinge: Stainless steel.
  2. Latch and Keeper: Manufacturer's **surface-mounted** latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at toilet enclosures designated as accessible.
    - a. Material: **Chrome-plated zamac.**
  3. Coat Hook: Manufacturer's combination hook and rubber-tipped bumper, sized to prevent inswinging door from hitting compartment-mounted accessories.
    - a. Material: **Chrome-plated zamac.**
  4. Door Bumper: Manufacturer's rubber-tipped bumper at outswinging doors.
    - a. Material: Manufacturer's standard.
  5. Door Pull: Manufacturer's unit at outswinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at toilet enclosures designated as accessible.
    - a. Material: **Chrome-plated zamac.**
- 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 anchors compatible with related materials.

## 2.4 MATERIALS

- A. Particleboard: ANSI A208.1, Grade M-2.
- B. Plastic Laminate: ISO 4586-3, general-purpose HGS grade.
- C. Aluminum Castings: ASTM B26/B26M.
- D. Aluminum Extrusions: ASTM B221 (ASTM B221M).



- E. Zamac: ASTM B86, commercial zinc-alloy die castings.

## 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. Urinal-Screen Posts: Manufacturer's standard corrosion-resistant anchoring assemblies at posts and walls, with leveling adjustment nuts at **tops and** bottoms of posts. Provide shoes **and sleeves (caps)** at posts to conceal anchorage.
- E. Door Size and Swings: Unless otherwise indicated, provide 24-inch- (610-mm-) wide inswinging doors for standard toilet enclosures and 36-inch- (914-mm-) wide outswinging doors with a minimum 32-inch- (813-mm-) wide clear opening for toilet enclosures designated as accessible.

## PART 3 - EXECUTION

### 3.1 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 (13 mm).
    - b. Panels or Screens and Walls: 1 inch (25 mm).
  - 2. Full-Height (Continuous) Brackets: Secure panels or screens to walls and to pilasters with full-height brackets.
    - a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.
    - b. Align brackets at pilasters with brackets at walls.
- B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches (44 mm) 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 (51 mm) 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.

### 3.2 ADJUSTING

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

END OF SECTION 102113.16

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**SECTION 10 28 00 - TOILET ACCESSORIES****PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes the following:
  - 1. Public-use washroom accessories.
  - 2. Under lavatory guards.
  - 3. Custodial accessories.

**1.2 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Product Schedule:
  - 1. Identify locations using room designations indicated on Drawings.
  - 2. Identify products using designations indicated on Drawings.

**PART 2 - PRODUCTS****2.1 PUBLIC-USE WASHROOM ACCESSORIES**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Refer to the drawing Accessory schedule and details.
  - 2. Bobrick Washroom Equipment, Inc.
  - 3. Bradley Corporation.
  - 4. A & J Washroom Accessories.
- B. Refer to the drawings for the accessories noted on the enlarged plans elevations. And schedules

**2.2 UNDERLAVATORY GUARDS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Plumberex Specialty Products, Inc.
  - 2. TCI Products.
  - 3. Truebro, Inc.
  - 4. LavGuard
- B. Under-lavatory Guard:
  - 1. Description: Provide insulating pipe covering for supply and drain piping assemblies, that prevent direct contact with and burns from piping, and allow service access without removing coverings at all exposed under counter lavatories.
  - 2. Material and Finish: Antimicrobial, molded-plastic, white.

**2.3 CUSTODIAL ACCESSORIES**

- A. Basis-of-Design Product: The design for accessories is based on products indicated. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:
  - 1. Bobrick Washroom Equipment, Inc.
  - 2. Bradley Corporation.
  - 3. A & J Washroom Accessories.

2.4 FABRICATION

- A. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

**Note: MOUNTING HEIGHTS FOR TOILET ACCESSORIES SHALL COMPLY WITH THE BUILDING CODE- \_ACCESSIBILITY CHAPTER.**

**END OF SECTION 10 28 00**

## SECTION 104413 - FIRE PROTECTION CABINETS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Fire-protection cabinets for the following:
  - a. Portable fire extinguisher.

##### B. Related Requirements:

1. Section 104416 "Fire Extinguishers" for portable, hand-carried fire extinguishers accommodated by fire-protection cabinets

#### 1.2 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.

##### D. Samples for Initial Selection: For each type of exposed finish required.

##### E. Samples for Verification: For each type of exposed finish required, prepared on samples **6 by 6 inches (150 by 150 mm)** square.

##### F. Product Schedule: For fire-protection cabinets. Indicate whether recessed, or semi-recessed, Coordinate final fire-protection cabinet schedule with fire-extinguisher schedule to ensure proper fit and function.

#### 1.3 CLOSEOUT SUBMITTALS

##### A. Maintenance Data: For fire-protection cabinets to include in maintenance manuals.

#### 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. Manufacturer's include but are not limited to:
  - a. JL Industries Ambassador Series, Factory White Finish
  - b. Nystrom
  - c. Potter Roemer

- B. Cabinet Construction: **Nonrated**.

- C. Cabinet Material: **Cold-rolled steel sheet**.

- 1. Shelf: Same metal and finish as cabinet.

- D. Semi-recessed 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. Rolled-Edge Trim: **2-1/2-inch (64-mm)** backbend depth.

- E. Cabinet Trim Material: **Extruded-aluminum shapes**.

- F. Door Material: **Aluminum sheet**.

- G. Door Glazing: **Acrylic (clear)**.

- 1. Provide **continuous hinge, of same material and finish as trim**, , permitting door to open 180 degrees.

- H. Accessories:

- 1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
- 2. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate **as directed by Architect**.

- a. Identify fire extinguisher in fire-protection cabinet with the words "**FIRE EXTINGUISHER**."

- 1) Location: Applied to **cabinet door**.
- 2) Application Process: **Pressure-sensitive vinyl letters**.
- 3) Lettering Color: **Black**.
- 4) Orientation: **Vertical**.

I. Materials:

1. Cold-Rolled Steel: ASTM A1008/A1008M, Commercial Steel (CS), Type B.
  - a. Finish: **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. Aluminum: **ASTM B221 (ASTM B221M)** for extruded shapes and aluminum sheet, with strength and durability characteristics of not less than Alloy 6063-T5 for aluminum sheet.

J. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated, and as follows:

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.
- 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 (13 mm)** thick.
  2. 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 walls and partitions for suitable framing depth and blocking where **semirecessed** cabinets will be installed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 PREPARATION

- A. Prepare recesses for **semi-recessed** 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 and in compliance with the Accessibility Code.**
  - 1. Fire-Protection Cabinet Mounting Height: **42 inches (1067 mm)** above finished floor to top of fire extinguisher.
- B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.
- C. Identification:
  - 1. Apply **vinyl lettering** at locations indicated.

## 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 10441

## SECTION 104416 - FIRE EXTINGUISHERS

## PART 1 - GENERAL

- 1.1 Section includes portable, hand-carried fire extinguishers.
- 1.2 ACTION SUBMITTALS
- A. Product Data: For each type of product..
- 1.3 COORDINATION
- A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.
- 1.4 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.
- B. Warranty Period: One year from date of Substantial Completion.

## PART 2 - PRODUCTS

- 2.1 PERFORMANCE REQUIREMENTS
- 2.2 NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- 2.3 Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
- 2.4 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS
- A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet indicated.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. JL Industries, Inc.; a division of the Activar Construction Products Group.  
1) COSMIC 5E
- b. Larsens Manufacturing Company.
- c. Potter-Roemer.
2. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B.
- B. Multipurpose Dry-Chemical Type: UL-rated 5 lb. 3A-40BC nominal capacity, with mono ammonium phosphate-based dry chemical in manufacturer's standard enameled container.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine fire extinguishers for proper charging and tagging.
- B. Remove and replace damaged, defective, or undercharged fire extinguishers.
- C. Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
  - 1. Mounting Brackets: 54 inches above finished floor to top of fire extinguisher.
- D. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION 104416

**SECTION 10 73 00.02 - ALUMINUM SUNSHADE**

**PART 1 – GENERAL**

**1.1 SUMMARY**

- A. Section Includes: Louvered Sunshade customized with wall mounted aluminum canopy. It is intended that the Aluminum Sunshade and Aluminum Canopy are the product of a single manufacturer.
- B. Related Requirements:
  - 1. Division 01 25 00 – Substitution Procedures D
  - 2. Section 10 73 01 – Aluminum Canopy S

**1.2 REFERENCES**

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.
- B. American Welding Society (AWS):
  - i. Standard D1.2 – Structural Welding Code – Aluminum S
- C. American Architectural Manufacturers Association (AAMA):
  - i. Aluminum finishes AAMA 2603 Powder Coat A
  - ii. Aluminum finishes AAMA 2605 Kynar A
  - iii. Aluminum finishes AAMA 611 Anodize A

**1.3 SUBMITTALS**

- A. Shop Drawings: Signed and sealed. Indicate size, material and finish. Include plan elevation pages to clearly outline sunshade locations. Include project specific installation procedures, details of joints, attachments to existing building and clearances. Provide lead time for product and note possible conflicts with standard line.
- B. Color charts showing manufacturer’s full range of colors from standard line.

- C. Delegated design. Engage a professional engineer, licensed in the jurisdiction where the project is located, to design aluminum sunshade in conjunction with aluminum canopy specified in other sections.

#### **1.4 Warranty**

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal canopies that fail in materials or workmanship within specified warranty period.

- i. Warranty Period: One year from date of Substantial Completion.

W

### **PART 2 – PRODUCTS**

#### **2.1 ACCEPTABLE MANUFACTURERS**

- A. Specifications are based on Architectural Fabrication, Inc. – Louvered Sunshade. Architectural Fabrication, Inc. – Manufacturer and Installer is located at 2100 E. Richmond Avenue, Fort Worth, TX 76104. 800.962.8027. [www.arch-fab.com](http://www.arch-fab.com)
- B. Substitutions are acceptable assuming they comply with these specifications, are submitted based on Division 01 25 00 “Substitution Procedures” –and have a minimum 10 years experience.

#### **2.2 MATERIALS**

- A. Framing: Aluminum flat bar with minimum nominal thickness .250 in.
- B. Infill: Aluminum airfoil, shutter blade, z-blade, round tube and half round tube alloy 6063-T5.
- C. Connections: Wall plates and sunshade mounting brackets are to be aluminum.
- D. Assembly Fasteners: Nuts, bolts, washers and screws to be stainless steel to suit application.
- E. Anchors and Supports: Anchors, nuts, bolts, washers and pipe spacers to be zinc plated or galvanized steel required to suit application.
- F. Finish: Powder-coat finish per ASTM D 3451, complying with finish manufacturer's written instructions for surface preparation including pretreatment, application, baking and minimum dry film thickness. Color to be selected from standard color line.

### **PART 3 – EXECUTION**

#### **3.1 FABRICATION**

- A. Preassemble sunshades in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- B. Infill must be mechanically fastened in order to easily replace individual parts due to damage sustained during shipping or installation.

### **3.2 INSTALLATION**

- A. Install sunshades per manufacturer's written instructions and as indicated on drawings.
- B. Locate and place sunshades level, plumb and at indicated alignment with adjacent work.
- C. Repair damaged finishes so no evidence remains of corrective work. Return items to the factory that cannot be refinished in the field. Make required alterations and refinish entire unit or provide new units.
- D. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a coating of bituminous paint or elastomeric coating on surfaces that will be in contact with concrete, masonry, or dissimilar metals. Use of nylon washers and neoprene pads are approved.

### **END OF SECTION**

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## SECTION 10 73 01 - ALUMINUM WALL HUNG CANOPY

## PART 1 GENERAL

## 1.01 SUMMARY

- A. Section Includes: Design, fabrication, and installation of welded extruded aluminum canopy systems.

## 1.02 REFERENCES

- A. The Aluminum Association (AA):
  - 1. The Aluminum Design Manual 2000, Specifications & Guidelines for Aluminum Structures.
- B. American Architectural Manufacturers Association (AAMA):
  - 1. AAMA 611, Voluntary Specification for Anodized Architectural Aluminum.
  - 2. AAMA 2603, Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.
  - 3. AAMA 2605, Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
- C. American Society of Civil Engineers (ASCE):
  - 1. ASCE 7, Minimum Design Loads for Buildings and Other Structures.
- D. American Society for Testing and Materials (ASTM):
  - 1. ASTM B 209, Specification for Aluminum and Aluminum- Alloy Sheet and Plate.
  - 2. ASTM B 221, Specification for Aluminum and Aluminum- Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
  - 3. ASTM C 150, Specification for Portland Cement.
  - 4. ASTM C 404, Specification for Aggregates for Masonry Grout.
- E. American Welding Society (AWS):
  - 1. ANSI/AWS D1.2, Structural Welding Code - Aluminum.

## 1.03 SYSTEM DESCRIPTION

- A. Design Requirements:
  - 1. Design in accordance with The Aluminum Design Manual 2000.
  - 2. Comply with the wind requirements of ASCE 7.
  - 3. Provide an all welded extruded aluminum canopy system complete with internal drainage. Non-welded systems are not acceptable.
  - 4. Provide expansion joints to accommodate temperature changes of 120 degrees F. Provide expansion joints with no metal to metal contact.
- A. 5. Delegated Design: The Contractor/ Bidder shall engage a qualified professional engineer, licensed in the jurisdiction where the project is located. to design aluminum wall hung canopy. .



#### 1.04 SUBMITTALS

- A. Product Data: Manufacturer's product information, specifications, and installation instructions for canopy components and accessories.
- B. Shop Drawings: Signed and sealed by the delegated engineer and shall include plan dimensions, elevations, and project specific details.
- C. Samples:
  - 1. Color: Submit Manufacturer's standard range of colors for the finishes selected.
  - 2. Verification: 2-inch-square samples of each finish selected on the substrate specified.
- D. Design Data: Design calculations bearing the seal of a Registered Professional Engineer, licensed in the state where the project is located. Design calculations shall state that the canopy system design complies with the wind requirements of ASCE 7, the stability criteria of applicable building code, and all other governing criteria.

#### 1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: At least ten years of experience in the design, fabrication, and erection of extruded aluminum canopy systems.
- B. Installer Qualifications: Have canopy installed by manufacturer, third party installation is not acceptable.

### PART 2 PRODUCT

#### 2.01 MANUFACTURERS

- A. Manufacturer:
  - a. (Basis of Design) Peachtree Protective Covers, Inc.,  
3255 South Sweetwater Rd.,  
Lithia Springs, GA 30122,  
770-439-2120, fax 770-439-2122

#### 2.02 MATERIALS

- A. Aluminum Members: Extruded aluminum, ASTM B 221, 6063 alloy, T6 temper.
- B. Fasteners: Aluminum, 18-8 stainless steel, or 300 series stainless steel.
- C. Protective Coating for Aluminum Columns Embedded in Concrete: Clear acrylic.
- D. Gaskets: Dry seal santoprene pressure type.
- E. Aluminum Flashing: ASTM B 209, Type 3003 H14, 0.040 inch, minimum.

## 2.04 FABRICATION

- A. General:
1. Shop Assembly: Assemble components in shop to greatest extent possible to minimize field assembly.
  2. Welding: In accordance with ANSI/AWS D1.2.
  3. Gutter Frame Construction: Factory assemble gutter fascia frames to form a one-piece welded frame. Make welds smooth and uniform using an inert gas shielded arc. Perform suitable edge preparation to assure 100% penetration. Grind welds only where interfering with adjoining structure to allow for flush connection. Field welding is not permitted. Gutter frames constructed by mechanically fastening components together are not acceptable.
  4. Deck Construction: Fabricate from extruded modules that interlock in a self-flashing manner. Positively fasten interlocking joints creating a monolithic structural unit capable of developing the full strength of the sections. The fastenings must have minimum shear strength of 350 pounds each.
- B. Beams: Where applicable provide open-top tubular extrusion, top edges thickened for strength and designed to receive deck members in self-flashing manner.
- C. Deck: Extruded self-flashing sections interlocking into a composite unit.
- D. Gutter Fascia: Where applicable provide “j-shaped” gutter fascia capable in manufacturer’s standard sizes.
- E. Fascia: Where applicable provide manufacturer’s standard fascia in standard sizes.
- F. Hanger Assemblies: Provide extruded aluminum hanger rods in manufacturer’s standard shapes and sized to meet the loads seen by canopy.
- H. Factory Finishing: Finish designations prefixed by AA comply with system established by the AAMA for designating aluminum finishes.
1. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.4 mils to 0.7 mils thick), complying with AAMA 611.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verification of Conditions: Verify that all concrete, masonry, and roofing work in the vicinity is complete and cleaned.

### 3.02 ERECTION

- A. Erect canopy true to line, level, and plumb.
- B. Provide hairline miters and fitted joints.

3.03 CLEANING

- A. Clean all canopy components promptly after installation.

3.04 PROTECTION

- A. Protect materials during and after installation.

END OF SECTION 10 73 01

**SECTION 113100 - RESIDENTIAL APPLIANCES****PART 1 - GENERAL****1.1 SUMMARY:**

- A. Related work specified elsewhere:
  - 1. Plastic Laminate Clad Architectural Cabinets.
  - 2. Solid Surface Countertops.
  - 3. Quarts Agglomerate Countertops.
  - 4. Plumbing connections.
  - 5. Ductwork connections.
  - 6. Electrical connections.

**1.2 SUBMITTALS:**

- A. Product data: Indicate product descriptions, full characteristics, sizes and finishes. Include rough-in details, electrical and plumbing requirements, as applicable.
- B. Certification: Submit written certification that products are ENERGY STAR qualified.

**1.3 QUALITY ASSURANCE:**

- A. ENERGY STAR: Provide appliances that qualify for the EPA/DOE ENERGY STAR product-labeling program.

**1.4 DELIVERY, STORAGE AND HANDLING:**

- A. Deliver equipment in manufacturer's protective packaging.
- B. Store equipment in packaging to prevent soiling or physical damage.
- C. Handle equipment in manner to prevent damage to finished surfaces and operating mechanisms.

**1.5 PROJECT/SITE CONDITIONS:**

- A. Protection: Protect prefinished surfaces from damage or staining. Following installation, provide protective covering for equipment until Date of Substantial Completion.
- B. Coordinate installation of appliances required to be built into other work. Secure templates or lay out to rough dimensions provided by equipment manufacturer.

**1.6 WARRANTIES:**

- A. Furnish manufacturer's standard appliance warranties as part of Contract closeout documents.

**PART 2 - PRODUCTS****2.1 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. Gas-fueled appliances: Certified by a qualified testing agency for each type of gas-fueled appliance according to ANSI Z21 Series standards.
- C. 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 the ABA standards of the Federal agency having jurisdiction and ICC A117.1.

**2.2 APPLIANCES**

- A. Refer to the Appliance Schedule on the drawings.

**PART 3 - EXECUTION****3.1 INSTALLATION:**

- A. Uncrate and set appliances in place, or install in cabinets as indicated. Level units, clean finishes and test all functions to ensure proper operation.
- B. Coordinate installation of food waste disposers with plumbing and electrical work.
- C. Perform final plumbing connections under requirements of Division 22 Plumbing, mechanical connections under requirements of Division 23 Heating Ventilating and Air Conditioning and electrical connections under requirements of Division 26, Electrical.
  - 1. Provide ductwork and connections as required for venting range hood. Exercise special care in hookup of ductwork to insure proper fitting of vents.
- D. Just prior to Date of Substantial Completion, clean exterior and interior of appliances using cleaners as recommended by manufacturer's product data.

END OF SECTION 113100

## SECTION 12 24 13 - WINDOW ROLLER SHADES

## PART 1 GENERAL

## 1.1 SECTION INCLUDES

- A. Roller shades for manual operation and accessories.
- B. Shade fabric.

## 1.2 RELATED SECTIONS

- A. Section 06 10 00 - Rough Carpentry.
- B. Section 09 21 16.33 - Gypsum Board Area Separation Wall Assemblies.
- C. Section 09 51 23 - Acoustical Tile Ceilings.

## 1.3 REFERENCES

- A. ASTM International (ASTM):
  - 1. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- B. Business and Institutional Furniture Manufacturers Association (BIFMA):
  - 1. BIFMA HCF 8.1 - Health Care Furniture Design - Guidelines for Cleanability.
- C. Cradle to Cradle Products Innovation Institute (C2C):
  - 1. C2C (DIR) - C2C Certified Products Registry.
- D. National Fire Protection Association (NFPA):
  - 1. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
  - 2. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films.
- E. Underwriters Laboratories (UL):
  - 1. UL (GGG) - GREENGUARD Gold Certified Products; Current Edition.
- F. Window Covering Manufacturers Association (WCMA):
  - 1. WCMA A100.1 - Safety of Window Covering Products; 2018.

## 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Coordinate the work with other trades to provide rough-in of electrical wiring as required for installation of hardwired motorized shades.
- B. Preinstallation Meeting: One week prior to commencing work related to this section. Require attendance of all affected installers.
- C. Sequencing:
  - 1. Do not fabricate shades until field dimensions for each opening have been taken with finished conditions in place. "Hold to" dimensions are not acceptable.
  - 2. Do not install shades until final surface finishes and painting are complete.

## 1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's catalog pages and data sheets for products specified including materials, finishes, dimensions, profiles, mountings, and accessories.
  - 1. Preparation instructions and recommendations.
  - 2. Styles, material descriptions, dimensions of individual components, profiles, features, finishes , accessories, and operating instructions.
  - 3. Storage and handling requirements and recommendations.
  - 4. Mounting details and installation methods.
  - 5. Manufacturer's Instructions: Include storage, handling, protection, examination, preparation, and installation.
  - 6. Project Record Documents: Record actual locations of control system components and show interconnecting wiring.
  - 7. Operation and Maintenance Data: Component list with part numbers, and operation and maintenance instructions.
- C. Shop Drawings: Project specific details, Plans, elevations, sections, product details, installation details, operational clearances, wiring diagrams and relationship to adjacent work. Field measure all openings prior to preparing shop drawings and notate measurements on shop drawings.
- D. Window Treatment Schedule: For all roller shades. Use same room designations as indicated on the Drawings and include opening sizes and key to typical mounting details.
- E. Verification Samples: For each finish product specified, one complete set of shade components, unassembled, demonstrating compliance with specified requirements.
  - 1. Shadecloth Sample: Mark face of material to indicate interior faces.
    - a. Test reports indicating compliance with specified fabric properties.
    - b. Verification Samples: 6 inches (150 mm) square, representing actual materials, color and pattern.
- F. Maintenance Data: Bill of materials for all components with part numbers. Methods for maintaining roller shades, precautions regarding cleaning materials and methods, instructions for operating hardware and controls.
- G. Warranty: Provide manufacturer's warranty documents as specified in this Section.
- H. Warranty: Manufacturer's warranty documents as specified in this Section.

## 1.6 QUALITY ASSURANCE

- A. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.
- B. Manufacturer Qualifications: Obtain roller shades system through one source from a single manufacturer with a minimum of ten years experience and minimum of five projects of similar scope and size in manufacturing products comparable to those specified in this section.
- C. Installer for Roller Shade System - Qualifications: Installer trained and certified by the manufacturer with a minimum of ten years experience in installing products comparable to those specified in this section.
- D. Product Listing Organization Qualifications: Organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.
- E. Fire-Test-Response Characteristics: Passes NFPA 701 small and large-scale vertical burn. Materials

tested shall be identical to products proposed for use.

- F. Shadecloth Anti-Microbial Characteristics: 'No Growth' per ASTM G 21 results for fungi ATCC9642, ATCC9644, ATCC9645.
- G. Resistance to Degradation When Exposed to Typical Cleaners: Passes BIFMA HCF 8.1 testing.

#### 1.7 MOCK-UP

- A. Provide a mock-up of one roller shade assembly for evaluation of mounting, appearance and accessories.
  - 1. Locate mock-up in window designated by Architect.
  - 2. Mockup Size: Full size.
  - 3. Mockup Size(WxH): 3 x 3 feet (0.94 x 0.94 m) minimum.
  - 4. Intent of mock-up is to demonstrate quality of workmanship and visual appearance.
  - 5. If mock-up is not acceptable, rebuild mock-up until satisfactory results are achieved.
  - 6. Do not proceed with remaining work until, mock-up is accepted by Architect.
  - 7. Retain mock-up during construction as a standard for comparison with completed work.
  - 8. Do not alter or remove mock-up until work is completed or removal is authorized.
  - 9. Full-sized mock-up may become part of the final installation.
  - 10. Full-sized mock-up will become the property of the Owner to be used for spare parts.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver in factory-labeled packages, marked with manufacturer and product name, fire-test-response characteristics, and location of installation using same room designations indicated on Drawings and in Window Treatment Schedule.
- B. Store and handle products per manufacturer's recommendations.

#### 1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Install roller shades after finish work including painting is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

#### 1.10 WARRANTY

- A. Roller Shade Hardware and Chain Warranty: Manufacturer's standard non-depreciating warranty for interior shading.
  - 1. Shade Hardware: 10 years unless otherwise indicated.
    - a. Mecho/7 including bead chain with ThermoVeil, EuroVeil, EuroTwill, Soho, Equinox, Midnite, Chelsea, or Classic Blackout shade fabric: 25 years.
  - 2. Standard Shadecloth: Manufacturer's standard twenty-five year warranty.
  - 3. Roller Shade Installation: One year from date of Substantial Completion, not including scaffolding, lifts or other means to reach inaccessible areas, which are deemed owner's responsibility.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Acceptable Manufacturer: MechoShade, which is located at: 42-03 35th St.; Long Island City, NY 11101; Contact Cherie Simmons, 770.519.0570, [cherie.simmons@mechoshade.com](mailto:cherie.simmons@mechoshade.com)
- B. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.



## 2.2 ROLLER SHADES, MANUAL OPERATION AND ACCESSORIES

- A. Shade System; General:
1. Components capable of being removed or adjusted without removing mounted shade brackets, or cassette support channel.
  2. Smooth operation raising or lowering shades.
  3. Cradle-to-Cradle certified for the complete shade system including operating hardware and shadecloth. Listed in C2C (DIR).
- B. Basis of Design: Mecho/7 System as manufactured by Mecho.
1. Description: Manually operated fabric window shades.
    - a. Shade Type: Single Roller.
    - b. Shade Type: Double Roller.
    - c. Universal drive capability to offset drive chain for reverse or regular roll shades.
    - d. Drop Position: Regular roll.
    - e. Mounting: As indicated on drawings.
    - f. Size: As indicated on drawings.
    - g. Fabric: As indicated under Shade Fabric article.
  2. Brackets and Mounting Hardware: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight.
    - a. Material: Steel, 1/8 inch (3 mm) thick.
    - b. Double Roller Brackets: Configured for light-filtering and room-darkening shades in one opening.
      - 1) Light-Filtering Fabric: Room-side of opening.
      - 2) Room-Darkening Fabric: Room-side of opening.
      - 3) Operating chain pulls for each fabric configured for opposite sides of the window.
    - c. Single Shade Operation Width: Up to 180 inches (4572 mm) dependent on fabric.
    - d. Multiple Shade Band Operation: Provide hardware as necessary to operate a maximum of six shade bands, totaling up to 50lbs hanging weight or 360 inches (9144 mm) wide; depending on fabric weight whichever is greater, using a single clutch operator.
    - e. Radiused Center Support Brackets: Provide brackets and connectors for radiused window applications.
      - 1) Maximum Offset: Eight degrees on each side for a 16 degree total offset.
  3. Roller Tubes:
    - a. Material: Extruded aluminum.
    - b. Size: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.
    - c. Fabric Attachment: Utilize extruded channel in tube to accept vinyl spline welded to fabric edge. Shade band to be removable and replaceable without removing roller tube from brackets or inserting spline from the side of the roller tube.
    - d. Roller tubes to be capable of being removed and reinstalled without affecting roller shade limit adjustments.
  4. Hembars: Designed to maintain bottom of shade straight and flat.
    - a. Style: Full wrap fabric-covered bottom bar, flat profile with heat sealed closed ends.
    - b. Style: Exposed aluminum bottom bar with matching finials.
      - 1) Color: To be selected by Architect from manufacturer's standard color selection.
    - c. Room-Darkening Shades: Provide a slot in bottom bar with wool-pile light seal.
  5. Clutch Operator: Manufacturer's standard material and design integrated with bracket/brake assembly.
    - a. Heavy-duty, 1/8" steel mounting bracket and integrated steel brake, clutch and sprocket assembly rigidly affix the shade support and user control to the building structure fully independent of the roller tube components.
    - b. Permanently lubricated maintenance-free brake assembly employs an oil-impregnated steel hub with wrapped spring clutch.
    - c. Brake must withstand minimum pull force of 50 pounds (22.7 kg) in the stopped position.

- d. Direct drive clutch requires no interstitial gear stages or plastic parts between the building structure and clutch ensuring reliable operation across the full range of shade sizes.
  - e. Urethane dampened clutch protects bead chain and clutch from failure due to high shock loads during shade operation minimizing down time.
  - f. Maximum shade hanging weight of 50 pounds (22.7 kg).
  - g. Clutch shall be upgradable to motorized drive on compatible tubes without requiring change in mounting attachment method/location, roller tube or fabric band.
  - h. Motorized drive options available require no additional wiring to be added for power or communication capability for switch or automated operation.
6. Drive Chain: Continuous loop T304 stainless steel beaded ball chain, 100 pound (45 kg) minimum breaking strength warranted from breaking for the life of the shade system hardware under prescribed operation. Provide upper and lower limit stops.
- a. Chain Retainer: Chain tensioning device complying with WCMA A100.1.
  - b. Limit stops: Bead stops affixed to the chain maintain consistent shadeband alignment at the top and bottom of shade travel across multiple shades, and help prevent shade damage resulting from unmanaged user control.
7. Mecho/7, Managed Lift Force, Hardware: Lifts single band or multiband shade assemblies:
- a. Lifting Force: 3 to 8.5 pounds (1.4 to 3.9 kg) max pull force to lift shade assemblies with a shade band hanging weight, not including mounting hardware, of up to 50 pounds (22.7 kg).
  - b. Direct drive clutch with Managed Lift Force provides the best user experience by managing the user pull force while using the fewest number of chain pulls to position a shade.
  - c. Backward compatible to Mecho/5 components including fascia, regular and reverse roll, pockets, and wall-mounting accessories.
  - d. Includes offset drive capability, left/right, front, or back to allow for utilization of blackout channels.
  - e. Allows for ease of operation when obstructions do not allow for direct drive chain access.
  - f. Offset chain drive shall not cause an increase of friction or pull force when operated up to a 26 degree angle from vertical.
8. Accessories:
- a. Fascia: Removable extruded aluminum fascia, size as required to conceal shade mounting, attachable to brackets without exposed fasteners.
    - 1) Single Fascia: Accommodate regular roll shades.
    - 2) Profile: Square.
  - b. Adjustable Multi-band Coupler: Field-adjustable coupler positioned between adjacent shadebands driven by the same clutch facilitates hembar alignment between the bands while maintaining the light gap between the shade bands to no more than 1.25 inches (32mm).

### 2.3 ROLLER SHADE FABRICATION

- A. Field measure finished openings prior to ordering or fabrication. Note field measurements on shop drawings.
- B. Openings Requiring Continuous Multiple Shade Units with Separate Rollers: Locate roller joints at window mullion centers; butt rollers end-to-end.

### 2.4 SHADE FABRIC

- A. Basis of Design: Shade fabric as manufactured by Mecho.
  - 1. Solar Shadecloths:
    - a. Fabric: Soho: 1100 series. 1 percent open. 2 x 2 basket-weave pattern of fine yarn PVC and polyester blend, same colors as in 1600 (3 percent open) and 1900 series, (5 percent open).
  - 2. Blackout Shadecloths:

- a. Fabric: Chelsea: 0250 series. Opaque.
- b. Color: Selected from manufacturer's standard colors.
3. Fabric Properties: Non-flammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.
  - a. Shade Type: Light filtering shades.
  - b. Shade Type: Room darkening shades.
4. Material Certificates and Product Disclosures:
  - a. Low-Emitting Material Certification: Greenguard Gold certified and listed in UL (GGG).
  - b. Cradle to Cradle Material Health Certificate:
    - 1) Achievement Level: Silver.
  - c. Health Product Declaration (HPD): Published declaration with full disclosure of known hazards.
5. Performance Requirements: As determined by Basis of Design product specified.

## PART 3 EXECUTION

### 3.1 EXAMINATION

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

### 3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under the project conditions.
- C. Coordinate with window installation and placement of concealed blocking to support shades.

### 3.3 INSTALLATION

- A. Install shades level, plumb, square, and true per manufacturer's instructions and approved shop drawings. Locate so shade band is at least 2 inches (51 mm) from interior face of glass. Allow proper clearances for window operation hardware. Use mounting devices as indicated.
- B. Replace shades exceeding specified tolerances at no extra cost to Owner.
- C. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range. Adjust level, projection, and shade centering from mounting bracket. Verify there is no telescoping of shade fabric.
- D. Clean roller shade surfaces after installation, per manufacturer's written instructions.
- E. Demonstrate operation and maintenance of window shade system to Owner's personnel.
- F. Manufacturer's authorized personnel are to train Owner's personnel on operation and maintenance of system.
  1. Use operation and maintenance manual as a reference, supplemented with additional training materials as required.

### 3.4 PROTECTION AND CLEANING

- A. Protect installed products until completion of project.

- B. Touch-up, repair or replace damaged products before Substantial Completion.
  - 1. Clean soiled shades and exposed components as recommended by manufacturer.
  - 2. Replace shades that cannot be cleaned to "like new" condition.

END OF SECTION 122413

## SECTION 12 24 13 - WINDOW ROLLER SHADES

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Roller shades for manual operation and accessories.
- B. Shade fabric.

#### 1.2 RELATED SECTIONS

- A. Section 06 10 00 - Rough Carpentry.
- B. Section 09 21 16.33 - Gypsum Board Area Separation Wall Assemblies.
- C. Section 09 51 23 - Acoustical Tile Ceilings.

#### 1.3 REFERENCES

- A. ASTM International (ASTM):
  - 1. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- B. Business and Institutional Furniture Manufacturers Association (BIFMA):
  - 1. BIFMA HCF 8.1 - Health Care Furniture Design - Guidelines for Cleanability.
- C. Cradle to Cradle Products Innovation Institute (C2C):
  - 1. C2C (DIR) - C2C Certified Products Registry.
- D. National Fire Protection Association (NFPA):
  - 1. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
  - 2. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films.
- E. Underwriters Laboratories (UL):
  - 1. UL (GGG) - GREENGUARD Gold Certified Products; Current Edition.
- F. Window Covering Manufacturers Association (WCMA):
  - 1. WCMA A100.1 - Safety of Window Covering Products; 2018.

#### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Coordinate the work with other trades to provide rough-in of electrical wiring as required for installation of hardwired motorized shades.
- B. Preinstallation Meeting: One week prior to commencing work related to this section. Require attendance of all affected installers.
- C. Sequencing:
  - 1. Do not fabricate shades until field dimensions for each opening have been taken with finished conditions in place. "Hold to" dimensions are not acceptable.
  - 2. Do not install shades until final surface finishes and painting are complete.

## 1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's catalog pages and data sheets for products specified including materials, finishes, dimensions, profiles, mountings, and accessories.
  - 1. Preparation instructions and recommendations.
  - 2. Styles, material descriptions, dimensions of individual components, profiles, features, finishes , accessories, and operating instructions.
  - 3. Storage and handling requirements and recommendations.
  - 4. Mounting details and installation methods.
  - 5. Manufacturer's Instructions: Include storage, handling, protection, examination, preparation, and installation.
  - 6. Project Record Documents: Record actual locations of control system components and show interconnecting wiring.
  - 7. Operation and Maintenance Data: Component list with part numbers, and operation and maintenance instructions.
- C. Shop Drawings: Project specific details, Plans, elevations, sections, product details, installation details, operational clearances, wiring diagrams and relationship to adjacent work. Field measure all openings prior to preparing shop drawings and notate measurements on shop drawings.
- D. Window Treatment Schedule: For all roller shades. Use same room designations as indicated on the Drawings and include opening sizes and key to typical mounting details.
- E. Verification Samples: For each finish product specified, one complete set of shade components, unassembled, demonstrating compliance with specified requirements.
  - 1. Shadecloth Sample: Mark face of material to indicate interior faces.
    - a. Test reports indicating compliance with specified fabric properties.
    - b. Verification Samples: 6 inches (150 mm) square, representing actual materials, color and pattern.
- F. Maintenance Data: Bill of materials for all components with part numbers. Methods for maintaining roller shades, precautions regarding cleaning materials and methods, instructions for operating hardware and controls.
- G. Warranty: Provide manufacturer's warranty documents as specified in this Section.
- H. Warranty: Manufacturer's warranty documents as specified in this Section.

## 1.6 QUALITY ASSURANCE

- A. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.
- B. Manufacturer Qualifications: Obtain roller shades system through one source from a single manufacturer with a minimum of ten years experience and minimum of five projects of similar scope and size in manufacturing products comparable to those specified in this section.
- C. Installer for Roller Shade System - Qualifications: Installer trained and certified by the manufacturer with a minimum of ten years experience in installing products comparable to those specified in this section.
- D. Product Listing Organization Qualifications: Organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.
- E. Fire-Test-Response Characteristics: Passes NFPA 701 small and large-scale vertical burn. Materials

tested shall be identical to products proposed for use.

- F. Shadecloth Anti-Microbial Characteristics: 'No Growth' per ASTM G 21 results for fungi ATCC9642, ATCC9644, ATCC9645.
- G. Resistance to Degradation When Exposed to Typical Cleaners: Passes BIFMA HCF 8.1 testing.

#### 1.7 MOCK-UP

- A. Provide a mock-up of one roller shade assembly for evaluation of mounting, appearance and accessories.
  - 1. Locate mock-up in window designated by Architect.
  - 2. Mockup Size: Full size.
  - 3. Mockup Size(WxH): 3 x 3 feet (0.94 x 0.94 m) minimum.
  - 4. Intent of mock-up is to demonstrate quality of workmanship and visual appearance.
  - 5. If mock-up is not acceptable, rebuild mock-up until satisfactory results are achieved.
  - 6. Do not proceed with remaining work until, mock-up is accepted by Architect.
  - 7. Retain mock-up during construction as a standard for comparison with completed work.
  - 8. Do not alter or remove mock-up until work is completed or removal is authorized.
  - 9. Full-sized mock-up may become part of the final installation.
  - 10. Full-sized mock-up will become the property of the Owner to be used for spare parts.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver in factory-labeled packages, marked with manufacturer and product name, fire-test-response characteristics, and location of installation using same room designations indicated on Drawings and in Window Treatment Schedule.
- B. Store and handle products per manufacturer's recommendations.

#### 1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Install roller shades after finish work including painting is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

#### 1.10 WARRANTY

- A. Roller Shade Hardware and Chain Warranty: Manufacturer's standard non-depreciating warranty for interior shading.
  - 1. Shade Hardware: 10 years unless otherwise indicated.
    - a. Mecho/7 including bead chain with ThermoVeil, EuroVeil, EuroTwill, Soho, Equinox, Midnite, Chelsea, or Classic Blackout shade fabric: 25 years.
  - 2. Standard Shadecloth: Manufacturer's standard twenty-five year warranty.
  - 3. Roller Shade Installation: One year from date of Substantial Completion, not including scaffolding, lifts or other means to reach inaccessible areas, which are deemed owner's responsibility.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Acceptable Manufacturer: MechoShade, which is located at: 42-03 35th St.; Long Island City, NY 11101; Contact Cherie Simmons, 770.519.0570, [cherie.simmons@mechoshade.com](mailto:cherie.simmons@mechoshade.com)
- B. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.

## 2.2 ROLLER SHADES, MANUAL OPERATION AND ACCESSORIES

- A. Shade System; General:
1. Components capable of being removed or adjusted without removing mounted shade brackets, or cassette support channel.
  2. Smooth operation raising or lowering shades.
  3. Cradle-to-Cradle certified for the complete shade system including operating hardware and shadecloth. Listed in C2C (DIR).
- B. Basis of Design: Mecho/7 System as manufactured by Mecho.
1. Description: Manually operated fabric window shades.
    - a. Shade Type: Single Roller.
    - b. Shade Type: Double Roller.
    - c. Universal drive capability to offset drive chain for reverse or regular roll shades.
    - d. Drop Position: Regular roll.
    - e. Mounting: As indicated on drawings.
    - f. Size: As indicated on drawings.
    - g. Fabric: As indicated under Shade Fabric article.
  2. Brackets and Mounting Hardware: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight.
    - a. Material: Steel, 1/8 inch (3 mm) thick.
    - b. Double Roller Brackets: Configured for light-filtering and room-darkening shades in one opening.
      - 1) Light-Filtering Fabric: Room-side of opening.
      - 2) Room-Darkening Fabric: Room-side of opening.
      - 3) Operating chain pulls for each fabric configured for opposite sides of the window.
    - c. Single Shade Operation Width: Up to 180 inches (4572 mm) dependent on fabric.
    - d. Multiple Shade Band Operation: Provide hardware as necessary to operate a maximum of six shade bands, totaling up to 50lbs hanging weight or 360 inches (9144 mm) wide; depending on fabric weight whichever is greater, using a single clutch operator.
    - e. Radiused Center Support Brackets: Provide brackets and connectors for radiused window applications.
      - 1) Maximum Offset: Eight degrees on each side for a 16 degree total offset.
  3. Roller Tubes:
    - a. Material: Extruded aluminum.
    - b. Size: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.
    - c. Fabric Attachment: Utilize extruded channel in tube to accept vinyl spline welded to fabric edge. Shade band to be removable and replaceable without removing roller tube from brackets or inserting spline from the side of the roller tube.
    - d. Roller tubes to be capable of being removed and reinstalled without affecting roller shade limit adjustments.
  4. Hembars: Designed to maintain bottom of shade straight and flat.
    - a. Style: Full wrap fabric-covered bottom bar, flat profile with heat sealed closed ends.
    - b. Style: Exposed aluminum bottom bar with matching finials.
      - 1) Color: To be selected by Architect from manufacturer's standard color selection.
    - c. Room-Darkening Shades: Provide a slot in bottom bar with wool-pile light seal.
  5. Clutch Operator: Manufacturer's standard material and design integrated with bracket/brake assembly.
    - a. Heavy-duty, 1/8" steel mounting bracket and integrated steel brake, clutch and sprocket assembly rigidly affix the shade support and user control to the building structure fully independent of the roller tube components.
    - b. Permanently lubricated maintenance-free brake assembly employs an oil-impregnated steel hub with wrapped spring clutch.
    - c. Brake must withstand minimum pull force of 50 pounds (22.7 kg) in the stopped position.



- d. Direct drive clutch requires no interstitial gear stages or plastic parts between the building structure and clutch ensuring reliable operation across the full range of shade sizes.
  - e. Urethane dampened clutch protects bead chain and clutch from failure due to high shock loads during shade operation minimizing down time.
  - f. Maximum shade hanging weight of 50 pounds (22.7 kg).
  - g. Clutch shall be upgradable to motorized drive on compatible tubes without requiring change in mounting attachment method/location, roller tube or fabric band.
  - h. Motorized drive options available require no additional wiring to be added for power or communication capability for switch or automated operation.
6. Drive Chain: Continuous loop T304 stainless steel beaded ball chain, 100 pound (45 kg) minimum breaking strength warranted from breaking for the life of the shade system hardware under prescribed operation. Provide upper and lower limit stops.
- a. Chain Retainer: Chain tensioning device complying with WCMA A100.1.
  - b. Limit stops: Bead stops affixed to the chain maintain consistent shadeband alignment at the top and bottom of shade travel across multiple shades, and help prevent shade damage resulting from unmanaged user control.
7. Mecho/7, Managed Lift Force, Hardware: Lifts single band or multiband shade assemblies:
- a. Lifting Force: 3 to 8.5 pounds (1.4 to 3.9 kg) max pull force to lift shade assemblies with a shade band hanging weight, not including mounting hardware, of up to 50 pounds (22.7 kg).
  - b. Direct drive clutch with Managed Lift Force provides the best user experience by managing the user pull force while using the fewest number of chain pulls to position a shade.
  - c. Backward compatible to Mecho/5 components including fascia, regular and reverse roll, pockets, and wall-mounting accessories.
  - d. Includes offset drive capability, left/right, front, or back to allow for utilization of blackout channels.
  - e. Allows for ease of operation when obstructions do not allow for direct drive chain access.
  - f. Offset chain drive shall not cause an increase of friction or pull force when operated up to a 26 degree angle from vertical.
8. Accessories:
- a. Fascia: Removable extruded aluminum fascia, size as required to conceal shade mounting, attachable to brackets without exposed fasteners.
    - 1) Single Fascia: Accommodate regular roll shades.
    - 2) Profile: Square.
  - b. Adjustable Multi-band Coupler: Field-adjustable coupler positioned between adjacent shadebands driven by the same clutch facilitates hembar alignment between the bands while maintaining the light gap between the shade bands to no more than 1.25 inches (32mm).

### 2.3 ROLLER SHADE FABRICATION

- A. Field measure finished openings prior to ordering or fabrication. Note field measurements on shop drawings.
- B. Openings Requiring Continuous Multiple Shade Units with Separate Rollers: Locate roller joints at window mullion centers; butt rollers end-to-end.

### 2.4 SHADE FABRIC

- A. Basis of Design: Shade fabric as manufactured by Mecho.
  - 1. Solar Shadecloths:
    - a. Fabric: Soho: 1100 series. 1 percent open. 2 x 2 basket-weave pattern of fine yarn PVC and polyester blend, same colors as in 1600 (3 percent open) and 1900 series, (5 percent open).
  - 2. Blackout Shadecloths:

- a. Fabric: Chelsea: 0250 series. Opaque.
- b. Color: Selected from manufacturer's standard colors.
3. Fabric Properties: Non-flammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.
  - a. Shade Type: Light filtering shades.
  - b. Shade Type: Room darkening shades.
4. Material Certificates and Product Disclosures:
  - a. Low-Emitting Material Certification: Greenguard Gold certified and listed in UL (GGG).
  - b. Cradle to Cradle Material Health Certificate:
    - 1) Achievement Level: Silver.
  - c. Health Product Declaration (HPD): Published declaration with full disclosure of known hazards.
5. Performance Requirements: As determined by Basis of Design product specified.

## PART 3 EXECUTION

### 3.1 EXAMINATION

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

### 3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under the project conditions.
- C. Coordinate with window installation and placement of concealed blocking to support shades.

### 3.3 INSTALLATION

- A. Install shades level, plumb, square, and true per manufacturer's instructions and approved shop drawings. Locate so shade band is at least 2 inches (51 mm) from interior face of glass. Allow proper clearances for window operation hardware. Use mounting devices as indicated.
- B. Replace shades exceeding specified tolerances at no extra cost to Owner.
- C. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range. Adjust level, projection, and shade centering from mounting bracket. Verify there is no telescoping of shade fabric.
- D. Clean roller shade surfaces after installation, per manufacturer's written instructions.
- E. Demonstrate operation and maintenance of window shade system to Owner's personnel.
- F. Manufacturer's authorized personnel are to train Owner's personnel on operation and maintenance of system.
  1. Use operation and maintenance manual as a reference, supplemented with additional training materials as required.

### 3.4 PROTECTION AND CLEANING

- A. Protect installed products until completion of project.

- B. Touch-up, repair or replace damaged products before Substantial Completion.
  - 1. Clean soiled shades and exposed components as recommended by manufacturer.
  - 2. Replace shades that cannot be cleaned to "like new" condition.

END OF SECTION 122413

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## SECTION 123661.16 - SOLID SURFACING COUNTERTOPS

## 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.
- C. Samples: For each type of material exposed to view.

## PART 2 - PRODUCTS

## 2.1 SOLID SURFACE COUNTERTOP MATERIALS

- A. Solid Surface Material: Homogeneous-filled plastic resin complying with ISFA 2-01.
1. Refer to the finish schedule for manufacturer and products.
  2. Type: Provide Standard type unless Special Purpose type is indicated.
  3. Colors and Patterns: **As selected by Architect from manufacturer's full range**, Refer to finish schedule on the drawings.
- B. Particleboard: ANSI A208.1, **Grade M-2-Exterior Glue**.
- C. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

## 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: **Premium**.
- B. Configuration:
1. Front: **Straight, slightly eased at top**
  2. Backsplash: **Straight, slightly eased at corner**.
  3. End Splash: **Matching backsplash**.
- C. Countertops:

1. **1/2-inch- (12.7-mm-)with front edge built up with same material.**
- D. Backsplashes: **1/2-inch- (12.7-mm-)** thick, solid surface material.
- E. Joints:
  1. Fabricate countertops without joints where possible. If joints cannot be avoided, indicate recommended locations on the shop drawings for architects review and comment.
- F. Cutouts and Holes:
  1. Undercounter Plumbing Fixtures: Make cutouts for fixtures **in shop** using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.

### 2.3 INSTALLATION MATERIALS

- A. Adhesive: Product recommended by solid surface material manufacturer.
- B. Sealant for Countertops: Comply with applicable requirements in Section 079200 "Joint Sealants."

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.
- B. Secure countertops to subtops with adhesive according to solid surface material manufacturer's written instructions.
- C. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.
- D. Install backsplashes and end splashes by adhering to wall and countertops with adhesive.
- E. Install aprons to backing and countertops with adhesive.
- 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.
- G. Apply sealant to gaps at walls; comply with Section 079200 "Joint Sealants."

END OF SECTION 123661.16

## SECTION 123661.19 - 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.
- C. Samples: For each type of material exposed to view.

## PART 2 - PRODUCTS

## 2.1 QUARTZ AGGLOMERATE COUNTERTOP MATERIALS

- A. Quartz Agglomerate: Solid sheets consisting of quartz aggregates bound together with a matrix of filled plastic resin and complying with ISFA 3-01.
  - 1. Refer to finish schedule on the drawings for products and Manufacturer's.
- B. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

## 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: Premium.
- B. Configuration:
  - 1. Front: Straight, slightly eased at top.
  - 2. Backsplash: Straight, slightly eased at corner.
  - 3. End Splash: Matching backsplash.
- C. Countertops: 3/4-inch- (3cm-) thick, quartz agglomerate.

- D. Backsplashes: 3/4-inch- (3 cm-) thick, quartz agglomerate.
- E. Joints:
  - 1. Fabricate countertops without joints. If joints are necessary due to design, so indicate on shop drawings for Architect's review
- F. Cutouts and Holes:
  - 1. Undercounter Plumbing Fixtures: Make cutouts for fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.

### 2.3 INSTALLATION MATERIALS

- A. Adhesive: Product recommended by quartz agglomerate manufacturer.
- B. Sealant for Countertops: Comply with applicable requirements in Section 079200 "Joint Sealants."

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.
- B. Secure countertops to subtops with adhesive according to quartz agglomerate manufacturer's written instructions.
- C. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.
- D. Install backsplashes and end splashes by adhering to wall and countertops with adhesive.
- E. Install aprons to backing and countertops with adhesive.
- 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.
- G. Apply sealant to gaps at walls; comply with Section 079200 "Joint Sealants."

END OF SECTION 123661.19



SECTION 142400 – ELEVATOR UPGRADES (Existing Elevator)

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Upgrade of existing elevator in accordance with the following document.

PART 2 PRODUCTS – See the following pages.

PART 3 EXECUTION – See the following pages.

**2665 BUFORD HIGHWAY**  
**BROOKHAVEN, GA**

**HYDRAULIC ELEVATOR MODERNIZATION**  
**SPECIFICATION**

**APRIL 17, 2020**

*Prepared For:*

**Shelly Hughes**  
*Managing Principal*



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SECTION 001000 –  
INSTRUCTIONS TO CONTRACTOR

**PART 1 - GENERAL**

1.1 EXAMINATION

- A. In order to discover and resolve conflicts or lack of definition which might create problems, Contractor must review Contract Documents, existing site conditions, and existing equipment specified to be retained for compatibility with its product prior to submitting quotation. Site review shall include, but not be limited to Adequacy of access, Retained equipment, elevator hoistways, pits, machine rooms, overhead clearance, electrical power characteristics, structural support, ect. Investigation and structural calculations required to determine compliance of existing elevator components, including machine support beams, with ASME A17.1, Rule 8.7.2.15.2 are responsibility of Contractor. Attach specific, written exception and/or clarification with quotation. Compliance with all provisions of Contract Documents is assumed and required in absence of written exception. If written exception is acceptable to contractor and consultant, an addendum to the specification will be issued and authorized. Purchaser will not pay for changes to building structure, structural supports, mechanical, electrical or other systems required to accommodate contractors equipment if not identified before contact award and authorized as stipulated above.
- B. Submission of quotation is considered evidence that Contractor has visited and is conversant with the site facilities, site conditions, requirements of the Contract Documents, pertinent state and local codes, state of labor and material markets, and has made due allowance in his quotation for all contingencies. Should Contractor’s investigation of site conditions or local codes or rules reveal requirements contrary to Contract Documents, or if Contractor finds any discrepancies or omissions from Contract Documents, or if Contractor is in doubt as to their meaning, he shall contact the Consultant for clarification at least five working days prior to quotation due date.
- C. No oral explanation will be made, and no oral instructions will be given before quotation due date. Contractor shall act promptly and allow sufficient time for Consultant to reply before submission of quotation. Any required interpretation or supplemental instructions will be issued in the form of an addendum to the specifications and forwarded to all pre-qualified Contractors.
- D. Provide everything necessary for and incidental to the satisfactory completion of work required by Contract Documents. All required preparations, hoisting and movement of new equipment, reused equipment, or removal of existing equipment shall be the responsibility of Contractor.

END OF SECTION

SECTION 000200

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SECTION 000200 –  
REQUEST FOR QUOTATION

**PART 1 - GENERAL**

1.1 PROJECT: ELEVATOR MODERNIZATION

- A. Lerch Bates Inc. has been authorized by HGL Studio and the city of Brookhaven to request your firm to submit a quotation for:
1. All engineering, labor, materials, transportation, services, and equipment necessary and reasonably incidental to perform work required by Contract Documents.
  2. Interim preventive maintenance.
  3. Warranty preventive maintenance.
  4. Continuing preventive maintenance subsequent to completion of work.

1.2 CONTRACT DOCUMENTS

- A. One set of electronic contract documents are provided for your use.
- B. Make inquiries to Lerch Bates Inc. Do not contact building personnel or the Purchaser, with the exception of requirement of item 1.2 C.
- C. Permission to review existing equipment and site conditions shall be secured from Shelly Hughes 678-570-8145, Greg Klima 678-367-5069, Alexis Ortega 786-294-2457, and Cooper Corley 470-832-9545.

1.3 CONSTRUCTION SCHEDULE

- A. See Section 003100, "Quotation Form" for project schedule.

1.4 ELECTRONIC QUOTATION

- A. Email quotations will be received until 5:00 PM prevailing local time May 5, 2023, identified as follows:

Contractor  
Address  
City/State/Zip

ELEVATOR MODERNIZATION

2665 Buford Highway  
Brookhaven, GA

CONFIDENTIAL QUOTATION

Email quotation to: Selected General Contractor

Email quotation to: Cooper Corley  
Lerch Bates Inc.  
Cooper.corley@lerchbates.com

- B. Quotations must be submitted on form provided as a part of Contract Documents, Section 003100. Quotations shall be subject to all requirements of Contract Documents, site conditions, General Conditions, Supplementary and Special Conditions and any other documents issued in connection with project. All blank spaces and questions on the quotation form must be completed and/or responded to. Failure to comply will constitute a non-responsive submittal.
- C. If Contractor desires to furnish items different from specified, Contractor shall submit substitution as an alternate quotation. Contractor shall supply Consultant with information in regard to proposed substitution of components or materials. Consultant shall decide whether the Contractor's substitution is equivalent to that specified. Deviation from requirements of Contract Documents shall be stated, in writing, in Contractor's transmittal letter submitted with quotation.

#### 1.5 NOTICE OF INTENT TO SUBMIT A QUOTATION

- A. Quotations have been invited from a limited number of pre-approved Contractors. Contractors who elect not to provide a quotation after having reviewed Contract Documents and site conditions shall notify Consultant no later than ten working days prior to quotation due date. Failure to submit a quotation without prior notice will be construed as justifiable cause for elimination of such Contractor for future consideration.

#### 1.6 OPENING

- A. Opening of quotations will be in private. Contractor selection will be based upon the following criteria:
  1. Cost of required work.
  2. Cost of interim maintenance.
  3. Cost of warranty maintenance.
  4. Cost of contract preventive maintenance.
  5. Completion schedule.
  6. Contractor's successful completion of similar projects and track record in the location of project.
  7. Contractor's maintenance capability in the location of the project.

#### 1.7 QUOTATION

- A. All quotations shall be firm. Escalation will not be permitted if Contract is awarded within 180 days from quotation due date.
- B. If award is deferred beyond 180 days, Contractors' quotations shall be subject to adjustment to reflect changes in the cost of labor and material.

#### 1.8 PURCHASER'S RIGHTS

- A. Purchaser reserves right to reject any or all quotations, to accept other than lowest quotation and to waive any informality in connection with opening and award of Contract.

#### 1.9 INVITED CONTRACTORS

- A. Contractor shall be prepared to provide evidence of experience, qualifications, and financial ability to carry out requirements of Contract Documents.



- B. If Contractor's contact person is other than indicated above, Contractor shall notify Consultant within five days of receipt of this Request for Quotation.

Contact: Chris Kuhn  
Company: KONE  
Address: Christopher.kuhn@kone.com  
Phone: 770-527-4528

Contact: Kevin Perdue  
Company: Otis Elevator  
Address: Kevin.perdue@otis.com  
Phone: 470-989-8170

Contact: Billy Moody  
Company: Phoenix Elevator  
Address: bmoody@pheonixelevator.com  
Phone: 404-732-8559

Contact: Cory Prader  
Company: Premier/Oracle Elevator  
Address: cory@premier-elevator.com  
Phone: 678-209-1254

Contact: Isaac Smith  
Company: Schindler  
Address: Isaac.smith@schindler.com  
Phone: 404-558-9834

Contact: Matt Slaats  
Company: TKE  
Address: Matt.slaats@tkelevator.com  
Phone: 770-250-6470

END OF SECTION

SECTION 003100

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SECTION 003100 –  
QUOTATION FORM

DATE:

PROJECT: 2665 Buford Highway  
Brookhaven, GA

SUBMITTED BY:   
Name of CONTRACTOR

CONTRACTOR'S Representative Telephone Number

Street Address

City State Zip Code

Send electronic copies to: Selected General Contractor

Cooper Corley  
Lerch Bates Inc.  
Cooper.corley@lerchbates.com

PART 1 - GENERAL

1.1 CONTRACTOR'S BASE QUOTATION

- A. Having examined documents prepared by Lerch Bates Inc. dated April 17, 2023, and having reviewed site conditions, applicable codes and all conditions affecting and governing the work, the Undersigned Contractor hereby offers to provide all engineering, labor, materials, transportation, services and equipment necessary and incidental to properly execute required work of the Contract Documents for the sum of:

ITEM 1: Modernize Passenger Elevators 1, Section 142400:

..... dollars \_\_\_\_\_ \$.....

ITEM 2: Related Work, Section 019000:

..... dollars \_\_\_\_\_ \$.....

ITEM 3: Total of Items 1-2:

..... dollars \_\_\_\_\_ \$.....

B. Maintenance:

1. Interim Maintenance: We agree to furnish interim, preventive maintenance during the period from written award of this Contract or verbal notice to proceed until all required work is complete for following amount per month per unit:

Passenger Elevator 1: \_\_\_\_\_ \$...../Month/Unit

NOTE: Do not include the cost of interim maintenance in "A" above, Base Quotations.

2. Twelve-Month Warranty Preventive Maintenance: Amount included in base quotation Item A. above.

Total Included in Item A. \$.....

Passenger Elevator 1: \_\_\_\_\_ \$...../Month/Unit

NOTE: Purchaser reserves the right to pay warranty maintenance cost in a lump sum or on a monthly basis during period maintenance is actually performed.

3. Contract Maintenance: We agree to provide continuing preventive maintenance as required by Owner's five-year contract included with these specifications Section 143250 at a charge per month as follows:

Passenger Elevator 1: \_\_\_\_\_ \$...../Month/Unit

NOTE: Contract preventive maintenance shall commence at the completion of the one year warranty maintenance program.

- C. Enter a cost figure for all pricing requested. Failure to comply, subjects quotation to disqualification.

- D. Bidders are directed to enter all maintenance and modernization pricing into the electronic spreadsheet identified as Excel Document 003100 (B). Spreadsheet to be electronically submitted with other required bidding documents.
- E. Undersigned affirms that quotations provided represent entire cost including site conditions, code requirements, drawings, specifications, addenda, and any other Contract Documents, and no claim will be made due to any increase in wage scales, material prices, taxes, insurance, cost indexes or any other factors affecting the construction industry or this project except as expressly allowed in Owner’s maintenance contract.

**1.2 ADDENDA**

- A. Undersigned acknowledges receipt of Addendum No. .... through .....

**1.3 CONTRACTOR’S OTHER SUPPORTING ENCLOSURES**

- A. Undersigned has enclosed the following (Check YES or NO):
  1. Separate letter containing any “Qualification” related to its Quotation.  YES  NO
  2. Separate Substitution Proposal.  YES  NO

**1.4 PROPOSED MODERNIZATION INSTALLATION SCHEDULE**

- A. Undersigned contractor submits the following completion schedule for project. Bidders are instructed to add additional rows to the following schedule grid to accommodate job specific phasing.

PHASE	DESCRIPTION	DURATION
1	Engineering Surveys	..... weeks
2	Submittal Preparation	..... weeks
3	Client Approval Period	..... weeks
4	Engineering, Procurement and Fabrication	..... weeks
5	Mod Installation, Sub-Phase 1: Car 1	..... weeks
6	Final Group Testing and Adjusting	..... weeks
7	Total Project Duration	..... weeks

**1.5 CONTRACTOR PROPOSED MODERNIZATION COMPONENTS AND TECHNOLOGY**

- A. Undersigned Contractor will utilize the following modernization technology for the projects and submits these systems for approval. Upon acceptance of these systems by Purchaser/Consultant, no substitutions shall be made without written approval of Consultant.

Modernization Systems and Components	Proposed Model Description/Vendor
Machine	
Control	
Door Operator	
Infrared Door Edge	
Fixtures	

Governor	
Safety	
Monitoring System	
Cab Interiors	
Door Panels/Entrances	

**1.6 CONTRACTOR'S LIST OF SUBCONTRACTORS**

- A. The undersigned Contractor will utilize the following subcontractors for major components of work and submits these firms for approval. Upon acceptance of these Sub-Contractors by Purchaser/Consultant, no substitutions shall be made without written approval of Consultant.

Subcontractor Name	Type of Work
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

**1.7 SUBMISSION AND ACCEPTANCE OF QUOTATIONS**

- A. Undersigned Contractor agrees to Purchaser's right to reject any and all quotations without explanation.
- B. Undersigned Contractor declares that preparation and submission of quotations herein contained do not obligate Purchaser or Consultant in any way.
- C. Undersigned Contractor agrees and understands that Purchaser assumes no obligation to enter into a Contract.

**1.8 ALTERNATES**

- A. State net sum to be added to or deducted from Stipulated Sum (Base Quotation) in event any Alternate Quotation is accepted.
- B. Submit Alternate Quotations by filling in blank spaces provided herein.
- C. Purchaser reserves right to accept or reject any or all Alternates.
- D. Provide lump sum price for all alternates as described below and in Section 01030, Alternates.

ALTERNATE 1: Modernize the complete elevator with the exclusion door frames. New.

..... dollars \_\_\_\_\_ \$.....

Schedule Impact: \_\_\_\_\_

**1.9 CONTRACTOR SIGNATURE**

DATE: \_\_\_\_\_

SIGNED: \_\_\_\_\_

PRINT NAME: \_\_\_\_\_

TITLE: \_\_\_\_\_

NAME OF FIRM: \_\_\_\_\_

STATE LICENSE No: \_\_\_\_\_

LEGAL ADDRESS:

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

TELEPHONE: \_\_\_\_\_

ORGANIZED AS A (MARK ONE):

INDIVIDUAL

PARTNERSHIP

CORPORATION UNDER STATE LAW OF

\_\_\_\_\_

END OF SECTION

SECTION 008000

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SECTION 008000 –  
SUPPLEMENTAL CONDITIONS

**PART 1 - GENERAL**

1.1 DEFINITION OF TERMS

- A. Term ELEVATOR CONSULTANT or CONSULTANT refers to Lerch Bates Inc. (Lerch Bates).
- B. OWNER/PURCHASER as used herein refers to selected General Contractor approved by HLG Studios.
- C. The term CONTRACT or CONTRACT DOCUMENTS consists of the Agreement, Conditions of Contract, Specifications, Addenda, Drawings if included, and Alternates if accepted.
- D. CONTRACTOR or ELEVATOR CONTRACTOR refers to any persons, partners, firm, or corporation having a contract with Purchaser to furnish labor and materials for the execution of work required.
- E. CONTRACT AWARD refers to Purchaser's verbal or written award for work required.
- F. SUBCONTRACTOR refers to any persons, partners, firm, or corporation having a contract with Contractor to furnish labor and materials for the execution of work required.
- G. As used in these Contract Documents "provide" shall be understood to mean "furnish and install".
- H. As used in these Contract Documents "retain or reuse existing" shall be understood to mean restore existing components or parts to like-new condition.
- I. Words in the singular shall include the plural whenever applicable or context so indicates.
- J. All technical terms in these Contract Documents are used as defined in the latest edition of American National Standard Safety Code for Elevators, Dumbwaiters, Escalators, and Moving Walks ASME A17.1. and A17.2.

1.2 CONSULTANT'S STATUS

- A. Consultant shall act as Purchaser's and/or Building Management's representative on all matters pertaining to required work. Consultant shall interpret Contract Documents, analyze Contractor's quotations, review Contractor's suggested alternates, review all Contractor's submittals, approve billings, review technical details and construction procedure, perform work progress reviews, and review and test completed work for compliance with Contract Documents prior to acceptance of work by Purchaser.
- B. Field Review Scheduling: Schedule progress and final work reviews with Consultant. Reply promptly, in writing, to corrective work indicated on Consultant's progress and/or final review reports, indicating status and schedule for completion. Consultant anticipates scheduled site review appointments will be met.

1.3 CONTRACT

- A. Contract includes all engineering, labor, tools, and material required to complete the work in every respect. Contractor is cautioned to familiarize itself with existing site conditions and to include all incidental work that might occur or be required during the work. After Contract has been awarded,

verbally or in writing, no extra charges will be allowed for any labor or material necessary to complete required work whether exactly described in these specifications.

- B. Any discrepancies or ambiguities found in Contract Documents or drawings shall be reported to the Consultant prior to Contractor's quotation submittal.

#### 1.4 MEASUREMENTS AND DRAWINGS

- A. Drawings or measurements included with Contract Documents are for convenience of Contractor. Complete responsibility for detailed dimensions lies with Contractor. Contractor shall verify all dimensions with the actual on-site conditions. Where work of Contractor is to be coordinated with another trade, Contractor's shop drawings shall show actual dimensions and method of joining work of those trades.

#### 1.5 CODES AND ORDINANCES

- A. All work covered by these Contract Documents is to be done in full accord with national code, state and local codes, ordinances, and elevator safety orders in effect at time elevator alteration permit issuance. All requirements of local Building Department and fire jurisdiction are to be fulfilled by Contractor and its Subcontractors. Also see Section 010400, Article 1.1.

#### 1.6 CONTRACTOR'S INSURANCE

- A. Contractor shall take out and maintain during the life of this Contract Worker's Compensation Insurance with statutory limits set by the State of Georgia laws for protection of its employees.
- B. Contractor shall carry a comprehensive general liability policy including completed operations blanket contractual broad form property damage, and Purchaser's and Contractor's protective liability in a casualty or liability insurance company acceptable to Purchaser. Insurance policy shall fully protect Contractor, its Subcontractors, Purchaser, and Consultant from all loss and liability.
- C. Prior to commencing work, Contractor shall secure required insurance, at its sole cost, and submit certificate of confirmation naming indemnified parties as additional insured. Said policies, including an endorsement which states that such insurance will not be cancelled or materially changed unless Purchaser is given thirty days' notice, in writing, of the intention of said insurer to cancel or change any such policy. In the event Property is owned by a joint venture or other multi-party entity, all joint venture partners, or parties with an equity interest in the ownership shall be named as additional insureds. Contractor's insurance shall be primary to any applicable loss. With Purchaser's prior approval, an Owners & Contractors Protective Liability (OCPL) Policy may be substituted for commercial general liability coverage. Please refer to the attached appendix that states the project specific insurance requirements.

Type Of Insurance Coverage	Amount
Workers' Compensation and Occupational Disease	Statutory Limits
Employer's Liability (Including Occupational Disease Coverage)	\$1,000,000
Commercial General Liability, Including Operations, Contractual, And Completed Operations Coverages, Occurrence Basis	\$1,000,000 Combined Single Limit for Bodily Injury And Property Damage

Commercial Automobile Liability  
Covering Owned, Non-Owned and Hired  
Vehicles Used In The Performance Of  
The Services

\$1,000,000 Combined Single Limit for  
Bodily Injury and Property Damage

- D. Contractor shall file with Purchaser a certificate of insurance from its insurance company, stating that such insurance is being carried and that Purchaser will be notified at least ten days prior to any cancellation of said insurance.

#### 1.7 PURCHASER INSURANCE

- A. Purchaser's insurance policy covers work and equipment in place in building and approved and accepted by Consultant and Purchaser. All material and equipment stored on site and not actually installed is not included in Purchaser's policy and such material and equipment shall be covered under Contractor's Property Damage Insurance.

#### 1.8 TAXES, OLD AGE PENSIONS AND UNEMPLOYMENT INSURANCE

- A. Contractor's quotations for required work, materials and equipment shall include all local, state and federal occupational and sales taxes, luxury taxes, excise taxes, federal and state old age pensions, unemployment insurance contributions, and any other similar taxes and contributions in effect at time of award of Contract (verbally or in writing). Contractor shall be liable for aforementioned taxes whether or not specifically included in his quotation or in final Contract Document. In event additional sales or use taxes are imposed after award of Contract, such sales or use taxes are to be paid, in addition to original Contract amount, by Purchaser to Contractor, who in turn is to pay them to proper authorities. Reciprocally, if any of above-mentioned taxes or contributions in effect at time of award of Contract should be revoked before consummation of Contract, Contractor shall rebate Purchaser amount of taxes included in original quotation and Contract. Where required by law, amount of the tax is to be specifically stated in Contractor's quotation; however, failing to do so will not relieve Contractor from responsibility for assumption of these taxes.

#### 1.9 LABOR LAWS

- A. Contractor and its Subcontractors performing work under this Contract shall comply with applicable provisions of all federal, state, and local labor laws.

#### 1.10 PATENTS

- A. Contractor shall save and hold harmless Purchaser and its officers, agents, servants, employees, and Consultant from liability of any nature or kind on account of any patented or unpatented invention, process, article, or appliance manufactured or used in performance of Contract, including its use by Purchaser including all cost and expenses for defending any suits unless otherwise specifically stipulated in Contract Documents.
- B. Licenses which may be required for completion of required work are to be obtained and paid for by the Contractor.

1.11 ASSIGNMENTS

- A. Neither party to this Contract shall assign Contract or sublet it as a whole without written consent of other party, nor shall Contractor assign any payment due him or to become due to him hereunder without previous written consent of Purchaser.

1.12 ADVERTISING

- A. Advertising privileges will be retained by Purchaser. It is the duty of Contractor to keep premises free from posters, signs, decorations, etc., unless specifically approved by Purchaser.

1.13 PROTECTION OF WORK AND PROPERTY

- A. Contractor shall continuously maintain adequate protection of all its work from damage and shall protect Purchaser property from injury or loss arising out of this Contract. Contractor shall make good any such damages, injury, or loss, except such as may be directly caused by agents, subcontractors, or employees of the Purchaser. Contractor shall provide all barricades required to protect open hoistways or shafts per OSHA regulations. Design of barricades in public areas shall be approved by Purchaser prior to fabrication and installation. **The contractor shall provide 6' collapsible barricading that will be taken down at the end of each day.**
- B. If Contract includes work which would be disruptive during normal business operations, or would be dangerous to building occupants, said work shall be performed during hours as building management dictates. Examples of such work include, without limitation, saw cutting of concrete, jack hammering, welding, metal cutting, pouring concrete, erecting steel, or hoisting equipment over occupied portions of the building, or performing tests requiring all elevators in a group. Contractor shall perform such work during off-hours and shall include all costs in its quotation.
- C. Contractor shall install a suitable protective covering on all finished floors whether marble, wood, carpet or other, in areas where work is being performed. No material handling equipment shall be permitted on or over finished floors unless said floors have been protected in a manner approved by building management.
- D. Portable fire extinguishers shall be provided throughout Contractor's area of work and shall be placed so as to be accessible at all times. Extinguishers shall be multi-purpose dry chemical type, provided on a basis of one 2A-20BC rated unit for each 3,000 square feet of floor area. Extinguishers will remain property of Contractor.
- E. Contractor shall at all times maintain work areas so all portions are accessible to fire department personnel and apparatus. Fire hydrants and fire department connections to building sprinkler systems must be kept free from obstruction at all times.
- F. Contractor shall strictly supervise any welding, metal cutting or other operations employing open flame work. All welding and cutting equipment shall be safely arranged and all combustibles in vicinity of any work being performed shall either be removed or protected by a noncombustible cover. Welding or cutting shall be attended by an assistant or fire watchman who is equipped with at least one 2A-20BC rated multi-purpose dry chemical fire extinguisher. Fire watchman will maintain strict surveillance during entire welding or cutting operation and extinguish flying sparks or burning slag. After welding or cutting operation fire watchman shall thoroughly search entire area for remnants of smoldering materials before he is released from his duty. Any welding or other operation employing open flame in any portion of building shall be scheduled with and receive approval of Purchaser. Hot work permits shall be scheduled and approved with Purchaser.

- G. Contractor shall keep noise level below 70 dBA level during normal building hours. When it is necessary to produce noise above this level, Contractor shall advise building management of such needs and times will be scheduled as directed. The Contractor shall anticipate and schedule excessive noise generating procedures and include allowance for same in its quotation and schedule. Anything above 80 dBA shall be conducted outside of normal building operation hours.

#### 1.14 ACCIDENT REPORTS

- A. In the event of accidents of any kind, Contractor shall furnish Purchaser with copies of all accident reports. Reports shall be sent without delay and at same time that they are forwarded to any other parties.

#### 1.15 STORAGE OF MATERIALS

- A. Contractor shall confine storage of materials on job site to limits approved by Purchaser and shall not unnecessarily encumber premises or overload any portion of building with materials to a greater extent than structure design load. Space will be provided on site for material storage.

#### 1.16 REMOVAL OF EQUIPMENT AND RUBBISH

- A. Contractor shall remove and properly dispose of all rubbish as fast as it accumulates including all existing parts and components not retained, keeping building and premises clean during progress of work and leave premises at completion in a condition acceptable to the Purchaser. Store parts and components identified by Consultant as useful for maintenance of units not being modernized as directed by Purchaser. All other parts and components not retained shall become property of Contractor. General contractor will provide trash removal.

#### 1.17 MATERIALS AND WORKMANSHIP

- A. All materials and equipment furnished shall be new and best quality. Installation shall be accurate, workmanlike, and subject to approval of Purchaser and Consultant. All materials and equipment provided shall conform to regulations of enforcement bodies having jurisdiction. Contractor shall furnish material samples for approval.

#### 1.18 SUPERVISION

- A. Contractor shall assign a competent Project Manager, superintendent, and on-site foreman for project satisfactory to Purchaser and Consultant. Such persons shall represent Contractor and all instructions given to them shall be binding as if given to Contractor.

#### 1.19 ROUTINE BUSINESS

- A. After award of Contract, all business relating to required work shall be transacted through Consultant, unless otherwise directed.

#### 1.20 CHANGES AND EXTRA WORK

- A. Purchaser may at any time make changes to Contract Documents, plans and drawings, omit work, or require additional work by Contractor. For such additional work performed hereunder, Purchaser shall pay Contractor on the basis of a mutually agreed lump sum. See Article 1.25 for method of computing lump sum cost of additional work. Contractor shall make no additions, changes, alterations, or omissions, or perform extra work, without receipt of written authorization of Purchaser.

1.21 PAYMENTS

- A. Unless otherwise agreed, Contractor shall submit monthly applications for payment together with necessary data, information, waivers, and affidavits to Consultant. Consultant shall review data for accuracy and forward such applications to Purchaser for payment. Information shall be submitted with payment request and work progress forms.
- B. Applications for payments are to cover 90% of the value of labor performed and material installed and delivered during the preceding month or materials delivered to Contractor's storage facility.
- C. Balance (retention) shall be paid by Purchaser upon final acceptance of entire work by Consultant and Purchaser and after performance guarantees have been satisfactorily demonstrated. See Section 017000.
- D. Contractors Payment Schedule is agreed to mirror the following: **(will need to be approved by selected General Contractor)**
  - 1. 35% Down Payment due at the award of the contract.
  - 2. 25% Material Payment due upon delivery.
  - 3. 30% Progress Payment.
  - 4. 10% Retainage Due at the completion of all work and at the satisfaction of owner.

\*\*\*\*\*All Payment terms are net 30 days\*\*\*\*\*

1.22 PAYMENT WITHHELD

- A. Purchaser and/or Consultant may withhold approval of payment on any Contractor request to such extent as may be necessary to protect Purchaser from loss on account of:
  - 1. Believed negligence on part of Contractor to execute the work properly or fail to perform any provision of Contract. Purchaser, after 15 days' written notice to Contractor, may without prejudice to any other remedy he may have, make good such deficiencies, and may deduct its cost from the overall Contract sum.
  - 2. Claims filed or reasonable evidence indicating probable filing of claims by other Contractors or Subcontractors.
  - 3. Failure of Contractor to make proper payments to its material suppliers or Subcontractors for material and labor.
  - 4. A reasonable doubt that required work can be completed by Contractor for balance then unpaid or in Contract time frame.
  - 5. Contractor's damage to building or another Contractor.
- B. When the above grounds are removed, payment shall be made in full, less retention.

1.23 LIENS AND AFFIDAVITS

- A. Neither final payment nor any part of billing retention shall become due until Contractor shall deliver to Purchaser a complete release of all liens arising out of this Contract or receipts marked paid in full in lieu thereof. In addition, Contractor shall furnish an affidavit to Purchaser that, so far as he has knowledge or information, releases, or receipts include all labor and materials for which a lien could be filed. If any lien remains unsatisfied after all payments are made by Purchaser, Contractor shall refund to Purchaser all monies the latter may be compelled to pay in discharging such a lien, including all costs and reasonable attorney's fees.

1.24 CLAIMS FOR EXTRA COST

- A. Contractor claims for extra cost due to additions or changes to required work shall be submitted to Consultant in writing within a reasonable time after such additions or changes identified or are requested and in any event before proceeding with required work. No such claim shall be valid unless so made. Maximum charge for additions/changes to work shall be Contractor cost +10% for overhead and profit. Contractor's cost shall be verifiable from actual supplier invoices, purchase orders, time tickets, etc.

1.25 DELAYS AND EXTENSION OF TIME

- A. If Contractor progress is delayed due to acts of Purchaser or Consultant, acts of other Contractors, fire, floods, strikes or other casualties beyond the control or without fault or negligence of Contractor, time for completion of the work shall be extended for a period determined by Consultant to be equivalent to time of such delay. Contractor must notify Consultant, in writing, of such delay within 48 hours after delay commences, or no extension of time will be granted. Extension of time without written request within said period on one or more occasions shall not be deemed a waiver of provisions of this article.

1.26 PERMITS

- A. Contractor shall obtain and pay for or cause its Subcontractor to obtain and pay for all permits required to complete required work. In addition, Contractor shall arrange, schedule, and pay for or cause its Subcontractors to arrange, schedule and pay for all required final inspections by state, local or independent certified inspecting authorities necessary for issuance of all required Purchaser utilization permits in regard to completed work.

**PART 2 - SPECIAL CONDITIONS**

2.1 PROGRESS OF WORK

- A. Upon award, verbally or in writing, Contractor shall reconfirm in writing, starting and completion schedule including equipment delivery dates based upon the information submitted on its quotation form, Section 003100.
- B. Contractor shall submit in writing monthly reports with payment request, including current equipment delivery dates and anticipated completion dates for individual units and groups of units.
- C. Project Manual: Upon award, verbally or in writing, contractor shall prepare three project manuals neatly bound in a three-ring binder. One manual shall be retained by the contractor, one provided to the Purchaser, and one provided to the Consultant. The manuals shall contain the following information and sections identified in an index with numbered divisions.
1. Project Specification revised if required to indicate basis of award. (While maintaining original text and clearly identifying revisions).
  2. Contractor completed Bid Form, specifications Section 00310. Include copy of original submission and any revisions.
  3. Alternate quotation indicating Purchaser acceptance or rejection.
  4. Purchaser's executed contract.
  5. Initial project schedule with estimated versus actual milestone dates. Include schedule revisions.
  6. Project payment requests including verification of payment and lien release.
  7. Code acceptance.
  8. Purchaser's temporary acceptance documents.

9. Purchaser's final acceptance documents.
  10. Consultant's progress review comments and requirements.
  11. Consultant's final Contract review comments and requirements.
  12. Shop drawings submittals, including set(s) with review remarks.
  13. As built drawings, including control wiring diagrams.
  14. Maintenance Agreement, Specification Section 14325.
- D. A second manual shall include the identical section numbers and shall be identified and utilized for general correspondence on these subjects. Additional sections shall include correspondence not specifically identified by one of these sections. An index in front of this section shall number and identify source of correspondence and subject.
- E. Contractor shall maintain all six manuals in an up-to-date condition. Prior to final payment, Contractor shall deliver to Purchaser the documents in items 1,2,3, and 13 above on a computer disk.

END OF SECTION



SECTION 010100

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SECTION 010100 –  
SUMMARY OF WORK

**PART 1 - GENERAL**

1.1 WORK COVERED BY CONTRACT DOCUMENTS

- A. Modernization of 1 Hydraulic elevator as follows:
  - 1. 2665 Buford Highway- One (1) Passenger Elevator. Car 1.
- B. Provide all labor, engineering, tools, transportation, services, supervision, materials, and equipment necessary for and incidental to satisfactory completion of required work as indicated in Contract Documents.
- C. Provide all required staging, hoisting and movement of new equipment, reused equipment, or removal of existing equipment.
  - 1. Disposal of all rubbish the responsibility of the contractor. Removal of material and job site cleanup is expected to be a daily occurrence.
- D. Applicable conditions of Purchaser's General, Special, and Supplemental Conditions. **General Contractor will provide contract, they may elect to use Contractors agreement.**
- E. Prime contracts are defined below and each is recognized to be a major part of required work to be performed concurrently in close coordination with work of other Contractors.
  - 1. This Contract: Elevator Modernization. Include associated work specified in Section 019000.
- F. Scope of Contract includes, but is not limited to, the following:
  - 1. Coordination, scheduling, and management of work of component suppliers and subcontractors.
  - 2. Furnish and install equipment as specified, utilizing existing and/or modified hoistways and machine rooms.
  - 3. Specific item of required work which cannot be determined to be included in another contract is thereby determined to be included in prime contract.
  - 4. Contractor shall provide owner and 3<sup>rd</sup> Party Consultant access to web based maintenance management system specific to the building being modernized. Access should provide full detail of all equipment related failures in a "push" manor via email or text message.

1.2 PRIME CONTRACTOR'S DUTIES

- A. Prime Contractor's duties include the following:
  - 1. Provide and pay for labor, materials and equipment, tools, construction equipment and machinery, and other facilities and services necessary for proper execution and completion of required work.
  - 2. Pay for legally required sales, consumer, and state remodel taxes.
  - 3. Secure and pay for required permits, fees, and licenses necessary for proper execution and completion of required work, as applicable at time of quotation due date.
  - 4. Give required notices.
  - 5. Comply with codes, ordinances, rules, regulations, orders, and other legal requirements of public authorities applicable to performance of required work.
  - 6. Promptly submit written notice to Consultant of observed variance of Contract Documents from legal requirements.
  - 7. Enforce strict discipline and good order among employees. Do not employ persons unskilled in assigned task.

1.3 WORK SEQUENCE

- A. Construct work in stages. Description and proposed sequence dates are as listed on Quotation Form Section 003100.

1.4 WORKING HOURS

- A. Unless otherwise stated below or elsewhere in the Contract Documents, Contractor shall have access to the building for work activities during the following regular building operating hours:
  - 1. Working hours will begin when General Contractor opens up the jobsite.
- B. Contractor shall perform all work that has the potential to result in any of the following conditions outside of regular building operating hours at no additional cost to the Purchaser:
  - 1. More than one elevator out of service in a group of elevators (not including a second car out of service for more than sixty minutes for regular preventive maintenance during non-peak traffic periods).
  - 2. Interruptions or changes in normal group automatic operation.
  - 3. Activation of Firefighter's Emergency Operation Phase I.
  - 4. Activation of Standby Power Operation.
  - 5. Noise levels in excess of **70 dBA** measured in any occupied or public space.
  - 6. Transport of large equipment through public or tenant spaces.

1.5 CONTRACTOR USE OF PREMISES

- A. Confine operations at site to areas permitted by law, ordinances, permits, Contract Documents, and Purchaser's specific instructions.
- B. Do not unreasonably encumber site with materials or equipment. Staging area will be located as directed by General Contractor.
- C. Do not load structure with weight that will endanger structure. Coordinate with Purchaser.
- D. Assume full responsibility for protection and safekeeping of tools and products stored on or off premises.
- E. Move stored products which interfere with operations of building or the operations of other trades.
- F. Obtain and pay for use of additional storage or work areas needed for operations.

1.6 CONCURRENT MODERNIZATION WORK AND BUILDING OPERATION

- A. This project is a major elevator modernization in an existing building which is open for public business and will continue to operate throughout all phases of required work. It is essential that Contractor give special attention and priority to all matters concerning project safety, protection from dust and loose materials, reduction of noise level, protection from water and air infiltration into building, and maintenance of neat, sightly conditions in and around work areas inside and outside of building. Packaging, scrap materials, and demolition debris shall be promptly removed from building and site on a daily basis.
- B. Unless otherwise stated in the Contract Documents, Contractor shall allow only one elevator to be out of service in each elevator group at any time during regular building operating hours.

- C. At all times Contractor shall provide clearly visible warning and directions signs, full height barricades with locking doors, temporary lighting, overhead protection, and hazard-free walking surfaces throughout public area. At all times give special attention to building entrances, exits, and proper safe exiting through work areas as required by law.
  
- D. Contractor shall consult Purchaser and other Contractors to establish and maintain safe temporary routes, including, but not limited to proper barricades, walking surfaces, lighting, fire protection, exiting, warning, and directional signs, and general protection of persons from all hazards in accordance with OSHA Standards due wholly or partially to its operations.

END OF SECTION

SECTION 01030

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SECTION 01030

ALTERNATES

PART 1 GENERAL

1.01 SCOPE

- A. Provide material and labor required for complete execution of accepted alternates. Comply with all provisions of the Contract Documents.
- B. Alternate Summary:
  - 1. Complete Elevator replacement excluding entrance frames and guide rails: New.
- C. Alternate Scope of Work:
  - 1. Complete Elevator replacement excluding entrance frames and guide rails: New.
    - a. Pit: New.
      - 1) Oil line.
      - 2) Twin post jacks.
      - 3) Buffers and channels.
    - b. Hoistway Entrances: New.
      - 1) Stainless Steel Hoistway Doors. (GAL)
      - 2) Hoistway Door Tracks. (GAL)
    - c. CAB and Platform: New.
      - 1) Platform.
      - 2) Car Sling.
      - 3) Cab Shell.
      - 4) Slide guides.
      - 5) Clutch to fit GAL door equipment.

**NOTE:** If car rails and supports need to be included for a jack replacement. Please clarify in bid.

END OF SECTION

SECTION 010400

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SECTION 010400  
PROJECT PROCEDURES

**Part 1 - General**

1.1 Applicable codes

- A. Compliance with regulatory agencies: comply with most stringent applicable provisions of following codes, laws, and/or authorities, including revisions and changes in effect:
  - 1. Safety code for elevators and escalators, ASME a17.1
  - 2. Guide for inspection of elevators, escalators, and moving walks, ASME a17.2
  - 3. Elevator and escalator electrical equipment, ASME a17.5
  - 4. National electrical code, NFPA 70
  - 5. Americans with disabilities act, ADA
  - 6. Local fire authority
  - 7. Requirements of most stringent provision of local applicable building code.
  - 8. Life safety code, NFPA 101
  - 9. Uniform federal accessibility standard, UFAS

1.2 Staging area

- A. An equipment staging area will be available for use by contractor General Contractor will provide contractor two (2) parking spots beside the building or adjacent lots. Location to be determined by owner/General Contractor. Contractor shall supply, maintain, and secure necessary storage area at job site. Service parking spots will be made available for unloading and loading of job-related material at the building. Contractor will be responsible for storage and security of material brought on site including but not limited fencing and temporary waterproof structures. Contractor shall take all precautions to protect the finished flooring and all other finishes in the provided area. Contractor shall restrict access to their stored material and shall notify purchaser/property management prior to storing of any large equipment which will impose heavy concentrated loading on floor area. A clear walkway will be identified by both Branam Towers LLC and contractor as this is the only roof access for the building. Do not store such equipment until approval is received.
  - 1. **Contractor shall make provisions to remove all remaining unretained parts and material before final inspection.**

1.3 WORK PHASE

- A. See section 003100, quotation form.
- B. No one elevator shall be taken out of normal operation until all material has arrived on site for the specific unit.
- C. It is the expectation that once work begins on any one (1) single unit, elevator contractor to continue its daily work processes without any gaps in schedule or work stoppages until completion of project.

1.4 OCCUPANCY AND WORK BY OTHERS

- A. Contractor expressly affirms purchaser's rights to let other contracts and employ other contractors in connection with required work. Contractor will afford other contractors and their workmen reasonable



opportunity for introduction and storage of materials and equipment, for execution of their work, and will properly connect and coordinate its work with theirs. Contractor will also incorporate comparable provisions in all its subcontracts.

- B. Contractor declares that other contractors employed by purchaser on basis of separate contracts may proceed at such times as necessary to install items of work required by purchaser.
- C. Contractor declares that it will cooperate with other contractors employed by purchaser and, in addition to other coordination and expediting efforts, will coordinate their work by written notices regarding necessity of such work to be done on or before certain dates.
- D. Contractor declares that it is responsible for review, stamped, and signed approval of all shop drawings for required work.
- E. Contractor hereby declares that content of foregoing paragraphs and influence they may have on project:
  - 1. Shall not cause a change in stipulated contract sum
  - 2. Shall not cause a change in construction time schedule

End of section

SECTION 013000

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SECTION 013000 –  
SUBMITTALS

**PART 1 - GENERAL**

1.1 ACTION SUBMITTALS

- A. Within Thirty (30) calendar days after award of contract and before beginning equipment fabrication submit shop drawings and required material samples for review. Allow 7 days for response to initial submittal.
1. Car and counterweight information:
    - a. Existing Total Car Weight:
      - 1) Documented on crosshead data tag, all cars.
      - 2) Field Verified: weigh single cars and one car per group of each identical duty type.
    - b. Field verified counterweight total weight: Weigh or balance verify at vertical center of hoistway, single cars and one car per group of each identical duty type.
    - c. Estimated total weight of means of suspension.
  2. Power Confirmation Information: Field verified existing conditions at each elevator main disconnect:
    - a. Actual maximum available voltage and current.
    - b. Verify true earth ground value.
- B. Within 60 calendar days after award of contract and before beginning equipment fabrication submit planned modernization design information, shop drawings, and required material samples for review. Allow 30 calendar days for response to initial submittal.
1. Indicate equipment lists, reactions, and design information on layouts in table form, including:
    - a. Car:
      - 1) Total car weight to be included on new crosshead data tag.
      - 2) Written confirmation that designed modernization total combined weight of car and rated load:
        - a) Is or is not more than 5% less or more than that of the original installation.
      - 3) Verify buffer capacity via data tags or known manufacturing data.
    - b. Power Confirmation Information: Design for existing conditions.
      - 1) Motor horsepower and code letter designation.
      - 2) Motor drive starting current, full load running current, and demand factor.
      - 3) Engineered power consumption based on 180 starts per hour full load, non-dynamic braking.
      - 4) Written confirmation that existing electrical provisions are adequate for post modernization installation equipment requirements.
    - c. Written confirmation that total planned modernization reactions on building structure do not exceed originally designed reactions by more than 5% due to increased post modernization weights of:
      - 1) Hydraulic machine and motor.
      - 2) Total car weight.
      - 3) Suspension means.
      - 4) Suspended compensation.
      - 5) Travelling cables.
      - 6) Car Capacity.
    - d. Product Data, Including:
      - 1) Capacities, sizes, performances, operation, control, signal systems operations, safety features, finishes, and similar information.
      - 2) Product data for car enclosures and hoistway entrances.

- 3) Product data for signal fixtures, lights, graphics, tactile marking plates, and details of mounting.
  - 4) Full details of ascending car protection means and installation.
  - 5) Two-way conversation devices.
  - 6) Post-modernization machine room heat emissions in BTU.
2. Shop Drawings:
- a. Fully Dimensioned Fixture Drawings:
    - 1) Car operating panels.
    - 2) Car floor indicators.
    - 3) Hall stations.
    - 4) Destination/landing input stations.
    - 5) Position indicators.
    - 6) Hall lanterns.
    - 7) Access key switch.
    - 8) Remote panels.
  - C. Written Maintenance Control Program (MCP) specifically designed for the equipment included under this contract.
    1. Include any unique or product specific procedures or methods required to inspect or test the equipment.
    2. Identify weekly, bi-weekly, monthly, quarterly, and annual maintenance procedures, including statutory and other required equipment tests.
  - D. Submittal review shall not be construed as an indication that submittal is correct or suitable or that the work represented by submittal complies with the Contract Documents. Compliance with Contract Documents, Code requirements, dimensions, fit, and interface with other work is Contractor's responsibility.
  - E. Acknowledge and/or respond to review comments within fourteen calendar days of return.
    1. Promptly incorporate required changes due to inaccurate data or incomplete definition so that delivery and installation schedules are not affected.
    2. Identify and cloud drawing revisions including Contractor elective revisions on each re-submittal.
  - F. Contractor's revision response time is not justification for equipment delivery or installation delay.
- 1.2 FINAL CONTRACT DOCUMENTS
- A. See Section 017000, Project Closeout.

END OF SECTION

SECTION 016000

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SECTION 016000 –  
MATERIAL AND HANDLING

**PART 1 - GENERAL**

1.1 SITE CONDITION INSPECTION

- A. Prior to beginning installation of equipment, examine hoistway and machine room areas. Verify no irregularities exist which affect execution of work specified.
- B. Do not proceed with installation until work in place conforms to project requirements.

1.2 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. General:

- 1. The protection of all equipment and exposed finishes shall be the responsibility of the Contractor during delivery, handling, and installation until completion of project.
- 2. The Elevator Contractor shall replace damaged materials with new at no additional cost for material and labor to Purchaser.

B. Delivery and Storage:

- 1. Manufacturers' original packing must adequately protect materials during delivery.
- 2. Deliver materials to the site ready for use in the accepted manufacturer's original and unopened containers and packaging, bearing labels as to type of material, brand name, and manufacturer's name. Delivered materials shall be identical to accepted samples.
- 3. Store materials in original protective packaging under cover in a dry and clean location off the ground. Remove delivered materials that are damaged or otherwise not suitable for installation from the job site and replace with acceptable materials.
- 4. It is the responsibility of the Contractor to properly store and protect all materials in space provided or designated by the Purchaser against damage, stains, scratches, corrosion, weather, construction debris, and environmental conditions.

1.3 INSTALLATION REQUIREMENTS

- A. Install all equipment in accordance with Manufacturer's instructions, referenced codes, specifications, and approved submittals.
- B. Install machine room equipment with clearances in accordance with referenced codes and specification.
- C. Install all equipment so it may be easily removed for maintenance and repair.
- D. Install all equipment for ease of maintenance.
- E. Install all equipment to afford maximum accessibility, safety, and continuity of operation.
- F. Remove oil, grease, scale, and other foreign matter from the following equipment and apply one coat of field-applied machinery enamel:
  - 1. All exposed equipment and metal work installed as part of this work which does not have architectural finish.
  - 2. Machine room equipment.
  - 3. Pit equipment.
  - 4. Neatly touch up damaged factory-painted surfaces with original paint color.

5. Protect machine-finish surfaces against corrosion.

#### 1.4 MANUFACTURER'S NAMEPLATES

- A. Manufacturer's name plates and other identifying markings shall not be affixed on surfaces exposed to public view. This requirement does not apply to Underwriter's Laboratories and code required labels.
- B. Each major component of mechanical and electrical equipment shall have an identification plate with the Manufacturer's name, address, model number rating, and any other information required by governing codes.

#### 1.5 COLORS OF FACTORY-FINISHED EQUIPMENT

- A. All colors will be selected from the Manufacturer's standard range unless custom colors are specified herein.
- B. Submit samples of all standard colors available and/or specified custom colors for review and approval. See Section 013000, Submittals.
- C. Submit samples of all specified architectural metals specified for review and approval. See Section 013000, Submittals.

#### 1.6 MATERIALS AND FINISHES

- A. Steel:
  1. Sheet Steel (Furniture Steel for Exposed Work): Stretcher-leveled, cold-rolled, commercial quality carbon steel, complying with ASTM A366, matte finish.
  2. Sheet Steel (for Unexposed Work): Hot-rolled, commercial quality carbon steel, pickled and oiled, complying with ASTM A568/A568M-03.
  3. Structural Steel Shapes and Plates: ASTM A36.
- B. Stainless Steel: Type 302 or 304 complying with ASTM A240, with standard tempers and hardness required for fabrication, strength, and durability. Apply mechanical finish on fabricated work in the locations shown or specified, Federal Standard and NAAMM nomenclature, with texture and reflectivity required to match Architect's sample. Protect with adhesive paper covering.
  1. No. 4 Sating Stainless Steel.
- C. Aluminum: Extrusions per ASTM B221; sheet and plate per ASTM B209.
- D. Plastic Laminate: ASTM E84 Class A and NEMA LD3.1, Fire-Rated Grade (GP-50), Type 7, 0.050"  $\pm$  0.005" thick, color and texture as follows:
  1. Exposed Surfaces: Color and texture selected by Architect.
  2. Concealed Surfaces: Contractor's standard color and finish.
- E. Fire-Retardant Treated Particle Board Panels: Minimum 3/4" thick backup for natural finished wood and plastic laminate veneered panels, edged and faced as shown, provided with suitable anti-warp backing; meet ASTM E84 Class "1" rating with a flame-spread rating of 25 or less, registered with Local Authorities for elevator finish materials.
- F. Natural Finish Wood Veneer: Standard thickness, 1/40" thoroughly dried conforming to ASME/HPMA HP-1983, Premium Grade. Place veneer, tapeless spliced with grain running in direction shown, belt and polish sanded, book-matched. Species and finish designated and approved by Architect.

- G. Paint: Clean exposed metal parts and assemblies of oil, grease, scale, and other foreign matter and factory paint one shop coat of standard rust-resistant primer. After erection, provide one finish coat of industrial enamel paint. Galvanized metal need not be painted.
- H. Prime Finish: Clean all metal surfaces receiving a baked enamel paint finish of oil, grease, and scale. Apply one coat of rust-resistant primer followed by a filler coat over uneven surfaces. Sand smooth and apply final coat of primer.
- I. Baked Enamel Finish: Prime finish per above. Unless specified "prime finish" only, apply and bake three additional coats of enamel in the selected solid color.
- J. Entrance Field Paint: Clean all surfaces to remove dirt and grease. Sand and finish surfaces as necessary to remove pits and scratches and prepare surface for painting. Apply filler to ensure smooth surface; sand and apply one coat of electrostatic enamel in the selected solid color.
- K. Refinishing of natural metals: Remove existing protective finish. Buff as necessary to remove scratches. Regrain or finish as specified and protect as indicated for particular metal type.
- L. Entrance Support Equipment within Hoistway: Include strut angles, headers, sill support angles, fascia, hanger covers, etc. Clean, remove, and check for corrosive activity. Replace components which exhibit severe deterioration. Tighten all fastenings. Repaint exposed surfaces.
- M. Glass: Laminated safety glass, minimum 9/16" thick, conforming to ANSI Z97.1 and CPSC 16 CFR Part 1201.

END OF SECTION



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SECTION 017000 –  
FINAL CONTRACT COMPLIANCE REVIEW

**PART 1 - GENERAL**

1.1 FINAL CLEANING

- A. See Section 008000, Supplemental Conditions, for contractual requirements governing site cleaning. As a minimum:
  - 1. Elevator hoistways and all equipment therein shall be cleaned and left free of rust, filings, welding slag, rubbish, loose plaster, mortar drippings, extraneous construction materials, dirt, and dust, including walls, building beams, sill ledges, and hoistway divider beams.
  - 2. Care shall be to not to mark, soil, or otherwise deface existing or new surfaces. Clean and restore such surfaces to their original condition.
  - 3. Clean down surfaces and areas which require final painting and finishing work. Cleaning includes removal of rubbish, broom cleaning of floors, removal of any loose plaster or mortar, dust, and other extraneous materials from finish surfaces, and surfaces which will remain visible after the work is complete.
  - 4. Paint machine room floors.

1.2 CONSULTANT'S FINAL OBSERVATION AND REVIEW REQUIREMENTS

- A. Review procedure shall apply for individual elevators, portions of groups of elevators, and completed groups of elevators accepted on an interim basis, or elevators and groups of elevators completed, accepted, and placed in operation.
- B. Contractor shall perform review and evaluation of all aspects of its work prior to requesting Consultant's final review. Work shall be considered ready for Consultant's final contract compliance review when all Contractor's tests are complete, all deficiencies noted by the AHJ have been rectified, and all elements of work or a designated portion thereof are in place and elevator, or group of elevators are deemed ready for service as intended.
  - 1. Provide 12 hours of accrued run-in time prior to inspection and field reviews.
  - 2. Run-in time must include door open and close cycles, without interfering with usual business activity.
- C. Contractor shall perform review and evaluation of all aspects of its work prior to requesting consultant's review.
- D. Furnish labor, materials, and equipment necessary for Consultant's review. Notify Consultant five (5) working days in advance when ready for final review of elevator or group of elevators.
- E. Consultant's written list of observed deficiencies of materials, equipment, and operating systems will be submitted to Contractor for corrective action. Consultant's review shall include as a minimum:
  - 1. Workmanship and equipment compliance with Contract Documents.
  - 2. Contract speed, capacity, floor-to-floor times, and door performance compliance with Contract Documents.
  - 3. Performance of following is satisfactory:
    - a. Starting, accelerating, running.
    - b. Decelerating, stopping accuracy.
    - c. Door operation and closing force.
    - d. Equipment noise levels.
    - e. Signal fixture utility.

- f. Overall ride quality.
      - g. Performance of door control devices.
      - h. Operations of emergency two-way communication device.
      - i. Operations of firefighters' service.
      - j. Operations of special security features and floor lock-off provisions.
      - k. Operations of remote monitoring devices.
      - l. Operations of emergency brake device.
    - 4. Test Results:
      - a. In all test conditions, obtain specified contract speed, performance times, stopping accuracy without re-leveling, and ride quality to satisfaction of Purchaser and Consultant. Tests will be conducted under both no load and full load condition.
      - b. Temperature rise in motor windings limited to 50° Celsius above ambient. A full-capacity one-hour running test, stopping at each floor for ten seconds in up and down directions, may be required.
  - F. Performance Guarantee: Should Consultant's review identify defects, poor workmanship, variance, or noncompliance with requirements of specified codes and/or ordinances, or variance or noncompliance with the requirements of Contract Documents, Contractor shall complete corrective work in an expedient manner to satisfaction of Purchaser and Consultant at no cost as follows:
    - 1. Replace equipment which does not meet code or Contract Document requirements.
    - 2. Perform work and furnish labor, materials, and equipment necessary to meet specified operation and performance.
    - 3. Perform retesting required by governing code authority, Purchaser, and Consultant.
  - G. A follow-up final contract compliance review shall be performed by Consultant after notification by Contractor that all deficiencies have been corrected. Provide Consultant with copies of the initial deficiency report marked to indicate items which Contractor considers complete.
- 1.3 MANUFACTURER'S WARRANTY
- A. Manufacturer agrees to repair, restore, or replace elevator equipment that fails due to defective materials or poor workmanship within specified warranty period.
  - B. Warranty Period: 12 months from date of Substantial Completion:
  - C. The Elevator Contractor guarantees that the materials and workmanship of the apparatus installed by them and any subcontractor, under this contract, is first class in every respect and that they will make good on any defects not due to ordinary wear and tear or improper use, which may develop within one year from the date of final acceptance of all equipment.
  - D. Manufacturer's warranty to repair or replace defective products or their components in the event of defects within a specified period.
  - E. Neither the final payment nor any provisions of the contract documents relieve the Elevator Contractor of any obligation provided by law. They shall remedy any defects and pay all expenses for any damage to other work.
  - F. The warranty as outlined above, for all devices, starts from the date of final acceptance of each device, by the Consultant and the Owner, of all work specified and intended under these contract documents.

1.4 PURCHASER'S INFORMATION

- A. Provide electronic copies (flash drive or Consultant-approved equivalent) of written information necessary for proper maintenance and adjustment of equipment within 30 days following final acceptance. Final retention will be withheld until data is received by Purchaser and reviewed by Consultant. Include the following as minimums:
1. Straight-line wiring diagrams of "as-installed" elevator circuits with index of location and function of components. Provide one set reproducible master. Mount one set wiring diagrams on panels, racked, or similarly protected, in elevator machine room. Provide remaining set rolled and in a protective drawing tube. Maintain all drawing sets with addition of all subsequent changes. These diagrams are Purchaser's property.
  2. Written Maintenance Control Program (MCP) specifically designed for the equipment included under this contract. Include any unique or product-specific procedures or methods required to inspect or test the equipment. In addition, identify weekly, bi-weekly, monthly, quarterly, and annual maintenance procedures, including statutory and other required equipment tests.
  3. Lubrication instructions, including recommended grade of lubricants.
  4. Parts catalogs for all replaceable parts, including ordering forms and instructions.
  5. Instructions explaining all operating features, including all apparatus in the car and lobby control panels.
  6. Maintenance Control Program documentation for all equipment.
- B. Provide Purchaser with the following:
1. Any interface cards required for equipment maintenance, code mandated testing, and troubleshooting.
  2. Four sets of keys for all switches and control features properly tagged and marked.
  3. Diagnostic equipment complete with access codes, adjusters' manuals, and set-up manuals for adjustment, diagnosis, and troubleshooting of elevator system, and performance of routine safety tests.
- C. Preventive Maintenance Contract: Furnish properly executed contract for continuing preventive maintenance. Utilize contract form herein provided, Section 14325, Vertical Transportation Preventive Maintenance Contract.
- D. Acceptance of such records by Purchaser/Consultant shall not be a waiver of any Contractor deviation from Contract Documents or shop drawings or in any way relieve Contractor from his responsibility to perform work in accordance with Contract Documents.

END OF SECTION

SECTION 018000

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SECTION 018000  
MAINTENANCE

**PART 1 - GENERAL**

1.1 INTERIM MAINTENANCE (UNTIL CAR IS TAKE OUT FOR MODERNIZATION)

- A. Furnish preventive maintenance service on elevators described herein for a period from mobilization, verbal or written, until each unit is removed from building service for modernization. In addition, furnish interim preventive maintenance on completed units until the modernization of each group of elevators is complete and one-year warranty maintenance, defined in Item 1.02 below, is commenced. Cost of interim maintenance shall not be included as part of modernization quotation. Indicate costs on a per-unit basis for interim maintenance as requested on quotation form, Section 003100. Costs for interim maintenance shall be paid by Purchaser separately and monthly based upon the number of units in service. Perform interim maintenance based upon terms and conditions of Purchaser's maintenance agreement.
- B. Use competent personnel, acceptable to Purchaser, employed and supervised by the Contractor.

1.2 WARRANTY MAINTENANCE

- A. Provide preventive maintenance and 24-hour emergency callback service for one year commencing on date of final acceptance of all modernized elevators by Purchaser. Warranty maintenance should expire for concurrently for all elevators. Systematically examine, adjust, clean, and lubricate all equipment. Repair or replace defective parts using parts produced by the Contractor of installed equipment. Maintain elevator machine room, hoistway, and pit in clean condition.
- B. Use competent personnel, acceptable to the Purchaser, supervised and employed by Contractor.
- C. The warranty maintenance period specified in Item 1.02, A. above shall be extended one (1) month for each three (3) month period in which equipment related failures average more than .25 per unit per month.
- D. Purchaser retains the option to delete cost of warranty maintenance from modernization equipment contract and remit twelve (12) equal installments directly to Contractor during period in which maintenance is being performed.

1.3 CONTRACT PREVENTIVE MAINTENANCE

- A. Quote monthly cost for five-year Preventive Maintenance Agreement with two, one-year extensions possible, commencing upon completion of the warranty period specified in Item 1.02, A. above. Submit quote based upon terms and conditions of the preventative maintenance agreement. Base quotation on present labor and material cost. Price adjustment will be made at Agreement commencement date and thereafter as provided in Agreement.
- B. Use competent personnel, acceptable to the Purchaser, employed and supervised by Contractor.

END OF SECTION

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SECTION 019000 –  
RELATED WORK

**PART 1 - GENERAL**

1.1 RELATED WORK PROVIDED BY CONTRACTOR

- A. Architectural and Structural, Hoistway and Hallway:
  - 1. Wall block outs and fire rated closure for control and signal fixture boxes which penetrate walls.
  - 2. Cutting and patching walls and floors to restore pre-modernization condition.
  - 3. Provide new pit access stationary ladder. A retractable ladder (if provided) shall include an electrical contact conforming to ASME A17.1, Rule 2.2.2.4.2.7.
  - 4. Protect open hoistways and entrances during construction per OSHA Regulations.
  - 5. Protect car enclosure, hoistway entrance assemblies, and special metal finishes from damage.
  - 6. Hoistway venting. Cover existing and properly fire rate.
  
- B. Architectural and Structural, Machine Room:
  - 1. Enclosure with access.
  - 2. Self-closing and locking rated access door. Include Signage: “ELEVATOR MACHINE ROOM” and “AUTHORIZED PERSONNEL ONLY.”
  - 3. Class “ABC” fire extinguisher in each elevator machine room.
  - 4. Ensure machine room is properly fire rated, seal fireproofing as needed to prevent flaking.
  - 5. Access for hoisting. Provide access for hoisting to machine room and repair same when complete as follows: If access holes or door frames are implemented to safely get material into the machine room or overhead space, the wall or doorway shall be repaired to “like new” condition.
  - 6. Designate a light switch for the machine room space.
  
- C. Plumbing and Fire Protection:
  - 1. No Sprinklers located in hoistway or pit.
  
- D. Mechanical:
  - 1. Machine Room or Control Space: Retain existing ventilation and heating. Maintain temperature range of 55°-90° F. Maintain maximum 80% relative humidity, non-condensing. Provide new directional duct throughout machine room to eliminate obstruction and provide even heating and cooling.
  
- E. Electrical Service, Conductors, and Devices:
  - 1. Machine Room Lighting: New. Guarded LED fixtures to provide minimum 19 footcandles average illumination. Provide toggle switch adjacent to strike side of machine room door. Occupancy sensor is not allowed.
  - 2. Pit Lighting: New. Guarded LED fixtures to provide minimum 10 footcandles average illumination.
  - 3. New. GFCI convenience outlets in pit.
  - 4. Non-GFCI convenience outlet in pit for sump pump.
  - 5. GFCI convenience outlets in machine room. Additional outlets to be installed.
  - 6. New. Heavy-duty three-phase mainline copper power feeder to terminals of each elevator controller in the machine room with protected lockable “open” disconnecting means.
  - 7. New. Single-phase copper power feeder to each elevator with individual protected lockable “open” disconnecting means.
    - a. Car lighting and blower.
    - b. In-car video display.
    - c. On-car wi-fi router.



- d. Machine room monitoring system.
  - e. Machine room rope brake air compressor.
8. Owner to provide emergency telephone line to each individual or designated elevator control panel in elevator machine room.
9. Automatic Fire Recall System:
- a. Fire alarm initiating devices in each elevator lobby, for each group of elevators or single elevator.
  - b. Fire alarm initiating devices in each elevator machine room.
  - c. Fire alarm initiating devices at top of hoistway if sprinklered.
  - d. Three Relay Activation Modules for each group of elevators or single elevator. Locate modules within three feet of controller designated by the Elevator Contractor to minimize un-supervised wiring. Program Modules as follows:
    - 1) PRIMARY: Activate when any hallway device, except primary floor, activates.
    - 2) ALTERNATE: Activate when hallway device at primary floor activates.
    - 3) FIRE HAT: Activate when machine room device activates.
  - e. Device in machine room and at top of hoistway (if provided) to provide signal for general alarm.
  - f. Provide technician from fire alarm contractor for pre-test of system during normal working hours.
  - g. Provide technician from fire alarm contractor for acceptance test of system with AHJ during normal or overtime working hours.
  - h. Remove fire alarm devices from pit where not required.
  - i. Remove fire alarm devices from hoistway overhead where not required.
10. Temporary power and illumination to install, test, and adjust elevator equipment.
11. **Owner to provide Internet access to each machine room for off-site web access to monitoring system and video text capable 2-way communication devices.**
12. When sprinklers are provided in the hoistway all electrical equipment, located less than 4'-0" above the pit floor shall be identified for use in wet locations.
13. Wiring from building security system to elevator controllers and all security system equipment.
14. Power for Mechanical Equipment: Provide power for HVAC and/or ventilation equipment where applicable.
15. Conduit from fire alarm panel to each fire alarm device location at each floor, hoistway, pit and machine room including three relay activation modules in machine room. Provide junction box at each location.
16. Review power confirmation data, provided by the Elevator Contractor, on behalf of the Owner. Verify electrical supply to the controllers meets the stated requirements. Where applicable, review standby power generator capability to meet stated requirements and absorb regenerated power.

END OF SECTION

SECTION 142400

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SECTION 142400 –  
ELECTRIC HYDRAULIC ELEVATOR MODERNIZATION

**PART 1 - GENERAL**

1.1 SUMMARY

- A. Section Includes: Hydraulic elevators as follows:
  - 1. One (1) Twin Post Passenger Elevator, Car 1.
- B. Products Installed but Not Furnished Under This Section:
  - 1. Emergency Voice/Alarm Communication System Provisions.
  - 2. CCTV camera provisions.
  - 3. Elevator security devices, control unit, mounting brackets, wiring materials, logic circuits, security system interface terminals, boxes, and relays.
  - 4. Monitoring system interface.
  - 5. Internet connectivity.

1.2 DEFINITIONS

- A. See Section 008000 Supplemental Conditions. Technical terms used are defined in the latest edition of the Safety Code for Elevators and Escalators, ASME A17.1. or in this section.

1.3 WORK INCLUDED

- A. See Section 010100, Summary of Work.
- B. **THIS IS A TURNKEY ALL INCLUSIVE PROJECT.** All engineering, equipment, labor, and permits required to satisfactorily complete elevator modernization required by Contract Documents.
- C. Applicable conditions of General, Special, and Supplemental Conditions, Division 1, and all sections listed in Contract Documents "Table of Contents."
- D. Applicable conditions of Purchaser's General, Special, and Supplemental Conditions.
- E. Preventive maintenance as described in Section 018000.
- F. Cartage and Hoisting: All required staging, hoisting, and movement to, on, and from the site including new equipment, retained equipment, or dismantling and removal of existing equipment.
- G. Unless specifically identified as "Retain," "Reuse," or "Refurbish," provide new equipment. Contractor may, with approval prior to quotation, provide new equipment in lieu of refurbishing existing. See Section 008000, Supplemental Conditions.
- H. Reference to a device or a part of the equipment applies to the number of devices or parts required to complete the installation.
- I. Provisions of this specification are applicable to all elevators unless identified otherwise.
- J. Protective barriers between cars in normal operation and adjacent cars in the modernization process. Full depth and height of hoistway. Installation of barriers or screening shall be completed on overtime

as to not interrupt normal building traffic. **All cost associated with screening the hoistway shall be included in this project.**

- K. Provide hoistway, pit, and machine room barricades.
- L. Provide temporary and permanent pit ladders, working platforms, inspection platforms, and guard rails required to comply with applicable Building Code and AHJ requirements.

#### 1.4 ALTERNATES

- A. See Section 010300, Alternates and Allowances.

#### 1.5 RELATED WORK

- A. See Section 019000, Related Work.

#### 1.6 ACTION AND INFORMATIONAL SUBMITTALS

- A. See Section 013000, Submittals.

#### 1.7 CLOSEOUT SUBMITTALS

- 1. See Section 017000, Final Compliance Review.

#### 1.8 PERMITS, TESTS, AND CERTIFICATES

- A. Permits:
  - 1. Secure and pay for all permits required for Work to be performed, including but not limited to:
    - a. Municipal and State permits.
    - b. Device or equipment removal permits.
    - c. Hot works permits.
    - d. Confined space access permits.
  - 2. Post, maintain, and renew all permits in compliance with local governmental requirements.
  - 3. Obtain final close-out of all required permits.
- B. Tests and Inspections:
  - a. Schedule with the AHJ and perform tests required by Governing Authority in accordance with procedure described in ASME A17.2 Guide for Inspection of Elevators, Escalators, and Moving Walks in the presence of Authorized Representative of the AHJ.
- C. Certificates: Obtain, pay for, and deliver to Purchaser with all temporary and final inspection certificates provided by proper governing authorities.
- D. Violations: Resolve any outstanding violations on record with the AHJ on devices being removed prior to final acceptance by the Purchaser.

#### 1.9 QUALITY ASSURANCE

- A. Compliance with Regulatory Agencies: Comply with most stringent applicable provisions of currently enforced codes, laws, and/or authorities, including revisions and changes in effect.

- B. Inspections: Provide access to areas where work is being performed for the Consultant at any time throughout the project.

1.10 WARRANTY

- A. See Sections 017000 Final Compliance Review and 018000 Maintenance.

1.11 MAINTENANCE

- A. See Section 018000 Maintenance.

1.12 DELIVERY, STORAGE, AND HOISTING

A. General:

1. Protect all equipment and exposed finishes during delivery, handling, and installation until completion of project.
2. Replace damaged materials with new, at no additional cost for material or labor to Purchaser.

B. Delivery and Storage:

1. Ensure manufacturers' original packing adequately protects materials during delivery.
2. Deliver materials, identical to accepted samples, to the site ready for use in the manufacturer's original and unopened containers and packaging, bearing labels as to type of material, brand name and manufacturer's name.
3. Store materials under cover in a dry and clean location, off the ground. Remove delivered materials that are damaged or otherwise not suitable for installation from the job site and replace with acceptable materials.
4. Store and protect all materials in space provided or designated by the Purchaser against damage, stains, scratches, corrosion, weather, construction debris, and other environmental conditions.
5. Comply with Purchaser's requirements for access to and use of any building loading docks, parking lots, parking garages, and any interior spaces required for delivery and storage.

- C. Hoisting: Arrange and pay for all required hoisting and movement of equipment.

1.13 COORDINATION

- A. See Section 010400, Summary of Work.

**PART 2 - PRODUCTS**

2.1 REFERENCES

A. American National Standard Institute (ANSI):

1. A117.1 - Accessible and Usable Buildings and Facilities

B. American Society of Mechanical Engineers:

1. ASME A17.1 - Safety Code for Elevators and Escalators.
2. ASME A17.5 – Elevator and Escalator Electrical Equipment
3. ASME A17.6 – Standard for Elevator Suspension, Compensation, and Governor Systems

C. International Building Code (IBC)

- D. National Fire Protection Association (NFPA):
  - 1. NFPA 70, National Electric Code.
  - 2. NFPA 80, Fire Doors and Windows.
  - 3. NFPA 101, Life Safety Code.
  - 4. NFPA 13, Installation of Sprinkler Systems
  
- E. Accessibility:
  - 1. American National Standard Institute (ANSI): A117.1, Accessible and Usable Buildings and Facilities

## 2.2 MANUFACTURERS AND PRODUCTS

- A. Approved Elevator Systems:
  - 1. Approved Subject to compliance with the requirements of the contract, provide products by one or more of the following Principal Manufacturers. Where specific product models are referenced below only those specific product models or types are approved.
    - a. GAL.
    - b. MCE.
    - c. Elevator Controls.
  
- B. Approved Elevator Components:

In addition to products manufactured by the Principal Manufacturers specified above, the following Manufacturers are approved for the specific components listed below, subject to the requirements of the contract:

  - 1. Controllers:
    - a. GAL E Hydro.
    - b. Elevator Controls Pixel.
    - c. MCE Element.
  - 2. Starter:
    - a. TKE
    - b. KONE
    - c. Schindler
    - d. Otis
    - e. Siemens
    - f. Sprecher and schuh
  - 3. Passenger Elevator Door Equipment (Operators, Tracks, Hangers, and Closers):
    - a. GAL.
    - b. Wittur.
  - 4. Car and Hall Signal Fixtures: vandal resistant. Custom:
    - a. EPCO.
    - b. Innovation.
    - c. MAD Fixtures.
    - d. Monitor.
    - e. National Elevator Cab and Doors.
  - 5. Two-Way Communication Device:
    - a. EMS.
    - b. Janus.
    - c. Rath Communications.
    - d. RingComm.
  - 6. Power Units:
    - a. MEI.

- b. MCE.
- c. TKE
- d. KONE
- e. Schindler
- f. Otis

## 2.3 PERFORMANCE REQUIREMENTS

- A. Car Speed:
  - 1.  $\pm 10\%$  of contract speed under any loading condition.
- B. Car Capacity:
  - 1. Safely lower, stop and hold 125% of rated load.
- C. Car Stopping Zone:
  - 1.  $\pm 1/4"$  under any loading condition.
- D. Door Times:
  - 1. Seconds from start to fully open or fully closed:
  - 2. Car 1: Door Open: 3.1 seconds. Door Close: 4.0 seconds.
- E. Car Floor-to-Floor Performance Time:
  - 1. Seconds from start of doors closing until doors are 3/4 open (1/2 open for side opening doors) and car level and stopped at next successive floor under any loading condition or travel direction:
    - a. Car 1: 15.5 seconds, floor height 9'8", between floors 1 and 2.
- F. Pressure:
  - 1. Fluid system components shall be designed for maximum operating pressure of 500 psi.
- G. Car Ride Quality: A "TAC" test will be performed at the beginning of the job and at the end.
  - 1. Ride Quality measured and analyzed according to the methods specified in ISO18738.
  - 2. Utilize EVA-625 Elevator Vibration Analysis System as manufactured by Physical Measurement Technologies (PMT) to record field measurements.
  - 3. Specified levels apply to horizontal and vertical acceleration measured from within car, from the point at which the car has moved  $\frac{1}{2}$  meter from start position to  $\frac{1}{2}$  meter from final position, as defined by ISO18738.
  - 4. Maximum Allowable Peak-to-Peak Vibration for the Horizontal and Vertical Axes: 25mg.
  - 5. Maximum Allowable A95 Peak-to-Peak Vibration for the Horizontal and Vertical Axes: 12.5.
  - 6. Acceleration and Deceleration: Smooth, constant, and not less than 3.0 feet/second<sup>2</sup> with an initial ramp between 0.5 and 0.75 second.
  - 7. Sustained Jerk: Not more than 6 feet/second<sup>3</sup>.
- H. Noise and Vibration Control:
  - 1. Airborne Noise:
    - a. Measured noise level of elevator equipment and its operation shall not exceed 60 dBA inside car under any condition including door operation and car ventilation exhaust blower on its highest speed.
    - b. Limit noise level in the machine room relating to elevator equipment and its operation to no more than 80 dBA.
    - c. All dBA readings to be taken 3'-0" off the floor and 3'-0" from the equipment using the "A" weighted scale.

2. Vibration Control: Mechanically isolate all new elevator equipment from the building structure and other components. Minimize objectionable noise and transmission of vibrations to occupied areas of the building.

2.4 ELEVATOR DUTY ALTERATIONS

A. Hydraulic Passenger Elevator:

<b>ALTERATION SUMMARY</b>		
<b>CAR 3</b>	<b>EXISTING INSTALLATION</b>	<b>MODERNIZED INSTALLATION</b>
Capacity:	4000 lbs.	Retain existing
Class of Loading:	Class A	Retain existing
Contract Speed:	125 fpm	Retain existing
Unit Type:	Dry	Retain existing
Motor Type:	AC	AC
Motion Control:	Valve	Retain existing
Operation Control:	Selective collective automatic Microprocessor-Based system	Selective collective automatic Microprocessor-Based system
Floors Served:	Front: 4	Retain existing
Total Entrances:	all front	Retain existing
Entrance Type:	Two-speed side-opening	Retain existing
Entrance Size:	48" wide x 84" high	Retain existing
Minimum Clear to Underside of Canopy:	109" high	Retain existing

2.5 MATERIALS

- A. See Section 016000, Materials.

2.6 ALTERNATES:

- A. Complete elevator replacement excluding rails and entrance frames. New.

2.7 OPERATION

- A. General: New.
1. Cars automatically slow down and stop level at floors in response to car and landing calls with stops made in sequence in the established direction of travel, regardless of order in which buttons are pressed.
  2. Landing calls are canceled when the assigned car arrives at the landing.
  3. Automatic Dispatch Failure: Provide auxiliary dispatch system to automatically dispatch elevators in the event of failure of the primary control system.



4. Hall Call Button Failure: Should failure of hall call button system occur, initiate operation providing predetermined service to all landings; elevators respond normally to car calls.
  5. Automatic Leveling:
    - a. When arriving at a floor cars level to within 1/8" above or below the landing sill prior to opening doors, without travelling past the landing during leveling
    - b. Maintain leveling accuracy regardless of carload, direction of travel, rope slippage or stretch.
  6. Power Conservation:
    - a. Shut off car interior illumination and ventilation after adjustable period (60-180 seconds) of no elevator demand.
    - b. turn on prior to opening car doors when elevator demand returns.
- B. Door Operation: New.
1. Automatically open doors when car arrives at a floor.
  2. Stop and reopen doors or hold doors in open position upon activation of "door open" button.
  3. At expiration of normal dwell time, or upon activation of "door close" button, close doors:
    - a. Prevent doors from closing and reverse doors at normal opening speed if door reopening device beams are obstructed while doors are closing, except during nudging operation.
    - b. In event of door reopening device failure, provide for automatic shutdown of car at floor level with doors open.
    - c. Close cycle does not begin upon activation of "door close" button until normal door dwell time for a car or hall call has expired, except firefighters' operation.
  4. Nudging Operation:
    - a. After beams of door reopening device are obstructed for a predetermined time interval (minimum 20.0-25.0 seconds), sound warning signal, and attempt to close doors with maximum of 2.5 foot-pounds kinetic energy.
    - b. Activation of the door open button overrides nudging operation and reopens doors.
  5. Interrupted Beam Time:
    - a. When beams are interrupted during initial door opening, hold door open a minimum of 3.0 seconds.
    - b. When beams are interrupted after the initial 3.0 second hold open time, reduce time doors remain open to an adjustable time of approximately 1.0-1.5 seconds after beams are reestablished.
  6. Differential Door Time:
    - a. Field adjustable time that doors remain open after stopping in response to calls.
    - b. Car Call: Hold open time adjustable between 3.0 and 5.0 seconds.
    - c. Hall Call:
      - 1) Hold open time adjustable between 5.0 and 8.0 seconds.
      - 2) Use hall call time when car responds to coincidental calls.
    - d. Reopen doors when car is designated for loading.
- C. Selective Collective Operation: New.
1. General:
    - a. Elevators shall operate via car and landing buttons.
  2. Elevators operate via momentary pressure buttons to
    - a. place hall call by selecting direction of travel at each hall landing (up and down buttons at each intermediate landing, single buttons at each terminal landing).
    - b. place car call by selecting destination floor from inside the car (individual buttons for each floor served).
    - c. Stops made in order in which landings are reached, irrespective of sequence in which calls are registered.

3. Parked Car (No Demand):
    - a. Elevator may remain at landing of last assignment (if no further demand) with doors closed, for a predetermined amount of time (programmable for any amount of time) if feature is enabled.
    - b. If this feature is enabled, upon expiration of time, the elevator shall return to the main egress landing with the doors closed.
  4. If this feature is disabled, if no further demand exists, the elevator shall remain at landing of last assignment with the doors closed until a hall call is registered.
  5. Car and Hall Lanterns:
    - a. Lanterns provide audio and visual signal upon each stop, regardless of responding to car or hall call.
    - b. Visual signal remains active from commencement of door opening until doors are completely closed.
- D. Motion Control: New.
1. Microprocessor-based AC variable-voltage, variable frequency with digitally encoded closed-loop velocity feedback suitable for operation specified and capable of providing smooth, comfortable car acceleration, retardation, and dynamic braking.
  2. Limit the difference in car speed between full load and no load to not more than  $\pm 10\%$  of the contract speed.
- E. Battery Lowering Operation: New.
1. Upon loss of normal power automatically lower car to the nearest landing depending on position at time of power outage.
  2. Upon arrival at the landing, the elevator doors shall open automatically and remain open until regular door time has expired; the elevator shall then be removed from service.
  3. The auxiliary power source shall be provided via 12-volt D.C. battery units installed in machine room.
  4. Include solid-state charger and testing means mounted in a common metal container.
  5. Battery to be rechargeable lead acid or nickel cadmium with a ten-year life expectancy.
  6. Upon restoration of normal power, the elevator shall automatically resume normal operation.
- F. Firefighters' Emergency Operation: New. Provide equipment and operation in accordance with code requirements. Replace all Firefighters Emergency Operation key switches that control non-modernized elevators in this building to match modernized elevators when first car in group is returned to service.
- G. Emergency Car Communication System Operation: New.
1. Hands-Free Phone System:
    - a. Two-way communication instrument in car with automatic dialing, tracking, and recall features, with shielded wiring to car controller in machine room.
    - b. Provide dialer with automatic rollover capability with minimum two numbers:
      - a) Actuate two-way communication via "Help" button.
      - b) Adjacent light jewel shall illuminate and flash when call is acknowledged.
      - c) Button shall match car operating panel pushbutton design.
      - d) Provide "Help" button tactile symbol, engraved signage, and Tactile marking adjacent to button mounted integral with car front return panel.
  2. Emergency Personnel Communication:
    - a. Communication system shall be provided allowing emergency personnel to establish communications with each elevator individually.
    - b. Emergency Personnel Communication shall override any existing connection outside of building.

- c. Adjacent light jewel shall illuminate and flash when call is acknowledged.
  - d. Provide operating instructions.
  - e. On the same car operating panel as the phone push button, provide capability to communicate with and obtain responses from passengers.
  - f. Provide display video capability for entrapment assessment.
3. Communication for Deaf, Hard of Hearing and Speech Impaired: On the same car operating panel as the phone pushbutton, provide capability to communicate with and obtain responses from passengers, including those passengers who cannot communicate verbally or hear.
- a. Provide shielded twisted pair wiring to communicate to machine room network box.
  - b. Device shall be open-sourced and capable of being monitored by any entity as selected by the owner. All software, hardware, and training cost associated with the device shall be included within this project. Associated monthly monitoring costs will only be accepted if Cellular connection is selected.
  - c. Connectivity shall be provided via hardwire internet connection or wirelessly through cellular connection.

## 2.8 MACHINE ROOM EQUIPMENT

- A. Provide and arrange equipment in existing machine room spaces.
- B. Identification: New. Permanently identify (painted on or securely attached) machine room equipment with minimum 3" characters corresponding to elevator identification.
1. Tank.
  2. Motor drive, transformer, choke/filter.
  3. Controller.
  4. Selector.
  5. Main line disconnect switch.
  6. Elevator hoistway pit equipment.
- C. Tank: New.
1. The tank shall be designed and constructed so that when completely filled the factor of safety shall not be less than 4, based on the ultimate strength of material.
  2. The tank shall be covered and vented.
  3. The tank shall be provided with a means for checking liquid level.
    - a. Such means shall be accessible without the removal of any covers or other part.
- D. Pump Unit: New.
1. Assembled unit consisting of dry positive displacement pump, induction motor, master-type control valves combining safety features, holding, direction, bypass, stopping, manual lowering functions, shut off valve, oil reservoir with protected vent opening, oil level gauge, outlet strainer, drip pan, muffler, all mounted on isolating pads.
  2. Tank Heater:
    - a. Provide an oil tank heater with adjustable thermostat to keep the oil tank temperature within the manufacturer's recommended operating range.
  3. Enclose entire unit with removable sheet steel panels lined with sound-absorbing material.
  4. Submersible pump motor shall be permitted up to 50 HP.
- E. Landing System: New.
1. Solid-state, magnetic, or optical type.

- F. Controller: New. UL/CSA labeled.
  - 1. Compartment: Securely mount all assemblies, power supplies, chassis switches, relays, etc., on a substantial, self-supporting steel frame. Completely enclose equipment with covers. Provide means to prevent overheating.
  - 2. Relay Design: Magnet operated with contacts of design and material to insure maximum conductivity, long life, and reliable operation without overheating or excessive wear. Provide wiping action and means to prevent sticking due to fusion. Contacts carrying high inductive currents shall be provided with arc deflectors or suppressors.
  - 3. Microprocessor-Related Hardware:
    - a. Provide built-in noise suppression devices providing a high level of noise immunity on all solid-state hardware and devices.
    - b. Provide power supplies with noise suppression devices.
    - c. Isolate inputs from external devices (such as pushbuttons) with opto-isolation modules.
    - d. Design control circuits with one leg of power supply grounded.
    - e. Safety circuits are not to be affected by accidental grounding of any part of the system.
    - f. System automatically restarts when power is restored.
    - g. System memory is retained in the event of power failure or disturbance.
    - h. Equipment is provided with Electro Magnetic Interference (EMI) shielding within FCC guidelines.
  - 4. Wiring: CSA labeled copper for factory wiring. Neatly route all wiring interconnections and securely attach wiring connections to studs or terminals.
  - 5. Permanently mark components (relays, fuses, PC boards, etc.) with symbols shown on wiring diagrams.
  - 6. Monitoring System Interface: Provide controller with serial data link through RJ45 Ethernet connection. Provide interface only.
  - 7. Provide unit specific service tools necessary for regular maintenance, troubleshooting, repairs, and mandated testing. Service tool shall be made available for any upgrades and recalibrations as required by OEM.
  - 8. Provide manual security override switch on the outside of the elevator controller to enable all car calls.
- G. Electrical Wiring and Wiring Connections: New.
  - 1. Auxiliary Disconnect:
    - a. Provide controller or machine mounted auxiliary, lockable “open” disconnect.
  - 2. Conductors and Connections:
    - a. Copper throughout with individual wires coded and connections on identified studs or terminal blocks.
    - b. Use no splices or similar connections in wiring except at terminal blocks, control compartments, or junction boxes.
- H. Muffler: New.
  - 1. Provide in discharge oil line near pump unit.
    - a. Design shall dampen and absorb pulsation and noise in the flow of hydraulic fluid.
    - b. Muffler shall be an air charged or non-baffled design.
- I. Piping and Oil: New.
  - 1. Provide piping, connections and oil for the system.
  - 2. Buried piping shall be secondarily contained with watertight Schedule 40 PVC sleeves between elevator machine room and pit.
  - 3. A minimum of two sound isolation couplings shall be provided between the pump unit and oil line and the oil line and jack unit.

4. Provide isolated pipe stands or hangers.

J. Shut-Off Valve: New.

1. Provide oil line shut off valve in the machine room or accessible from outside the hoistway.
2. Provide a second valve in pit adjacent to jack unit.

## 2.9 HOISTWAY EQUIPMENT

A. Provide and arrange equipment in existing hoistways.

B. Guide Rails: Retain. main and counterweight guide rails in place.

1. Clean rails and brackets.
2. Check all rail and bracket fastenings and tighten.
3. to existing structure.

C. Buffers, Car: Retain existing. Remove rust and repaint non-machined surfaces. Stencil car number on buffers

D. Terminal Stopping: New.

1. Provide normal and final devices.

E. Electrical Wiring and Wiring Connections: New.

1. Conductors and Connections: Copper throughout with individual wires coded and connections on identified studs or terminal blocks. Use no splices or similar connections in wiring except at terminal blocks, control compartments, or junction boxes. Provide a minimum of 10% spare conductors throughout. A minimum of ten #18 AWG wires shall be provided. Run spare wires from car connection points to individual elevator controllers in the machine room. Provide eight pairs of spare shielded communication wires in addition to those required to connect specified items. Tag spares in machine room.
2. Conduit: Painted or galvanized steel conduit, EMT, or duct. Flexible heavy-duty service cord may be used between fixed car wiring and car door switches for door protective devices.
3. Traveling Cables: Flame and moisture-resistant outer cover. Prevent traveling cable from rubbing or chafing against hoistway or equipment within hoistway. Provide 12 twisted shielded pairs in addition to wires needed to connect specified items and code required spares.
4. Auxiliary Wiring: Connect fire alarm initiating devices, emergency two-way communication system, firefighters' phone jack, paging speaker, CCTV, digital video display, card reader, intercom, and announcement speaker and/or background music in each car controller in machine room.

F. Hoistway Entrance Equipment: Retain, Refurbish or Replace as noted below to ensure smooth and quiet mechanical open and close of doors.

1. Door Hangers: Retain existing. As required, modify hangers to include door retainer mechanism to address failure of primary upper door panel guidance.
2. Door Rollers: New. Rollers shall have neoprene roller surface.
3. Door Track: Retain existing. Clean and sand to remove rusts at all floors for smooth, quiet operation of roller contact surface. Remove rust where existing.
4. Door Interlocks: New. Operable without retiring cam.
5. Door Closers: New. Spring activated spirator type or sill mounted spring closer. Design to insure smooth, quiet mechanical closer of doors.
6. Pick-up Assemblies: New. Rollers and linkages.
7. Relating Cables: New. Aircraft cable and metal sheaves.

- G. Hoistway Access Switches: New. Mount in entrance frame side jamb or hoistway door sight guard at top and bottom floors. Provide switch without faceplate. If mounted in sight guard, provide retainer clip at back of hoistway door panel for wiring.
- H. Floor Numbers: New.
  - 1. Stencil paint 4" high floor designations in contrasting color on inside face of hoistway doors or hoistway fascia. Must be visible from within car.

## 2.10 HOISTWAY ENTRANCES

- A. Provide and arrange equipment in same location as existing entrances.
- B. Frames: Retain existing and Electrostatic paint.
  - 1. Owner to select paint color.
  - 2. Provide new Arabic floor designation/tactile marking plates:
    - a. Centered at 60" above finished floor.
    - b. Located on both side jambs of all entrances.
    - c. Minimum 4" high.
    - d. Tactile marking indications shall be below Arabic floor designation.
  - 3. Provide plates at main egress landing with "Star" designation.
  - 4. Provide car identification label:
    - a. Mounted directly below floor designation/tactile marking plates.
    - b. Located on both side jambs at the following levels:
      - 1) Designated level.
      - 2) Alternate level.
    - c. Finish and design to match floor designation/tactile marking plates.
    - d. Provide cast metal plate indications mounted onto surface of jambs.
- C. Transom Panels: Retain existing at all floors.
- D. Hoistway Door Panels: Retain existing.
  - 1. Provide new door gibs with fire tabs at all floors.
  - 2. Minimum two gibs per panel, one at leading edge, and one at trailing edge of each panel.
  - 3. Provide code required door panel retainer mechanism on lower edge of door panel.
- E. Sight Guards: Retain existing.
  - 1. Replace damaged sight guard at necessary floors.
  - 2. Replace damaged astragals throughout the building as needed.
- F. Sills, Hoistway Entrance: Retain existing. Clean. Check and tighten all fastenings.
- G. Fascia and Hanger Covers: Retain existing. Toe Guard: New.
  - 1. Provide as required where damaged or missing.
  - 2. Check and tighten all fastenings.
  - 3. Paint/Stencil floor number on fascia or hoistway wall all floors visible where car doors are initially opened.
- H. Struts and Headers: Retain existing. Check and tighten all fastenings. Check and tighten all fastenings. Provide door open bumpers on entrances equipped with vertical struts where missing or damaged.

## 2.11 PIT EQUIPMENT

- A. Buffers: Retain.
  - 1. Clean and paint black.
  - 2. Stencil car ID on buffer.
  
- B. Hydraulic Jack Assembly: Retain. New Cylinder packings.
  - 1. Cylinders: New Packing.
    - a. Seamless steel pipe.
    - b. Design head to receive unit-type packing and provide means to collect oil at cylinder head and return automatically to oil reservoir.
    - c. Provide secondary containment/cylinder protection.
  - 2. Plungers:
    - a. Polished seamless steel tubing or pipe.
    - b. If plunger length exceeds 24'-0", provide two or more sections not exceeding 16'-0" in length, or coordinate installation of longer unit at the jobsite.
    - c. Join sections by internal threaded couplings.
    - d. Multiple section jack units shall be factory polished while assembled and marked.
    - e. Isolate plunger from car frames.
  
- C. Jack Support and Fluid Shut-Off Valves: Retain.
  - 1. Provide steel pit channels to support jack assembly and transmit loads to building structure.
  - 2. Provide intermediate stabilizers as required.
  - 3. Provide manual on/off valves in oil lines adjacent to pump unit and jack units in pit.
  
- D. Scavenger Pump: New.
  - 1. Provide electrically operated scavenger pump to collect oil at cylinder head and return directly to oil reservoir in elevator machine room.
  
- E. Refuge Space: New.
  - 1. Identify and clearly mark refuge space in the pit.
  
- F. Pit Access: New.
  - 1. Hoistway Access Key Switch:
    - a. Provide key switch at lowest terminal landing.
    - b. Mount in wall, sight guard or entrance frame side jamb.
    - c. Provide switch with faceplate.
  - 2. Provide pit stop switch(es).

## 2.12 CAR EQUIPMENT

- A. Frame: Retain Existing. Check and tighten all fastenings. Adjust as required for plumb and square alignment.
  
- B. Safety Device: Refurbish existing.
  - 1. Check and tighten all fastenings.
  - 2. Disassemble, clean, lubricate, and inspect components in compliance with manufacturer's recommended procedures.
  
- C. Platform: Retain existing.
  - 1. Adjust as necessary for plumb and level alignment.

2. Reinforce if required.
  3. Check and tighten all fastenings.
  4. Replace isolation pads.
- D. Cartop Guard Rail: New.
1. Provide a railing system provided on the outside perimeter of the car top on all sides where the horizontal distance between the edges of the car top and the adjacent hoistway enclosure exceeds 12 inches.
- E. Slide Guides: New.
1. Cleaning the existing oil off the rails and replacing the lubricated (oiled) slide guides with non-lubricated slide guides.
- F. Car Sills: Retain existing. Clean full width. Check and tighten all fastenings.
- G. Car Door Panels: New.
1. Fully enclosed 16-gauge steel, sandwich construction without binder angles
  2. Constructed with interlocking, stiffening ribs.
  3. Leading edges of center-opening doors equipped with rubber astragals full height of panel.
  4. Minimum of two gibs per panel, one at leading and one at trailing edge with gibs in the sill groove entire length of door travel.
  5. Wrap Architectural metal cladding around leading and trailing edge of panel and return a minimum of 1/2" on rear side of leading edge of panel.
- H. Door Hangers and Rollers: New. Two-point hanger roller with neoprene roller surface and suspension with eccentric upthrust roller adjustment.
- I. Door Track: New. Bar or formed, cold-drawn removable steel track with smooth roller contact surface.
- J. Door Header: New. Construct of minimum 12-gauge steel, shape with stiffening flanges.
- K. Door Electrical Contact: New.
1. Prohibit car operation unless car door is closed.
  2. Provide car door interlock to prevent opening of car doors outside the unlocking zone, where clearance between the car platform and hoistway enclosure exceeds code maximum on the loading side.
- L. Door Clutch: New.
1. Heavy-duty clutch, linkage arms, vane assembly and pickup rollers or cams to provide positive, smooth, quiet door operation.
- M. Restricted Opening Device: New.
1. Restrict opening of car doors to Code required limit outside unlocking zone.
  2. Adjust for smooth and quiet operation with operating noise undetectable from inside any car or outside of the hoistway.
  3. Plunger type restrictors not acceptable.
  4. Utilize mechanical angle to prevent door opening.
- N. Door Operator: New.
1. High-speed, linear drive, heavy-duty door operator capable of opening doors at no less than 2.5 fps.



2. Accomplish reversal in no more than 2½" of door movement.
  3. Solid-state door control with closed loop circuitry to constantly monitor and automatically adjust door operation based upon velocity, position, and motor current.
  4. Maintain consistent, smooth, and quiet car door operation at all floors, regardless of door weight or varying air pressure.
- O. Door Reopening Device: New.
1. Infrared Reopening Device: Black, 3-Dimensional Capability, fully enclosed device with full screen infrared matrix or multiple beams extending vertically along leading edge of each door panel to minimum height of 7'-0" above finished floor. Device shall prevent doors from closing and reverse doors at normal opening speed if beams are obstructed while doors are closing, except during nudging operation. In event of device failure, provide for automatic shutdown of car at floor level with doors open.
    - a. 3D device to be mounted within car transom. Contractor to provide housing for sensor for finished look.
  2. Nudging Operation: After beams of door control device are obstructed for a predetermined time interval (minimum 20.0 - 25.0 seconds), warning signal shall sound and doors shall attempt to close with a maximum of 2.5 foot pounds kinetic energy. Activation of the door open button shall override nudging operation and reopen doors.
  3. Interrupted Beam Time: When beams are interrupted during initial door opening, hold door open a minimum of 3.0 seconds. When beams are interrupted after the initial 3.0 second hold open time, reduce time doors remain open to an adjustable time of approximately 1.0 - 1.5 seconds after beams are reestablished.
  4. Differential Door Time: Provide separately adjustable timers to vary time that doors remain open after stopping in response to calls.
    - a. Car Call: Hold open time adjustable between 3.0 and 5.0 seconds.
      - 1) Hall Call: Hold open time adjustable between 5.0 and 8.0 seconds. Use hall call time when car responds to coincidental calls.
- P. Car Operating Panel: New.
1. One (1) car mini swing operating panel with faceplate:
    - a. Consisting of a metal box containing operating fixtures, mounted behind the car stationary wall panel.
    - b. Faceplate shall be hinged, slightly smaller than existing applied faceplate and constructed of satin finish stainless steel.
    - c. Refinish satin stainless steel on front return and transom.
  2. Pushbuttons:
    - a. Provide minimum ¾" diameter raised or flush floor pushbuttons which illuminate to indicate call registration.
    - b. Provide brushed stainless buttons with illuminated LED halo.
    - c. Locate operating controls no higher than 48" above the car floor; no lower than 35" for emergency push-to-call button and alarm button.
    - d. Identify buttons with stainless tactile symbols flush mounted.
  3. Locked Firefighters' Emergency Operation Panel:
    - a. Openable by the same key which operates the Fire Operation switch.
    - b. Including the following features:
      - 1) Phase II fire access switch.
      - 2) Firefighters' visual indication.
      - 3) Call cancel button.
      - 4) Stop switch, manually operated.
      - 5) Door open button.

- 6) Door close button.
  - 7) Floors served.
  4. Service Compartment:
    - a. Provide lockable service compartment with recessed flush door.
    - b. Door material and finish to match car return panel or car operating panel faceplate.
    - c. Include the following controls in lockable service cabinet with function and operating positions identified by permanent signage or engraved legend:
      - 1) Access switch.
      - 2) Light switch.
      - 3) Four-position exhaust blower switch.
      - 4) Independent service switch.
      - 5) Constant pressure test button for battery pack emergency lighting.
      - 6) 120-volt, AC, GFCI protected electrical convenience duplex outlet.
      - 7) Card reader override switch.
      - 8) Switch to select either floor voice annunciation, floor passing tone, or chime.
      - 9) Car lighting dimmer switch.
      - 10) Keyed stop switch.
  5. Provide black paint filled (except as noted), engraved, or approved etched signage as follows with approved size and font:
    - a. Phase II firefighters' operating instructions on inside face of firefighters' compartment door.
    - b. Engrave filled red firefighters' operation on outside face of compartment door.
    - c. Building identification car number on main and auxiliary car operating panel (owners desired location).
    - d. Car capacity in pounds on main car operating panel at Owners desired location.
- Q. Car Top Control Station: New.
1. Mount to provide safe access and utilization while standing on car top.
  2. Operating device shall contain Up and Down direction buttons, a Run button, an Inspection/Automatic switch and Emergency Stop switch.
  3. Operating device shall contain an audible and visible indicator that fire recall has been initiated.
  4. This station shall be fixed to the car crosshead or may be portable provided the extension cord and housing is permanently attached to the car crosshead.
  5. The car will be operated by constant pressure on the appropriate directional button and the Run button simultaneously.
  6. Normal operating devices will be inoperative while this device is in use.
- R. Emergency Audible Signaling: New.
1. Provide on top of each elevator.
  2. Activation of Alarm Button or Emergency Stop switch will initiate Emergency Audible Signal.
  3. Provide auxiliary power supply to provide 1hr power in the event of normal power loss.
- S. Work Light and Duplex Plug Receptacle: New.
1. GFCI protected outlet at top and bottom of car.
  2. Include on/off switch and lamp guard.
  3. Provide additional GFCI protected outlet on car top for installation of car CCTV and digital video display.

## 2.13 COMMUNICATION

- A. Car Communication System: New.
1. Hands-Free Phone System:
    - a. Two-way communication instrument in car with automatic dialing, tracking, and recall features Include shielded wiring to car controller in machine room.
    - b. Provide automatic programmable dialer for two (2) numbers with automatic rollover capability.
      - 1) "Help" button on car operating panel to initiate two-way communication from Car. Button shall match car operating panel pushbutton design.
      - 2) Auto dialer with automatic rollover capability with minimum two numbers:
      - 3) Adjacent light jewel illuminates and flashes when call is acknowledged.
      - 4) "Help" button tactile symbol, engraved signage, and Tactile marking adjacent to button mounted integral with car front return panel.
  2. Emergency Personnel Communication:
    - a. Communication system allowing emergency personnel to establish communications with each elevator individually.
    - b. Adjacent light jewel shall illuminate and flash when call is acknowledged.
    - c. Provide operating instructions.
    - d. On the same car operating panel as the phone push button, provide capability to communicate with and obtain responses from passengers.
    - e. Provide display video capability for entrapment assessment.
  3. Communication for Deaf, Hard of Hearing and Speech Impaired: Device is located on the same car operating panel as the phone pushbutton.
    - a. On the same car operating panel as the phone push button, provide capability to communicate with and obtain responses from passengers, including those passengers who cannot communicate verbally or hear.
    - b. 2-way communication shall comply with IBC-2018 Section 3001.2.
  4. Device shall be open-sourced and capable of being monitored by any entity as selected by the owner. All software, hardware, and training cost associated with the device shall be included within this project. Associated monthly monitoring costs will only be accepted if Cellular connection is selected.
    - a. Connectivity shall be provided via hardwire internet connection or wirelessly through cellular connection.

## 2.14 CAR ENCLOSURE

- A. Unless specifically identified as "Retain," "Reuse," or "Refurbish," provide new equipment. Contractor may, with Consultant approval, provide new equipment in lieu of refurbishing existing. See Section 008000, Supplemental Conditions.
- B. Car Enclosure and Interior Finishes, Service Elevator: Retain existing car shell. Provide the following features:
1. Shell: Retain existing. Provide and install microswitch on non-hinged side of shell and tie into safety circuit to disable car operation if contact is broken.
  2. Canopy: Retain existing. Alter as required for lockable, hinged emergency exit to be tied into existing safety circuit.
  3. Main Return Panel: Provide mini swing panel to fit in existing location.
  4. Integral Entrance Columns: Refinish existing. Alter with cutouts as required to accept new vandal-resistant car direction lanterns.
  5. Transom: Refinish existing.

6. Car Door Panels: New. Reinforced minimum 16 gauge stainless steel satin finish. Same construction as hoistway door panels. Architectural metal cladding shall wrap around leading and trailing edge of panel and return a minimum of 1/2" on rear side of leading edge of panel.
7. Base: **LVT-1 6"x46" is to be furnished by owner. Provide labor to rip out existing carpet and install new.**
8. Interior Wall Finish: New. Layers 4-6 Wilsonart Laminate colored "natural" and Layer 2 consists of textured stainless steel as in example below.
9. Ventilation: New. Two-speed type OE exhaust blower. Mount to car canopy on isolated rubber grommets. Exhaust blower shall meet noise requirements specified herein.
10. Lighting: New recessed LED's.
11. Suspended Ceiling: 4-6 Panel texture stainless steel drop ceiling. Satin Stainless Steel finish.
12. Handrails: New. Install new satin stainless steel flat bar handrail on rear wall.

C. CAB INTERIOR EXAMPLE: Snap cab APEX-1: AP-81 (finishes specified above)



elevator code and LEED compliant.

Personalize with the options below.

Materials Options Resources

**AP-81:** Layers 3-6 in Boardwalk Oak, fine velvet texture, Layer 2 in Textured stainless (SWL); 1.5" Round handrail (rear wall only); Frame ceiling (translucent)

**AP-45:** Layers 4-6 in Windsor Mahogany, finegrain, Layer 3 in Black, matte, Layer 2 in Satin Stainless; 2" Flat Bar handrails; Modular ceiling in Wilsonart Laminate (Black, high gloss)

**AP-66:** Layers 4-6 in Vapor Strandz, linearity, Layer 3 in Black, matte, Layer 2 in Textured stainless (SWL); 2" Flat Bar handrail (rear wall only); Island ceiling in satin stainless

**AP-21:** Layers 3-6 in Madagascar, high gloss, Layer 2 in Textured stainless (ICS); 2" Flat Bar handrails; Frame ceiling (translucent)

**AP-48:** Layers 4-6 in Tangerine, matte, Layer 3 in North Sea, matte, Layer 2 in Textured stainless (SWL); 2" Flat Bar handrail (rear wall only); Aurora ceiling in satin stainless

1.

- D. Pads and Removable Clamps: New. Three-piece removable pads. Two pads covering side walls and adjacent front returns and one covering rear wall. Provide cutouts to access main car operating panel.
- E. Top of Car Guardrail: New. Provide car top railings where fall hazard exceeds 12". Install guardrails, necessary hardware, and toe board to meet code requirements.

2.15 HALL CONTROL STATIONS

- A. Pushbuttons: New.
  1. Provide one (1) riser with flush mounted faceplates. Include pushbuttons for each direction of travel which illuminate to indicate call registration. Include approved engraved message and pictorial representation prohibiting use of elevator during fire or other emergency situation as part of faceplate. Pushbutton design shall match car operating panel pushbuttons. Provide enlarged faceplate to cover existing wall blockout and facilitate handicapped access requirements. Include approved engraved message and pictorial representation prohibiting use of elevator during fire or other emergency situation as part of faceplate. Provide any cutting and patching required.

## 2.16 SIGNALS

- A. Voice Synthesizer: New.
  - 1. Provide electronic device with easily reprogrammable message and female voice to announce car direction, floor, emergency exiting instructions, etc.
  - 2. Once the doors close, the destinations remain illuminated until the car approaches the next destination floor, whereupon the floor numeral or light flashes and the audible signal sounds to denote the next stopping floor.
  - 3. When the doors open, Destination Indicator displays the next floors to be served.
- B. Fixture Faceplate Material and Finish: New.
  - 1. Satin stainless steel, all fixtures.
  - 2. Tamper resistant fasteners for all public facing fastenings.
- C. Firefighters' Key Box: New.
  - 1. Flush-mounted box with lockable hinged cover. Engrave instructions for use on cover per Local Fire Authority requirements.

## 2.17 CLIENT INTERFACE TOOL

- A. Provide access to real-time data for elevators, including the following: New.
  - 1. Complete service history for all vertical transformation.
  - 2. Key performance indicators.
  - 3. Access to service request logs, disposition, and total downtime.
  - 4. Create service requests.
  - 5. View customer contracts.
  - 6. View and or accept Work Orders.
  - 7. Provide document repository.
- B. Data accessible from any device, including mobile.
- C. Confirm proper safeguards, protecting clients from malware and virus receipt.

## 2.18 REMOTE MAINTENANCE (IOT)

- A. Enable component performance data capture of information provided through elevator monitoring systems.
- B. Perform data analysis to determine maintenance requirements and schedule those maintenance activities.
- C. Analyzed data shall not alleviate the need to provide maintenance and repairs in accordance with the Maintenance Control Program (MCP), specifically expand timeframes or scheduling for maintenance tasks, but may reduce the timeframe between maintenance tasks as deemed necessary based on, but not limited to:
  - 1. Cycles.
  - 2. Voltages.
  - 3. Resistance.
  - 4. Delay.

- D. System shall not allow remote maintenance or the ability to login remotely and affect changes to the operability of the elevator system.

### **PART 3 - EXECUTION**

#### **3.1 SITE CONDITION INSPECTION**

- A. Prior to beginning installation of equipment, examine hoistway and machine room areas. Verify no irregularities exist which affect execution of work specified.
- B. Inform Purchaser Consultant of any irregularities in writing prior to commencing work.
- C. Do not proceed with installation until work in place conforms to project requirements.

#### **3.2 INSTALLATION**

- A. See Section 016000, Materials and Handling.
- B. Install all equipment as follows:
  - 1. in accordance with Contractor's instructions, referenced codes, specifications, and approved submittals.
  - 2. with clearances in accordance with referenced codes, and specifications.
  - 3. to be easily maintained and/or removed.
  - 4. to afford maximum accessibility, safety, and continuity of operation.
- C. Remove oil, grease, scale, and other foreign matter from the following equipment and apply one coat of field-applied machinery enamel.
  - 1. All exposed equipment and metal work installed as part of this work which does not have architectural finish.
  - 2. Machine room equipment, and pit equipment.
  - 3. Neatly touch up damaged factory-painted surfaces with original paint color.
  - 4. Protect machine-finish surfaces against corrosion.
- D. Paint machine room and pit floors. Stencil car ID on all equipment including Controller and pit buffers.

#### **3.3 FIELD QUALITY CONTROL**

- A. Work at jobsite will be checked during course of installation. Full cooperation with reviewing personnel is mandatory. Accomplish corrective work required prior to performing further installation.
- B. Perform complete "Acceptance" level pre-testing as specified in the latest edition of ASME A17.2 "Guide for Inspection of Elevators, Escalators, and Moving Walks" prior to AHJ witnessed acceptance testing. Complete any adjustments, repairs, or replacements necessary to achieve code compliant operation including but not limited to:
  - 1. Car and counterweight safety.
  - 2. Car emergency communications. Inform Purchaser and Consultant of any noted failures of Purchaser provided and maintained equipment or systems.
  - 3. Car and counterweight buffers.
  - 4. Phase I and II Firefighters' Emergency Operation. Phase I initiated by smoke sensing devices.
  - 5. Power car door operation including door closing force, reopening device, and restricted opening.
  - 6. Suspension members.

7. Compensation members.
  8. Have Code Authority acceptance inspection performed and complete corrective work.
  9. Provide access to installed equipment and elevator personnel assistance for Consultants final observation and review requirements. See Section 017000, Final Compliance Review.
- C. Provide access to installed equipment and elevator personnel assistance for Consultants final observation and review requirements. See Section 017000, Final Compliance Review.

### 3.4 ADJUSTMENTS

- A. Static balance car to equalize pressure of guide shoes on guide rails.
- B. Lubricate all equipment in accordance with Contractor's instructions.
- C. Adjust motors, power conversion units, brakes, controllers, leveling switches, limit switches, stopping switches, door operators, interlocks, and safety devices to achieve required performance levels.

### 3.5 CLEANUP

- A. See Section 010400, Project Procedures.
- B. Keep work areas orderly and free from debris during progress of project. Remove packaging materials daily.
- C. Remove all loose materials and filings resulting from work.
- D. Clean machine room equipment and floor.
- E. Clean hoistways, car, car enclosure, entrances, operating and signal fixtures.
- F. Paint Machine room floors deck grey.
- G. Paint Pit floors deck grey.
- H. Paint Buffers and supports black or as selected by owner.
- I. Paint all factory prime material/components (whether new or retained) such as hoist machines, governors, machine beams, etc. with color scheme as selected by contractor. Exception: all rotating equipment shall be painted with demarcating yellow.
- J. Paint car tops and crossheads black.

### 3.6 PURCHASER'S INFORMATION

- A. Provide all documentation required in Section 017000, Final Compliance Review.

END OF SECTION

**SECTION 21 05 17 - 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.

**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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Advance Products & Systems, Inc.
  - 2. CALPICO, Inc.
  - 3. GPT; an EnPro Industries company.
- B. 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.
- C. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, anticorrosion coated or galvanized, with plain ends and integral welded waterstop collar.
- D. Galvanized-Steel Sheet Sleeves: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
- E. PVC Pipe Sleeves: ASTM D 1785, Schedule 40.

**2.2 STACK-SLEEVE FITTINGS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Jay R. Smith Mfg. Co.
  - 2. Zurn Industries, LLC.
- B. Description: Manufactured, Dura-coated or Duco-coated 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:



1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. GPT; an EnPro Industries company.
4. Metraflex Company (The).
5. Proco Products, Inc.

B. 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 (137 kPa) 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: Stainless steel.
5. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

#### 2.4 SLEEVE-SEAL FITTINGS

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

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. GPT; an EnPro Industries company.
4. Metraflex Company (The).
5. Proco Products, Inc.

B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall.

C. 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 (34.5-MPa), 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 (25-mm) 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 (50 mm) 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 (6.4-mm) 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 07 84 13 "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 (6.4-mm) 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 07 62 00 "Sheet Metal Flashing and Trim."
  3. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) 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 07 84 13 "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 (DN 150): Cast-iron pipe sleeves.

- b. Piping NPS 6 (DN 150) and Larger: Cast-iron pipe sleeves.
2. Exterior Concrete Walls below Grade:
  - a. Piping Smaller Than NPS 6 (DN 150): Cast-iron pipe sleeves with sleeve-seal system.
    - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
  - b. Piping NPS 6 (DN 150) and Larger: Cast-iron pipe sleeves with sleeve-seal system.
    - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
3. Concrete Slabs-on-Grade:
  - a. Piping Smaller Than NPS 6 (DN 150): Cast-iron pipe sleeves with sleeve-seal system.
    - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
  - b. Piping NPS 6 (DN 150) and Larger: Cast-iron pipe sleeves with sleeve-seal system.
    - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
4. Concrete Slabs above Grade:
  - a. Piping Smaller Than NPS 6 (DN 150): Steel pipe sleeves.
  - b. Piping NPS 6 (DN 150) and Larger: Steel pipe sleeves.
5. Interior Partitions:
  - a. Piping Smaller Than NPS 6 (DN 150): Steel pipe sleeves.
  - b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel sheet sleeves.

**END OF SECTION 21 05 17**

**SECTION 21 05 18 - 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

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. BrassCraft Manufacturing Co.; a Masco company.
  - 2. Dearborn Brass.
  - 3. Jones Stephens Corp.
  - 4. Keeney Manufacturing Company (The).
  - 5. Mid-America Fittings, Inc.
  - 6. ProFlo; a Ferguson Enterprises, Inc. brand.

## 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.

## 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 cast brass with polished, chrome-plated finish.
    - c. Insulated Piping: One-piece steel with polished, chrome-plated finish.
    - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish.
    - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece stamped steel with polished, chrome-plated finish.
    - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish.
    - g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece stamped steel with polished, chrome-plated finish.
    - h. Bare Piping in Unfinished Service Spaces: One-piece stamped steel with polished, chrome-plated finish.
    - i. Bare Piping in Equipment Rooms: One-piece stamped steel 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.

### 3.2 FIELD QUALITY CONTROL

- A. Using new materials, replace broken and damaged escutcheons and floor plates.

**END OF SECTION 21 05 18**

**SECTION 21 05 23 - GENERAL-DUTY VALVES FOR WATER-BASED 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. 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: Non-Rising 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 (DN 50) and smaller.

## 2.2 TWO-PIECE BALL VALVES WITH INDICATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. NIBCO INC.
  - 2. Victaulic Company.
- B. 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 (1200 kPa).
  - 3. Body Design: Two piece.
  - 4. Body Material: Forged brass or bronze.
  - 5. Port Size: Full.
  - 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 (DN 25) through NPS 2 (DN 50): Threaded ends.
  - 12. End Connections for Valves NPS 2-1/2 (DN 65): Grooved ends.

## 2.3 BRONZE BUTTERFLY VALVES WITH INDICATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Fivalco Inc.
  - 2. Globe Fire Sprinkler Corporation.

3. Milwaukee Valve Company.

B. 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 (1200 kPa).
3. Body Material: Bronze.
4. Seat Material: EPDM.
5. Stem Material: Bronze or stainless steel.
6. Disc: Bronze.
7. Actuator: Worm gear or traveling nut.
8. Supervisory Switch: Internal or external.
9. Ends Connections for Valves NPS 1 (DN 25) through NPS 2 (DN 50): Threaded ends.
10. Ends Connections for Valves NPS 2-1/2 (DN 65): Grooved ends.

2.4 IRON BUTTERFLY VALVES WITH INDICATORS

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

1. Anvil International.
2. Fivalco Inc.
3. Globe Fire Sprinkler Corporation.
4. Kennedy Valve Company; a division of McWane, Inc.
5. NIBCO INC.
6. Tyco Fire & Building Products LP.
7. Victaulic Company.
8. Zurn Industries, LLC.

B. 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 (1200 kPa).
3. Body Material: Cast or ductile iron with nylon, EPDM, epoxy, or polyamide coating.
4. Seat Material: EPDM.
5. Stem: Stainless steel.
6. Disc: Ductile iron, nickel plated.
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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Anvil International.
2. Fire Protection Products, Inc.
3. Fivalco Inc.
4. Globe Fire Sprinkler Corporation.
5. Kennedy Valve Company; a division of McWane, Inc.
6. Matco-Norca.
7. Mueller Co.
8. NIBCO INC.
9. Reliable Automatic Sprinkler Co., Inc. (The).
10. Shurjoint Piping Products.
11. Tyco Fire & Building Products LP.
12. United Brass Works, Inc.
13. Venus Fire Protection Ltd.
14. Victaulic Company.
15. Viking Corporation.
16. Watts; a Watts Water Technologies company.



17. Wilson & Cousins Inc.

18. Zurn Industries, LLC.

B. Description:

1. Standard: UL 312 and FM Global standard for swing check valves, Class Number 1210.
2. Minimum Pressure Rating: 175 psig (1200 kPa).
3. Type: Single swing check.
4. Body Material: Cast iron, ductile iron, or bronze.
5. Clapper: Bronze, ductile iron, or stainless steel with elastomeric seal.
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 IRON OS&Y GATE VALVES

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

1. American Cast Iron Pipe Company.
2. Clow Valve Company; a subsidiary of McWane, Inc.
3. Hammond Valve.
4. Kennedy Valve Company; a division of McWane, Inc.
5. Mueller Co.
6. NIBCO INC.
7. Victaulic Company.
8. Watts; a Watts Water Technologies company.
9. Zurn Industries, LLC.

B. 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 (1200 kPa).
3. Body and Bonnet Material: Cast or ductile iron.
4. Wedge: Cast or ductile iron, or bronze with elastomeric coating.
5. Wedge Seat: Cast or ductile iron, or bronze with elastomeric coating.
6. Stem: Brass or bronze.
7. Packing: Non-asbestos PTFE.
8. Supervisory Switch: External.
9. End Connections: Flanged or Grooved.

## 2.7 NRS GATE VALVES

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

1. American Cast Iron Pipe Company.
2. Clow Valve Company; a subsidiary of McWane, Inc.
3. Kennedy Valve Company; a division of McWane, Inc.
4. Mueller Co.
5. NIBCO INC.
6. Victaulic Company.
7. Zurn Industries, LLC.

B. 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 (1200 kPa).
3. Body and Bonnet Material: Cast or ductile iron.
4. Wedge: Cast or ductile iron with elastomeric coating.
5. Wedge Seat: Cast or ductile iron, or bronze with elastomeric coating.
6. Stem: Brass or bronze.
7. Packing: Non-asbestos PTFE.

8. Supervisory Switch: External.
9. End Connections: Threaded.

## 2.8 INDICATOR POSTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. American Cast Iron Pipe Company.
  2. Clow Valve Company; a subsidiary of McWane, Inc.
  3. Kennedy Valve Company; a division of McWane, Inc.
  4. Mueller Co.
  5. NIBCO INC.
- B. Description:
1. Standard: UL 789 and FM Global standard for indicator posts.
  2. Type: Underground, Pit, or Wall.
  3. Base Barrel Material: Cast or ductile iron.
  4. Extension Barrel: Cast or ductile iron.
  5. Cap: Cast or ductile iron.
  6. Operation: Wrench for underground or pit installations and handwheel for wall installations.

## 2.9 TRIM AND DRAIN VALVES

- A. Ball Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Conbraco Industries, Inc.
    - b. Fire Protection Products, Inc.
    - c. Fire-End & Croker Corporation.
    - d. Flowserve Corporation.
    - e. FNW; Ferguson Enterprises, Inc.
    - f. Jomar Valve.
    - g. KITZ Corporation.
    - h. Legend Valve & Fitting, Inc.
    - i. Metso Automation USA Inc.
    - j. Milwaukee Valve Company.
    - k. NIBCO INC.
    - l. Potter Roemer LLC.
    - m. Red-White Valve Corporation.
    - n. Tyco Fire & Building Products LP.
    - o. Victaulic Company.
    - p. Watts; a Watts Water Technologies company.
    - q. Zurn Industries, LLC.
  2. Description:
    - a. Pressure Rating: 175 psig (1200 kPa).
    - 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 (DN 25) through NPS 2-1/2 (DN 65): Threaded ends.
    - j. End Connections for Valves NPS 1-1/4 and NPS 2-1/2 (DN 32 and DN 65): Grooved ends.
- B. Angle Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Fire Protection Products, Inc.

- b. NIBCO INC.
- c. United Brass Works, Inc.
- 2. Description:
  - a. Pressure Rating: 175 psig (1200 kPa).
  - 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. NIBCO INC.
    - b. United Brass Works, Inc.
  - 2. Description:
    - a. Pressure Rating: 175 psig (1200 kPa).
    - 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 21 11 00 "Facility Fire-Suppression Water-Service Piping" for application of valves in fire-suppression water-service piping outside the building.
  - 2. Section 21 12 00 "Fire-Suppression Standpipes" for application of valves in fire-suppression standpipes.
  - 3. Section 21 13 13 "Wet-Pipe Sprinkler Systems" for application of valves in wet-pipe, fire-suppression sprinkler systems.
  - 4. Section 21 13 16 "Dry-Pipe Sprinkler Systems" for application of valves in dry-pipe, fire-suppression sprinkler systems.
- 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 21 05 53 "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 21 05 23**

**SECTION 21 05 29 - HANGERS AND SUPPORTS 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. 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 05 50 00 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
  - 2. Section 21 05 48.13 "Vibration Controls for Fire-Suppression Piping and Equipment" for vibration isolation devices.

**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 01 40 00 "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.
- 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 stainless 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. Manufacturer Metal Framing Systems:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. B-line, an Eaton business.
    - b. Flex-Strut Inc.
    - c. G-Strut.
    - d. Unistrut; Part of Atkore International.
    - e. Anvil International.
  - 2. Description: Shop- or field-fabricated pipe-support assembly, made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
  - 3. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.
  - 4. Channels: Continuous slotted carbon-steel channel with inturred lips.
  - 5. Channel Width: Selected for applicable load criteria.
  - 6. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
  - 7. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
  - 8. Metallic Coating: Plain.
  - 9. Paint Coating: Green epoxy, acrylic, or urethane.

## 2.5 THERMAL HANGER-SHIELD INSERTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Carpenter & Paterson, Inc.
  - 2. Pipe Shields Inc.
  - 3. Piping Technology & Products, Inc.

4. Value Engineered Products, Inc.

- B. Insulation-Insert Material: ASTM C 552, Type II cellular glass with 100-psi (688-kPa) 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 (50 mm) 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.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Hilti, Inc.
    - b. ITW Ramset/Red Head; Illinois Tool Works, Inc.
    - c. MKT Fastening, LLC.
- 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. B-line, an Eaton business.
    - b. Hilti, Inc.
    - c. ITW Ramset/Red Head; Illinois Tool Works, Inc.
    - d. MKT Fastening, LLC.
  - 2. Indoor Applications: Zinc-coated or Stainless steel.
  - 3. 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 (ASTM B 221M).
- 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 (34.5-MPa), 28-day compressive strength.

## PART 3 - EXECUTION

### 3.1 APPLICATION

- A. Comply with requirements in Section 07 84 13 "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. (90 kg).

### 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 (100 mm) 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 (DN 65) 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 (DN 100) 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 (DN 100) 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 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
    - b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
    - c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.



- d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches (610 mm) long and 0.075 inch (1.91 mm) thick.
  - e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches (610 mm) long and 0.105 inch (2.67 mm) thick.
5. Pipes NPS 8 (DN 200) 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 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.

### 3.5 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 (40 mm).

### 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 (0.05 mm).
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded, shop-painted areas on miscellaneous metal are specified in Section 09 91 23 "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 or stainless-steel 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 (DN 15 to DN 750).
  - 2. Steel Pipe Clamps (MSS Type 4): For suspension of NPS 1/2 to NPS 24 (DN 15 to DN 600) 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 (DN 15 to DN 200).
  - 4. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8 (DN 10 to DN 200).
  - 5. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3 (DN 10 to DN 80).
  - 6. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
  - 7. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), 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 (DN 100 to DN 900), 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 (DN 65 to DN 900) 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 (DN 24 to DN 600).
  - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 (DN 20 to DN 600) 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 21 05 29**

**SECTION 21 05 48.13 - VIBRATION 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.
- B. Related Requirements:
  - 1. Section 22 05 48.13 "Vibration Controls for Plumbing Piping and Equipment" for devices for plumbing equipment and systems.
  - 2. Section 23 05 48.13 "Vibration Controls for HVAC" for devices for HVAC equipment and systems.

**1.3 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 type required.
- B. Delegated-Design Submittal: For each vibration isolation device.
  - 1. Include design calculations for selecting vibration isolators.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Show coordination of vibration isolation device installation 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 testing agency.
- C. Welding certificates.

**1.5 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 ELASTOMERIC ISOLATION PADS**

- A. Elastomeric Isolation Pads:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Ace Mountings Co., Inc.

- b. California Dynamics Corporation.
  - c. Isolation Technology, Inc.
  - d. Kinetics Noise Control, Inc.
  - e. Mason Industries, Inc.
  - f. Vibration Eliminator Co., Inc.
  - g. Vibration Isolation.
  - h. Vibration Mountings & Controls, Inc.
2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
  3. Size: Factory or field cut to match requirements of supported equipment.
  4. Pad Material: Oil and water resistant with elastomeric properties.
  5. Surface Pattern: Waffle pattern.
  6. Infused nonwoven cotton or synthetic fibers.
  7. Load-bearing metal plates adhered to pads.
  8. Sandwich-Core Material: Resilient .
    - a. Surface Pattern: Waffle pattern.
    - b. Infused nonwoven cotton or synthetic fibers.

## 2.2 ELASTOMERIC ISOLATION MOUNTS

### A. Double-Deflection, Elastomeric Isolation Mounts:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Ace Mountings Co., Inc.
  - b. California Dynamics Corporation.
  - c. Isolation Technology, Inc.
  - d. Kinetics Noise Control, Inc.
  - e. Mason Industries, Inc.
  - f. Vibration Eliminator Co., Inc.
  - g. Vibration Isolation.
  - h. Vibration Mountings & Controls, Inc.
2. 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.
3. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

## 2.3 RESTRAINED ELASTOMERIC ISOLATION MOUNTS

### A. Restrained Elastomeric Isolation Mounts:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. California Dynamics Corporation.
  - b. Isolation Technology, Inc.
  - c. Kinetics Noise Control, Inc.
  - d. Mason Industries, Inc.
  - e. Vibration Eliminator Co., Inc.
  - f. Vibration Isolation.
  - g. Vibration Mountings & Controls, Inc.
2. Description: All-directional isolator with 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.

## 2.4 PIPE-RISER RESILIENT SUPPORTS

- A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch- (13-mm-) 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 (3.45 MPa) on isolation material providing equal isolation in all directions.

## 2.5 RESILIENT PIPE GUIDES

- A. Description: Telescopic arrangement of 2 steel tubes or post and sleeve arrangement separated by a minimum 1/2-inch- (13-mm-) 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.

## 2.6 ELASTOMERIC HANGERS

- A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. California Dynamics Corporation.
    - b. Isolation Technology, Inc.
    - c. Kinetics Noise Control, Inc.
    - d. Mason Industries, Inc.
    - e. Vibration Eliminator Co., Inc.
    - f. Vibration Mountings & Controls, Inc.
  2. 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.
  3. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation 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 VIBRATION CONTROL 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 03 30 00 "Cast-in-Place Concrete" and/or Section 03 30 53 "Miscellaneous 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.

## END OF SECTION 21 05 48.13

**SECTION 21 05 53 - 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. Warning signs and labels.
  - 2. Pipe labels.
  - 3. Stencils.
  - 4. Valve tags.
  - 5. Warning tags.

## 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Equipment-Label Schedule: Include a listing of all equipment to be labeled and the proposed content for each label.
- C. Valve Schedules: Valve numbering scheme.

## PART 2 - PRODUCTS

## 2.1 WARNING SIGNS AND LABELS

- 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. Brady Corporation.
  - 2. Champion America.
  - 3. Seton Identification Products.
- B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, with predrilled holes for attachment hardware.
- C. Letter Color: White.
- D. Background Color: Red.
- E. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
- F. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
- G. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- H. Fasteners: Stainless-steel rivets or self-tapping screws.
- I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- J. Label Content: Include caution and warning information, plus emergency notification instructions.

## 2.2 PIPE LABELS

- 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. Brady Corporation.
  - 2. Champion America.

3. Seton Identification Products.
- B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service and showing flow direction according to ASME A13.1.
- C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.
- D. Self-adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- E. 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: Size letters according to ASME A13.1 for piping.
- F. Pipe-Label Colors:
  1. Background Color: Safety Red.
  2. Letter Color: White.

### 2.3 VALVE TAGS

- 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. Brady Corporation.
  2. Champion America.
  3. Seton Identification Products.
- B. Description: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping-system abbreviation and 1/2-inch (13-mm) numbers.
  1. Tag Material: Brass, 0.032 inch (0.8 mm) or anodized aluminum, 0.032 inch (0.8 mm) thick, with predrilled holes for attachment hardware.
  2. Fasteners: Brass wire-link chain.
  3. Valve-Tag Color: Safety Red.
  4. Letter Color: White.
- C. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) 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.

### 2.4 WARNING TAGS

- 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. Brady Corporation.
  2. Champion America.
  3. Seton Identification Products.
- B. Description: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
  1. Size: Approximately 4 by 7 inches (100 by 178 mm).
  2. Fasteners: Brass grommet and wire.
  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 PIPE LABEL INSTALLATION**

- A. Piping: Painting of piping is specified in Section 09 91 23 "Interior Painting." Section 09 96 00 "High-Performance Coatings."
- 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 (15 m) along each run. Reduce intervals to 25 feet (7.6 m) 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.

**3.4 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 (38 mm), round.
    - b. Wet-Pipe Sprinkler System: 1-1/2 inches (38 mm), round.
    - c. Clean-Agent Fire-Extinguishing System: 1-1/2 inches (38 mm), round.

**3.5 WARNING-TAG INSTALLATION**

- A. Write required message on, and attach warning tags to, equipment and other items where required.

**END OF SECTION 21 05 53**



**SECTION 21 11 19 - 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.

## 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 EXPOSED-TYPE FIRE-DEPARTMENT CONNECTION

- 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. Elkhart Brass Mfg. Company, Inc.
  - 2. Fire-End & Croker Corporation.
  - 3. Guardian Fire Equipment, Inc.
  - 4. Potter Roemer.
- B. Standard: UL 405.
- C. Type: Exposed, projecting, for wall mounting.
- D. Pressure Rating: 175 psig (1200 kPa) minimum.
- E. Body Material: Corrosion-resistant metal.
- F. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
- G. Caps: Brass, lugged type, with gasket and chain.
- H. Escutcheon Plate: Round, brass, wall type.
- I. Outlet: Back, with pipe threads.
- J. Number of Inlets: Three.
- K. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE."
- L. Finish: Polished chrome plated.
- M. Outlet Size: NPS 6 (DN 150).

## 2.2 FLUSH-TYPE FIRE-DEPARTMENT CONNECTION

- 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. Elkhart Brass Mfg. Company, Inc.
  - 2. Fire-End & Croker Corporation.
  - 3. Guardian Fire Equipment, Inc.
  - 4. Potter Roemer.
- B. Standard: UL 405.
- C. Type: Flush, for wall mounting.

- D. Pressure Rating: 175 psig (1200 kPa) minimum.
- E. Body Material: Corrosion-resistant metal.
- F. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
- G. Caps: Brass, lugged type, with gasket and chain.
- H. Escutcheon Plate: Rectangular, brass, wall type.
- I. Outlet: With pipe threads.
- J. Body Style: Horizontal or Vertical.
- K. Number of Inlets: Four.
- L. Outlet Location: Back.
- M. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE."
- N. Finish: Polished chrome plated.
- O. Outlet Size: NPS 6 (DN 150).

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

#### 3.2 INSTALLATION

- A. Install wall-type fire-department connections.
- B. Install two protective pipe bollards on sides of each fire-department connection. Comply with requirements for bollards in Section 05 50 00 "Metal Fabrications."
- C. Install automatic (ball-drip) drain valve at each check valve for fire-department connection.

**END OF SECTION 21 11 19**

**SECTION 21 13 13 - 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. Specialty valves.
  - 3. Sprinklers.
  - 4. Alarm devices.
  - 5. Manual control stations.
  - 6. Control panels.
  - 7. Pressure gages.
- B. Related Requirements:
  - 1. Section 21 11 19 "Fire Department Connections" for exposed-, flush-, and yard-type fire department connections.
  - 2. Section 23 05 23 "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. High-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure higher than standard 175 psig (1200 kPa), but not higher than 250 psig (1725 kPa).
- B. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175-psig (1200-kPa) 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.

**1.5 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Domestic water piping.
  - 2. HVAC hydronic piping.
  - 3. Items penetrating finished ceiling include the following:
    - a. Lighting fixtures.
    - b. Air outlets and inlets.
- B. Qualification Data: For qualified Installer and professional engineer.
- C. 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.
  - D. Welding certificates.
  - E. 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.
  - F. Field quality-control reports.
- 1.6 CLOSEOUT SUBMITTALS
- A. Operation and Maintenance Data: For wet-pipe sprinkler systems and specialties to include in emergency, operation, and maintenance manuals.
- 1.7 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.
- 1.8 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.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
  1. NFPA 13.
  2. Insurance Underwriters.
- B. Standard-Pressure Piping System Component: Listed for 175-psig (1200-kPa) minimum working pressure.
- C. High-Pressure Piping System Component: Listed for 250-psig (1725-kPa) minimum working pressure.
- D. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design wet-pipe sprinkler systems.
  1. Refer to plans for available fire-hydrant flow test records.
  2. Sprinkler system design shall be approved by authorities having jurisdiction.
    - a. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
    - b. 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 1.

- 4) Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
3. Minimum Density for Automatic-Sprinkler Piping Design:
  - a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. (4.1 mm/min. over 139-sq. m) area.
  - b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. (6.1 mm/min. over 139-sq. m) area.
  - c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. (8.1 mm/min. over 139-sq. m) area.
4. Minimum Density for Deluge-Sprinkler Piping Design:
  - a. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm (6.1 mm/min.) over entire area.
  - b. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm (8.1 mm/min.) over entire area.
5. Maximum Protection Area per Sprinkler: According to UL listing.
6. Maximum Protection Area per Sprinkler:
  - a. Office Spaces: 120 sq. ft. (11.1 sq. m).
  - b. Storage Areas: 130 sq. ft. (12.1 sq. m).
  - c. Mechanical Equipment Rooms: 130 sq. ft. (12.1 sq. m).
  - d. Electrical Equipment Rooms: 130 sq. ft. (12.1 sq. m).
  - e. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.

## 2.2 STEEL PIPE AND FITTINGS

- A. Standard-Weight, Black-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. 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 (DN 125) and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10 (DN 150 to DN 250), plain end.
- C. Malleable- or Ductile-Iron Unions: UL 860.
- D. Cast-Iron Flanges: ASME 16.1, Class 125.
- E. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
  1. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick or EPDM rubber gasket.
    - 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.
- F. 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.
- G. Grooved-Joint, Steel-Pipe Appurtenances:
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Anvil International.
    - b. Shurjoint Piping Products USA Inc.
    - c. Tyco Fire Products LP.
    - d. Victaulic Company.
  2. Pressure Rating: 175-psig (1200-kPa) minimum.
  3. Painted 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.
- H. 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.
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Victaulic Company.

## 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 (1200-kPa) minimum.
  - 2. High-Pressure Piping Specialty Valves: 250-psig (1725-kPa) minimum.
- C. Body Material: Cast or ductile iron.
- D. Size: Same as connected piping.
- E. End Connections: Flanged or grooved.
- F. Alarm Valves:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Globe Fire Sprinkler Corporation.
    - b. Tyco Fire Products LP.
    - c. Victaulic Company.
    - d. Viking Corporation.
  - 2. Standard: UL 193.
  - 3. Design: For horizontal or vertical installation.
  - 4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, retarding chamber, and fill-line attachment with strainer.
  - 5. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.
  - 6. Drip Cup Assembly: Pipe drain with check valve to main drain piping.
  - 7. 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. Deluge Valves:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Globe Fire Sprinkler Corporation.
    - b. Tyco Fire Products LP.
    - c. Victaulic Company.
    - d. Viking Corporation.
  - 2. Standard: UL 260.
  - 3. Design: Hydraulically operated, differential-pressure type.
  - 4. Include trim sets for alarm-test bypass, drain, electrical water-flow alarm switch, pressure gages, drip cup assembly piped without valves and separate from main drain line, and fill-line attachment with strainer.
  - 5. Wet, Pilot-Line Trim Set: Include gage to read diaphragm-chamber pressure and manual control station for manual operation of deluge valve, and connection for actuation device.
- H. Automatic (Ball Drip) Drain Valves:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Reliable Automatic Sprinkler Co., Inc. (The).
    - b. Tyco Fire Products LP.
  - 2. Standard: UL 1726.
  - 3. Pressure Rating: 175-psig (1200-kPa) minimum.
  - 4. Type: Automatic draining, ball check.
  - 5. Size: NPS 3/4 (DN 20).
  - 6. End Connections: Threaded.

## 2.4 SPRINKLER PIPING SPECIALTIES

- A. Branch Outlet Fittings:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Anvil International.
    - b. Shurjoint Piping Products USA Inc.

- c. Tyco Fire Products LP.
  - d. Victaulic Company.
  2. Standard: UL 213.
  3. Pressure Rating: 175-psig (1200-kPa) minimum.
  4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
  5. Type: Mechanical-tee and -cross fittings.
  6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
  7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
  8. Branch Outlets: Grooved, plain-end pipe, or threaded.
- B. Flow Detection and Test Assemblies:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Reliable Automatic Sprinkler Co., Inc. (The).
    - b. Tyco Fire Products LP.
    - c. Victaulic Company.
  2. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
  3. Pressure Rating: 175-psig (1200-kPa) minimum.
  4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
  5. Size: Same as connected piping.
  6. Inlet and Outlet: Threaded or grooved.
- C. Branch Line Testers:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Elkhart Brass Mfg. Co., Inc.
    - b. Potter Electric Signal Company, LLC.
    - c. Potter Roemer LLC.
  2. Standard: UL 199.
  3. Pressure Rating: 175 psig (1200 kPa).
  4. Body Material: Brass.
  5. Size: Same as connected piping.
  6. Inlet: Threaded.
  7. Drain Outlet: Threaded and capped.
  8. Branch Outlet: Threaded, for sprinkler.
- D. Sprinkler Inspector's Test Fittings:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Tyco Fire Products LP.
    - b. Victaulic Company.
    - c. Viking Corporation.
  2. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
  3. Pressure Rating: 175-psig (1200-kPa) minimum.
  4. Body Material: Cast- or ductile-iron housing with sight glass.
  5. Size: Same as connected piping.
  6. Inlet and Outlet: Threaded.
- E. Adjustable Drop Nipples:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Aegis Technologies, Inc.
    - b. Corcoran Piping System Co.
    - c. Merit Manufacturing.
  2. Standard: UL 1474.
  3. Pressure Rating: 250-psig (1725-kPa) minimum.
  4. Body Material: Steel pipe with EPDM-rubber O-ring seals.
  5. Size: Same as connected piping.
  6. Length: Adjustable.

7. Inlet and Outlet: Threaded.
- F. Flexible Sprinkler Hose Fittings:
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. FlexHead Industries, Inc.
    - b. Gateway Tubing, Inc.
    - c. Victaulic Company.
  2. Standard: UL 1474.
  3. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
  4. Pressure Rating: 175-psig (1200-kPa) minimum.
  5. Size: Same as connected piping, for sprinkler.

## 2.5 SPRINKLERS

- 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. Globe Fire Sprinkler Corporation.
  2. Tyco Fire Products LP.
  3. Victaulic Company.
  4. Viking Corporation.
- B. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
- C. Pressure Rating for Automatic Sprinklers: 175-psig (1200-kPa) minimum.
- D. Pressure Rating for High-Pressure Automatic Sprinklers: 250-psig (1725-kPa) minimum.
- E. Automatic Sprinklers with Heat-Responsive Element:
  1. Early-Suppression, Fast-Response Applications: UL 1767.
  2. Nonresidential Applications: UL 199.
  3. Residential Applications: UL 1626.
  4. Characteristics: Nominal 1/2-inch (12.7-mm) orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.
- F. Sprinkler Finishes: Chrome plated, bronze, and painted.
- G. Special Coatings: Wax and corrosion-resistant paint.
- H. 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: Chrome-plated steel, two piece, with 1-inch (25-mm) vertical adjustment.
  2. Sidewall Mounting: Chrome-plated steel, one piece, flat.
- I. Sprinkler Guards:
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Tyco Fire Products LP.
    - b. Victaulic Company.
    - c. Viking Corporation.
  2. Standard: UL 199.
  3. 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. Water-Motor-Operated Alarm:
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Globe Fire Sprinkler Corporation.
    - b. Tyco Fire Products LP.
    - c. Victaulic Company.
    - d. Viking Corporation.
  2. Standard: UL 753.
  3. Type: Mechanically operated, with Pelton wheel.



4. Alarm Gong: Cast aluminum with red-enamel factory finish.
  5. Size: 8-1/2-inches (216-mm) diameter.
  6. Components: Shaft length, bearings, and sleeve to suit wall construction.
  7. Inlet: NPS 3/4 (DN 20).
  8. Outlet: NPS 1 (DN 25) drain connection.
- C. Electrically Operated Alarm Bell:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Fire-Lite Alarms, Inc.; a Honeywell International company.
    - b. Notifier.
    - c. Potter Electric Signal Company, LLC.
  2. Standard: UL 464.
  3. Type: Vibrating, metal alarm bell.
  4. Size: 6-inch (150-mm) minimum-diameter.
  5. Finish: Red-enamel factory finish, suitable for outdoor use.
  6. 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. Water-Flow Indicators:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Potter Electric Signal Company, LLC.
    - b. Viking Corporation.
    - c. WATTS.
  2. Standard: UL 346.
  3. Water-Flow Detector: Electrically supervised.
  4. 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.
  5. Type: Paddle operated.
  6. Pressure Rating: 250 psig (1725 kPa).
  7. Design Installation: Horizontal or vertical.
- E. Pressure Switches:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Potter Electric Signal Company, LLC.
    - b. Tyco Fire Products LP.
    - c. United Electric Controls Co.
    - d. Viking Corporation.
  2. Standard: UL 346.
  3. Type: Electrically supervised water-flow switch with retard feature.
  4. Components: Single-pole, double-throw switch with normally closed contacts.
  5. Design Operation: Rising pressure signals water flow.
- F. Valve Supervisory Switches:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Kennedy Valve Company; a division of McWane, Inc.
    - b. Potter Electric Signal Company, LLC.
    - c. System Sensor.
  2. Standard: UL 346.
  3. Type: Electrically supervised.
  4. Components: Single-pole, double-throw switch with normally closed contacts.
  5. Design: Signals that controlled valve is in other than fully open position.
  6. 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 MANUAL CONTROL STATIONS

- A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide" for hydraulic operation, with union, NPS 1/2 (DN 15) pipe nipple, and bronze ball valve.
- B. Include metal enclosure labeled "MANUAL CONTROL STATION," with operating instructions and cover held closed by breakable strut to prevent accidental opening.

## 2.8 CONTROL PANELS

- A. Description: Single-area, two-area, or single-area cross-zoned control panel as indicated, including NEMA ICS 6, Type 1 enclosure, detector, alarm, and solenoid-valve circuitry for operation of deluge valves.
  - 1. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide" when used with thermal detectors and Class A detector circuit wiring.
  - 2. Electrical characteristics are 120-V ac, 60 Hz, with 24-V dc rechargeable batteries.
  - 3. 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. Manual Control Stations: Electric operation, metal enclosure, labeled "MANUAL CONTROL STATION," with operating instructions and cover held closed by breakable strut to prevent accidental opening.
- C. Manual Control Stations: Hydraulic operation, with union, NPS 1/2 (DN 15) pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION," with operating instructions and cover held closed by breakable strut to prevent accidental opening.
- D. Panels Components:
  - 1. Power supply.
  - 2. Battery charger.
  - 3. Standby batteries.
  - 4. Field-wiring terminal strip.
  - 5. Electrically supervised solenoid valves and polarized fire-alarm bell.
  - 6. Lamp test facility.
  - 7. Single-pole, double-throw auxiliary alarm contacts.
  - 8. Rectifier.

## 2.9 PRESSURE GAGES

- 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. AGF Manufacturing, Inc.
  - 2. Brecco Corporation.
  - 3. WIKA Instrument Corporation.
- B. Standard: UL 393.
- C. Dial Size: 3-1/2- to 4-1/2-inch (90- to 115-mm) diameter.
- D. Pressure Gage Range: 0 to 300 psig (0 to 2070 kPa).
- E. 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 21 11 00 "Facility Fire-Suppression Water-Service Piping" for exterior piping.
- B. Install shutoff valve, 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. Connect sprinkler piping to building's interior water-distribution piping. Comply with requirements for interior piping in Section 22 11 16 "Domestic Water Piping."
- B. Install shutoff valve, pressure gage, drain, and other accessories indicated at connection to water-distribution piping.
- C. 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. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- D. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller.
- E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.
- F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
- G. Install sprinkler piping with drains for complete system drainage.
- H. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- I. 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.
- J. Install alarm devices in piping systems.
- K. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.
- L. 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 (DN 8) 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.
- M. Pressurize and check preaction sprinkler system piping and air-pressure maintenance devices or air compressors.
- 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 21 05 17 "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 21 05 17 "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 21 05 18 "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 (DN 50) and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) 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, Pressure-Sealed Joints: Join lightwall steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.
- I. 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.
- J. 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.
- K. 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.
- L. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

### 3.6 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.

### 3.7 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.
- B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.
- C. Install sprinklers into flexible, sprinkler hose fittings, and install hose into bracket on ceiling grid.

### 3.8 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 26 05 53 "Identification for Electrical Systems."

### 3.9 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.

### 3.10 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.

### 3.11 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain specialty valves and pressure-maintenance pumps.

### 3.12 PIPING SCHEDULE

- A. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.
- B. Standard-pressure, wet-pipe sprinkler system, NPS 2 (DN 50) and smaller, shall be one of 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. Standard-weight, black-steel pipe with plain ends; steel welding fittings; and welded joints.
  - 4. 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.
  - 5. Schedule 10 black-steel pipe with plain ends; welding fittings; and welded joints.
  - 6. Schedule 5 steel pipe; steel pressure-seal fittings; and pressure-sealed joints.
  - 7. Type L (Type B) or Type M (Type C), hard copper tube with plain ends; cast- or wrought-copper, solder-joint fittings; and brazed joints.
  - 8. Type L (Type B) or Type M (Type C), hard copper tube with plain ends; copper pressure-seal fittings; and pressure-sealed joints.
  - 9. NPS 2 (DN 50), Type L (Type B) or Type M (Type C), hard copper tube with roll-grooved ends; copper, grooved-end fittings; grooved-end-tube couplings; and grooved joints.
- C. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 (DN 6) and larger, shall be one of the following:
  - 1. 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. Standard-weight, black-steel pipe with plain ends; steel welding fittings; and welded joints.
4. 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.
5. Schedule 10 black-steel pipe with plain ends; welding fittings; and welded joints.

### 3.13 SPRINKLER SCHEDULE

- A. Use sprinkler types in subparagraphs below for the following applications:
  1. Rooms without Ceilings: Upright sprinklers.
  2. Rooms with Suspended Ceilings: Pendent, recessed, flush, and concealed sprinklers as indicated.
  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. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
  3. Upright Pendent and Sidewall 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 21 13 13**

**SECTION 21 22 00 - CLEAN-AGENT FIRE-EXTINGUISHING 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. Clean-agent systems.
  - 2. Pipe and fittings.
  - 3. Valves.
  - 4. Extinguishing-agent containers.
  - 5. Fire-extinguishing clean agent.
  - 6. Discharge nozzles.
  - 7. Manifold and orifice unions.
  - 8. Fire control panels.
  - 9. Detection devices.
  - 10. Manual stations.
  - 11. Switches.
  - 12. Alarm devices.

## 1.3 DEFINITIONS

- A. ATS: Acceptance Testing Specifications.
- B. EPO: Emergency Power Off.

## 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For clean-agent fire-extinguishing system signed and sealed by a qualified professional engineer.
  - 1. Include plans, elevations, sections, details, and attachments to other work.
  - 2. Include design calculations.
  - 3. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 4. Wiring Diagrams: For power, signal, and control wiring.
- C. Delegated-Design Submittal: For clean-agent fire-extinguishing system signed and sealed by the qualified professional engineer.
  - 1. Indicate compliance with performance requirements and design criteria, including analysis data.
  - 2. Include design calculations for weight, volume, and concentration of extinguishing agent required for each hazard area.
  - 3. Indicate the Following on Reflected Ceiling Plans:
    - a. Ceiling penetrations and ceiling-mounted items.
    - b. Extinguishing-agent containers if mounted above floor, piping and discharge nozzles, detectors, and accessories.
    - c. Method of attaching hangers to building structure.
    - d. Other ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, and access panels.
  - 4. Indicate the Following on Occupied Work Area Plans:
    - a. Controls and alarms.

- b. Extinguishing-agent containers, piping and discharge nozzles if mounted in space, detectors, and accessories.
- c. Equipment and furnishings.
5. Indicate the Following on Access Floor Space Plans:
  - a. Extinguishing-agent containers, piping and discharge nozzles, detectors, and accessories.
  - b. Method of supporting piping.
6. Indicate the Following on Ceiling Plans:
  - a. Extinguishing-agent containers, piping and discharge nozzles, detectors, and accessories.
  - b. Method of supporting piping.
  - c. Other equipment located in the ceiling space that is being protected including sprinkler piping, HVAC equipment, raceways, or conduit.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
  1. Domestic water piping.
  2. Items Penetrating Finished Ceiling Include the Following:
    - a. Lighting fixtures.
    - b. Air outlets and inlets.
- B. Design Data:
  1. Permit Approved Drawings: Working plans, prepared according to NFPA 2001, that have been approved by authorities having jurisdiction. Include design calculations.
- C. Seismic Qualification Data: Certificates, for extinguishing-agent containers and control panels 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.
- D. Field quality-control reports.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For special agent system to include in emergency, operation, and maintenance manuals.

#### 1.7 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. Deliver extra materials to Owner.
  1. Detection Devices: Not less than 20 percent of amount of each type installed.
  2. Container Valves: Not less than 10 percent of amount of each size and type installed.
  3. Nozzles: Not less than 20 percent of amount of each type installed.
  4. Extinguishing Agent: Not less than 100 percent of amount installed in largest hazard area. Include pressure-rated containers with valves.

#### 1.8 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. FM Global Compliance: Provide components that are FM Approved and that are listed in FM Global's "Approval Guide."
- C. UL Compliance: Provide equipment listed in UL's "Fire Protection Equipment Directory."



## PART 2 - PRODUCTS

## 2.1 CLEAN-AGENT SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide Novec 1230 clean agent system.
- B. Description: Clean-agent fire-extinguishing system shall be an engineered system for total flooding of the hazard area including the room cavity above the ceiling, below the ceiling, and below the raised floor. System includes separate zones above and below the ceiling and beneath the raised floor. If smoke is detected below the raised floor, extinguishing agent shall be discharged in the underfloor zone only. If smoke is detected below the ceiling, extinguishing agent shall be discharged in zones above and below the ceiling and below the floor. If smoke is detected above the ceiling, extinguishing agent shall be discharged in the zone above the ceiling only.
- C. Delegated Design: Design clean-agent fire-extinguishing system and obtain approval from authorities having jurisdiction. Design system for Class A, B, and C fires as appropriate for areas being protected, and include safety factor. Use clean agent indicated and in concentration suitable for normally occupied areas.
- D. Performance Requirements: Discharge HFC 227ea within 10 seconds and maintain 7.1 percent concentration by volume at 70 deg F (21 deg C) for 10-minute holding time in hazard areas.
1. HFC 227ea concentration in hazard areas greater than 9.0 percent immediately after discharge or less than 5.8 percent throughout holding time will not be accepted without written authorization from Owner and authorities having jurisdiction.
  2. System Capabilities: Minimum 620-psig (4278-kPa) calculated working pressure and 360-psig (2484-kPa) initial charging pressure.
- E. Performance Requirements: Discharge FK-5-1-12 within 10 seconds and maintain 6.6 percent concentration by volume at 70 deg F (21 deg C) for 10-minute holding time in hazard areas.
1. FK-5-1-12 concentration in hazard areas greater than 10.0 percent immediately after discharge or less than 6.5 percent throughout holding time will not be accepted without written authorization from Owner and authorities having jurisdiction.
  2. System Capabilities: Minimum 620-psig (4278-kPa) calculated working pressure and 360-psig (2484-kPa) initial charging pressure.
- F. Performance Requirements: Discharge IG-541 within 60 seconds and maintain 38 percent concentration by volume at 70 deg F (21 deg C) for 10-minute holding time in hazard areas.
1. IG-541 concentration in hazard areas greater than 40 percent immediately after discharge or less than 32 percent throughout holding time will not be accepted without written authorization from Owner and authorities having jurisdiction.
  2. System Capabilities: Minimum 2175-psig (15-MPa) calculated working pressure upstream from orifice union, minimum 1000-psig (6895-kPa) calculated working pressure downstream from orifice union, and 2175-psig (15-MPa) initial charging pressure.
- G. Cross-Zoned Detection: Devices located in two separate zones. Sound alarm on activating single-detection device, and discharge extinguishing agent on actuating single-detection device in other zone.
- H. Verified Detection: Devices located in single zone. Sound alarm on activating single-detection device, and discharge extinguishing agent on actuating second-detection device.
- I. System Operating Sequence:
1. Actuating First Detector: Visual indication on annunciator panel. Energize audible and visual alarms (slow pulse), shut down air-conditioning and ventilating systems serving protected area, close doors in protected area, and send signal to fire-alarm system.
  2. Actuating Second Detector: Visual indication on annunciator panel. Energize audible and visual alarms (fast pulse), shut down power to protected equipment, start time delay for extinguishing-agent discharge for 30 seconds, and discharge extinguishing agent.
  3. Extinguishing-agent discharge will operate audible alarms and strobe lights inside and outside the protected area.
- J. System Operating Sequence: System shall be cross-zoned, air-sampling detectors and photoelectric detectors reporting to a fully programmable microprocessor-based control panel programmed to operate as follows:
1. If one photoelectric detector and air-sampling detector reaches the third detection level (Fire 1), agent discharge will be initiated as described for the third detection level (Fire 1) below.

2. Air-Sampling System:
  - a. First Detection Level (Alert): Mild audible and visual indication on annunciator panel. Strobe lights flash slowly in the protected area.
  - b. Second Detection Level (Action): Strong audible and visual indication on annunciator panel. Strobe lights flash rapidly in the protected area.
  - c. Third Detection Level (Fire 1): Strong audible and visual indication on annunciator panel. Energize horn(s), bell(s), and strobe light(s) in the protected area and outside entry doors. Shut down air-conditioning and ventilating systems serving the protected area, and close doors in the protected area. Send signal to fire-alarm system, initiate 30-second time delay for extinguishing-agent discharge, and discharge extinguishing agent. At agent discharge, terminate power to equipment in the protected area.
  - d. Fourth Detection Level (Fire 2): Same as Fire 1.
- K. Manual stations shall immediately discharge extinguishing agent when activated.
- L. Operating abort switches will delay extinguishing-agent discharge while being activated, and switches must be reset to prevent agent discharge. Release of hand pressure on the switch will cause agent discharge if the time delay has expired.
- M. EPO: Will terminate power to protected equipment immediately on actuation.
- N. Low-Agent Pressure Switch: Initiate trouble alarm if sensing less than set pressure.
- O. Power Transfer Switch: Transfer from normal to stand-by power source.

## 2.2 PIPE AND FITTINGS

- A. See "HFC 227ea Agent Piping Applications" "IG-541 Agent Piping Applications" "FK-5-1-12 Agent Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.
- B. Piping, Valves, and Discharge Nozzles: Comply with types and standards listed in NFPA 2001, Section "Distribution," for charging pressure of system.
- C. Steel Pipe: ASTM A 53/A 53M, Type S, Grade B or ASTM A 106/A 106M, Grade A and Grade B; Schedule 40, Schedule 80, and Schedule 160, seamless steel pipe.
  1. Threaded Fittings:
    - a. Malleable-Iron Fittings: ASME B16.3, Class 300.
    - b. Flanges and Flanged Fittings: ASME B16.5, Class 300 unless Class 600 is indicated.
    - c. Fittings Working Pressure: 620 psig (4278 kPa) minimum.
    - d. Flanged Joints: Class 300 minimum.
  2. Forged-Steel Welding Fittings: ASME B16.11, Class 3000, socket pattern.
  3. Steel, Grooved-End Fittings: FM Approved and NRTL listed, ASTM A 47/A 47M malleable iron or ASTM A 536 ductile iron, with dimensions matching steel pipe and ends factory grooved according to AWWA C606.
- D. 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 (3.2-mm) maximum thickness unless thickness or specific material is indicated.
- E. Flange Bolts and Nuts: ASME B18.2.1, carbon steel.
- F. 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.
- G. Steel, Keyed Couplings: UL 213, AWWA C606, approved or listed for clean-agent service, and matching steel-pipe dimensions. Include ASTM A 536, ductile-iron housing, rubber gasket, and steel bolts and nuts.

## 2.3 VALVES

- A. General Valve Requirements:
  1. UL listed or FM Approved for use in fire-protection systems.
  2. Compatible with type of clean agent used.
- B. Container Valves: With rupture disc or solenoid and manual-release lever, capable of immediate and total agent discharge and suitable for intended flow capacity.
- C. Valves in Sections of Closed Piping and Manifolds: Fabricate to prevent entrapment of liquid, or install valve and separate pressure relief device.

- D. Valves in Manifolds: Check valve; installed to prevent loss of extinguishing agent when container is removed from manifold.

#### 2.4 EXTINGUISHING-AGENT CONTAINERS

- A. Description: Steel tanks complying with ASME Boiler and Pressure Vessel Code: Section VIII, for unfired pressure vessels. Include minimum working-pressure rating that matches system charging pressure, valve, pressure switch, and pressure gage.
  - 1. Finish: Red, enamel or epoxy paint.
  - 2. Manifold: Fabricate with valves, pressure switches, and connections for multiple storage containers, as indicated.
  - 3. Manifold: Fabricate with valves, pressure switches, selector switch, and connections for main- and reserve-supply banks of multiple storage containers.
  - 4. Storage-Tank Brackets: Factory- or field-fabricated retaining brackets consisting of steel straps and channels; suitable for container support, maintenance, and tank refilling or replacement.

#### 2.5 FIRE-EXTINGUISHING CLEAN AGENT

- A. HFC 227ea Clean Agent: Heptafluoropropane.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. DuPont.
    - b. Great Lakes Chemical Corporation.
- B. FK-5-1-12 Clean Agent: Dodecafluoro-2-methylpentan-3-one.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. 3M.
- C. IG-541 Clean Agent: Mixture of nitrogen, argon, and carbon dioxide inert gases.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Ansul Incorporated; Tyco International.

#### 2.6 DISCHARGE NOZZLES

- 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. Ansul Incorporated; Tyco International.
  - 2. Chemetron Fire Systems.
- B. Equipment manufacturer's standard one-piece brass or aluminum alloy of type, size, discharge pattern, and capacity required for application.
- C. Material: Corrosion-resistant metal.
- D. Stamped with orifice size and type.

#### 2.7 MANIFOLD AND ORIFICE UNIONS

- A. Description: NRTL-listed device with minimum 2175-psig (15-MPa) pressure rating, to control flow and reduce pressure of IG-541 gas in piping.
  - 1. NPS 2 (DN 50) and Smaller: Piping assembly with orifice, sized for system design requirements.
  - 2. NPS 2-1/2 (DN 65) and Larger: Piping assembly with nipple, sized for system design requirements.

#### 2.8 FIRE CONTROL PANELS

- 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. Ansul Incorporated; Tyco International.
2. Chemetron Fire Systems.
- B. Description: FM Approved or NRTL listed, including equipment and features required for testing, supervising, and operating fire-extinguishing system.
- C. Power Requirements: 120/240-V ac; with electrical contacts for connection to system components and fire-alarm system, and transformer or rectifier as needed to produce power at voltage required for accessories and alarm devices.
- D. Enclosure: NEMA ICS 6, Type 1, enameled-steel cabinet.
  1. Mounting: Surface.
- E. Supervised Circuits: Separate circuits for each independent hazard area.
  1. Detection circuits equal to the required number of zones, or addressable devices assigned to the required number of zones.
  2. Manual pull-station circuit.
  3. Alarm circuit.
  4. Release circuit.
  5. Abort circuit.
  6. EPO circuit.
- F. Control-Panel Features:
  1. Electrical contacts for shutting down fans, activating dampers, and operating system electrical devices.
  2. Automatic switchover to standby power at loss of primary power.
  3. Storage container, low-pressure indicator.
  4. Service disconnect to interrupt system operation for maintenance with visual status indication on the annunciator panel.
- G. Annunciator Panel: Graphic type showing protected, hazard-area plans, as well as locations of detectors and abort, EPO, and manual stations. Include lamps to indicate device-initiating alarm, electrical contacts for connection to control panel, and stainless-steel or aluminum enclosure.
- H. Standby Power: Sealed lead calcium Sealed, valve-regulated, recombinant lead acid Vented, wet-cell pocket, plate nickel cadmium batteries with capacity to operate system for 24 hours and alarm for minimum of 15 minutes. Include automatic battery charger that has a varying charging rate between trickle and high depending on battery voltage, and that is capable of maintaining batteries fully charged. Include manual voltage control, dc voltmeter, dc ammeter, electrical contacts for connection to control panel, automatic transfer switch, and suitable enclosure.

## 2.9 DETECTION DEVICES

- A. General Requirements for Detection Devices:
  1. Comply with NFPA 2001, NFPA 72, and UL 268.
  2. 24-V dc, nominal.
- B. Ionization Detectors: Dual-chamber type, having sampling and referencing chambers, with smoke-sensing element.
- C. Photoelectric Detectors: LED light source and silicon photodiode receiving element.
- D. Remote Air-Sampling Detector System: Includes air-sampling pipe network, a laser-based photoelectric detector, a sample transport fan, and a control unit.
  1. Pipe Network: CPVC tubing connects control unit with calibrated sampling holes.
  2. Smoke Detector: Particle-counting type with continuous laser beam. Sensitivity adjustable to a minimum of four preset values.
  3. Sample Transport Fan: Centrifugal type, creating a minimum static pressure of 0.05-inch wg (12.5 Pa) at all sampling ports.
  4. Control Unit: Multizone unit as indicated on Drawings. Provides same system power supply, supervision, and alarm features as specified for the control panel plus separate trouble indication for airflow and detector problems.
- E. Signals to the Central Fire Alarm Control Panel: Any type of local system trouble is reported to the central fire alarm control panel as a composite "trouble" signal. Alarms on each system zone are individually reported to the central fire alarm control panel as separately identified zones.

## 2.10 MANUAL STATIONS

- A. General Description: Surface FM Approved or NRTL listed, with clear plastic hinged cover, 120-V ac or low voltage compatible with controls. Include contacts for connection to control panel.
- B. Manual Release: "MANUAL RELEASE" caption, and red finish. Unit can manually discharge extinguishing agent with operating device that remains engaged until unlocked.
- C. Abort Switch: "ABORT" caption, momentary contact, with green finish.
- D. EPO Switch: "EPO" caption, with yellow finish.

## 2.11 SWITCHES

- A. Description: FM Approved or NRTL listed, where available, 120-V ac or low voltage compatible with controls. Include contacts for connection to control panel.
  - 1. Low-Agent Pressure Switches: Pneumatic operation.
  - 2. Power Transfer Switches: Key-operation selector, for transfer of release circuit signal from main supply to reserve supply.
  - 3. Door Closers: Magnetic retaining and release device or electrical interlock to cause the door operator to drive the door closed.

## 2.12 ALARM DEVICES

- A. Description: Listed and labeled by an NRTL or FM Approved, low voltage, and surface mounting. Comply with requirements in Section 28 46 21.11 "Addressable Fire-Alarm Systems" or Section 28 46 21.13 "Conventional Fire-Alarm Systems" for alarm and monitoring devices.
- B. Bells: Minimum 6-inch (150-mm) diameter.
- C. Horns: 90 to 94 dBA.
- D. Strobe Lights: Translucent lens, with "FIRE" or similar caption.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

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

### 3.2 HFC 227ea AGENT PIPING APPLICATIONS

- A. Flanged pipe and fittings and flanged joints may be used to connect to specialties and accessories and where required for maintenance.
- B. NPS 2 (DN 50) and Smaller: Schedule 40, steel pipe; malleable-iron threaded fittings; and threaded joints.
- C. NPS 2-1/2 (DN 65) and Larger: Schedule 40, steel pipe; forged-steel welding fittings; and welded joints.

### 3.3 IG-541 AGENT PIPING APPLICATIONS

- A. Piping between Storage Containers and Orifice Union: Schedule 80, steel pipe; forged-steel welding fittings; and welded joints.
- B. Piping Downstream from Orifice Union: Schedule 80, steel pipe; forged-steel welding fittings; and welded joints.

### 3.4 FK-5-1-12 AGENT PIPING APPLICATIONS

- A. Flanged pipe and fittings and flanged joints may be used to connect to specialties and accessories and where required for maintenance.

- B. NPS 2 (DN 50) and Smaller: Schedule 40, steel pipe; malleable-iron threaded fittings; and threaded joints.
- C. NPS 2-1/2 (DN 65) and Larger: Schedule 40, steel pipe; forged-steel welding fittings; and welded joints.

### 3.5 CLEAN-AGENT PIPING INSTALLATION

- A. Install clean-agent extinguishing piping and other components level and plumb, according to manufacturers' written instructions.
- B. Grooved Piping Joints: Groove pipe ends according to AWWA C606 dimensions. Assemble grooved-end steel pipe and steel, grooved-end fittings with steel, keyed couplings and lubricant according to manufacturer's written instructions.
- C. Install extinguishing-agent containers anchored to substrate.
- D. Install pipe and fittings, valves, and discharge nozzles according to requirements listed in NFPA 2001, Section "Distribution."
  - 1. Install valves designed to prevent entrapment of liquid, or install pressure relief devices in valved sections of piping systems.
  - 2. Support piping using supports and methods according to NFPA 13.
  - 3. Install seismic restraints for extinguishing-agent containers and piping systems.
  - 4. Install control panels, detection system components, alarms, and accessories, complying with requirements of NFPA 2001, Section "Detection, Actuation, and Control Systems," as required for supervised system application.

### 3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to equipment, allow space for service and maintenance.
- C. Connect electrical devices to control panel and to building's fire-alarm system. Electrical power, wiring, and devices are specified in Section 28 46 21.11 "Addressable Fire-Alarm Systems" or Section 28 46 21.13 "Conventional Fire-Alarm Systems."

### 3.7 IDENTIFICATION

- A. Identify system components and equipment. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."
- B. Identify piping, extinguishing-agent containers, other equipment, and panels according to NFPA 2001.
- C. Install signs at entry doors for protected areas to warn occupants that they are entering a room protected with a clean-agent fire-extinguishing system.
- D. Install signs at entry doors to advise persons outside the room the meaning of the horn(s), bell(s), and strobe light(s) outside the protected space.

### 3.8 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 inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. 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.
- D. Tests and Inspections:
  - 1. After installing clean-agent extinguishing piping system and after electrical circuitry has been energized, test for compliance with requirements.
  - 2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Sections "Inspection and Test Procedures" and "System Function Tests." Certify compliance with test parameters.

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. Remove malfunctioning units, replace with new units, and retest.
  5. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Units will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports.

### 3.9 CLEANING

- A. Each pipe section shall be cleaned internally after preparation and before assembly by means of swabbing, using a suitable nonflammable cleaner. Pipe network shall be free of particulate matter and oil residue before installing nozzles or discharge devices.

### 3.10 SYSTEM FILLING

- A. Preparation:
1. Verify that piping system installation is completed and cleaned.
  2. Check for complete enclosure integrity.
  3. Check operation of ventilation and exhaust systems.
- B. Filling Procedures:
1. Fill extinguishing-agent containers with extinguishing agent, and pressurize to indicated charging pressure.
  2. Install filled extinguishing-agent containers.
  3. Energize circuits.
  4. Adjust operating controls.

### 3.11 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain clean-agent fire-extinguishing systems.

**END OF SECTION 21 22 00**

**SECTION 22 05 13 - COMMON MOTOR REQUIREMENTS FOR PLUMBING 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 general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on alternating-current power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

**1.3 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 3300 feet (1000 m) 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: Premium efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
  - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
  - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Multispeed Motors: Separate winding for each speed.
- F. Rotor: Random-wound, squirrel cage.
- G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- H. Temperature Rise: Match insulation rating.
- I. Insulation: Class F.
- J. 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.



- K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

#### 2.4 ADDITIONAL REQUIREMENTS FOR POLYPHASE MOTORS

- 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. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
  - 3. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

#### 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 22 05 13**

**SECTION 22 05 16 - EXPANSION FITTINGS AND LOOPS FOR PLUMBING 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. Rubber union connector packless expansion joints.
  - 2. Flexible-hose packless expansion joints.
  - 3. Metal-bellows packless expansion joints.
  - 4. Externally pressurized metal-bellows packless expansion joints.
  - 5. Rubber packless expansion joints.
  - 6. Grooved-joint expansion joints.
  - 7. Alignment guides and anchors.
  - 8. Pipe loops and swing connections.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Delegated-Design Submittal: For each anchor and alignment guide, including analysis data, signed and sealed by the qualified professional engineer responsible for their preparation.
  - 1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
  - 2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
  - 3. Alignment Guide Details: Detail field assembly and attachment to building structure.
  - 4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Welding certificates.

**1.5 CLOSEOUT SUBMITTALS**

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

**1.6 QUALITY ASSURANCE**

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

**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. Rubber Union Connector Expansion Joints:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Amber/Booth Company, Inc.; a VMC Group Company.
  - b. Flex-Hose Co., Inc.
  - c. Flexicraft Industries.
  - d. General Rubber Corporation.
  - e. Mason Industries, Inc.
  - f. Proco Products, Inc.
  - g. Unaflex.
2. Material: Twin reinforced-rubber spheres with external restraining cables.
3. Minimum Pressure Rating: 150 psig at 170 deg F (1035 kPa at 77 deg C), unless otherwise indicated.
4. End Connections for NPS 2 (DN 50) and Smaller: Threaded.

### B. Flexible-Hose Packless Expansion Joints:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Flex Pression Ltd.
  - b. Flex-Hose Co., Inc.
  - c. Flexicraft Industries.
  - d. Mason Industries, Inc.
  - e. Metraflex Company (The).
2. 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.
3. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.
4. Expansion Joints for Copper Tubing NPS 2 (DN 50) 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 (3100 kPa at 21 deg C) and 340 psig at 450 deg F (2340 kPa at 232 deg C) ratings.
  - b. Bronze hoses and double-braid bronze sheaths with 700 psig at 70 deg F (4830 kPa at 21 deg C) and 500 psig at 450 deg F (3450 kPa at 232 deg C) ratings.
5. Expansion Joints for Copper Tubing NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Copper-alloy fittings with threaded end connections.
  - a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 300 psig at 70 deg F (2070 kPa at 21 deg C) and 225 psig at 450 deg F (1550 kPa at 232 deg C) ratings.
  - b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 420 psig at 70 deg F (2890 kPa at 21 deg C) and 315 psig at 450 deg F (2170 kPa at 232 deg C) ratings.
6. Expansion Joints for Steel Piping NPS 2 (DN 50) and Smaller: Carbon-steel fittings with threaded end connections.
  - a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 450 psig at 70 deg F (3100 kPa at 21 deg C) and 325 psig at 600 deg F (2250 kPa at 315 deg C) ratings.
  - b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 700 psig at 70 deg F (4830 kPa at 21 deg C) and 515 psig at 600 deg F (3550 kPa at 315 deg C) ratings.
7. Expansion Joints for Steel Piping NPS 2-1/2 to NPS 6 (DN 65 to DN 150): Carbon-steel fittings with flanged or welded end connections.
  - a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 200 psig at 70 deg F (1380 kPa at 21 deg C) and 145 psig at 600 deg F (1000 kPa at 315 deg C) ratings.
  - b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 275 psig at 70 deg F (1900 kPa at 21 deg C) and 200 psig at 600 deg F (1380 kPa at 315 deg C) ratings.
8. Expansion Joints for Steel Piping NPS 8 to NPS 12 (DN 200 to DN 300): Carbon-steel fittings with flanged or welded end connections.

- a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 125 psig at 70 deg F (860 kPa at 21 deg C) and 90 psig at 600 deg F (625 kPa at 315 deg C) ratings.
- b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 165 psig at 70 deg F (1130 kPa at 21 deg C) and 120 psig at 600 deg F (830 kPa at 315 deg C) ratings.
9. Expansion Joints for Steel Piping NPS 14 (DN 350) and Larger: Carbon-steel fittings with flanged or welded end connections.
  - a. Stainless-steel hoses and double-braid, stainless-steel sheaths with 165 psig at 70 deg F (1130 kPa at 21 deg C) and 120 psig at 600 deg F (830 kPa at 315 deg C) ratings.
- C. Metal-Bellows Packless Expansion Joints:
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Adscos Manufacturing LLC.
    - b. American BOA, Inc.
    - c. Badger Industries, Inc.
    - d. Expansion Joint Systems, Inc.
    - e. Flex Pression Ltd.
    - f. Flex-Hose Co., Inc.
    - g. Flexicraft Industries.
    - h. Flex-Weld, Inc.
    - i. Metraflex Company (The).
    - j. U.S. Bellows, Inc.
    - k. Unaflex.
  2. Standards: ASTM F 1120 and EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."
  3. Type: Circular, corrugated bellows with external tie rods.
  4. Minimum Pressure Rating: 150 psig (1035 kPa), unless otherwise indicated.
  5. Configuration: Single joint with base and double joint with base class(es), unless otherwise indicated.
  6. Expansion Joints for Copper Tubing: Single- or multi- ply phosphor-bronze bellows, copper pipe ends, and brass shrouds.
    - a. End Connections for Copper Tubing NPS 2 (DN 50) and Smaller: Solder joint or threaded.
    - b. End Connections for Copper Tubing NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Solder joint or threaded.
    - c. End Connections for Copper Tubing NPS 5 (DN 125) and Larger: Flanged.
  7. Expansion Joints for Steel Piping: Single- or multi- ply stainless-steel bellows, steel pipe ends, and carbon-steel shroud.
    - a. End Connections for Steel Pipe NPS 2 (DN 50) and Smaller: Threaded.
    - b. End Connections for Steel Pipe NPS 2-1/2 (DN 65) and Larger: Flanged or Welded.
- D. Externally Pressurized Metal-Bellows Packless Expansion Joints:
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Adscos Manufacturing LLC.
    - b. Flex-Hose Co., Inc.
    - c. Hyspan Precision Products, Inc.
    - d. Mason Industries, Inc.
    - e. Metraflex Company (The).
  2. Minimum Pressure Rating: 150 psig (1035 kPa), unless otherwise indicated.
  3. Description:
    - a. Totally enclosed, externally pressurized, multi-ply, stainless-steel bellows isolated from fluid flow by an internal pipe sleeve.
    - b. Carbon-steel housing.
    - c. Drain plugs and lifting lug for NPS 3 (DN 80) and larger.
    - d. Bellows shall have operating clearance between the internal pipe sleeves and the external shrouds.
    - e. Joints shall be supplied with a built-in scale to confirm the starting position and operating movement.

- f. Joint Axial Movement: 6 inches (150 mm) of compression and 2 inches (50 mm) of extension.
- 4. Permanent Locking Bolts: Set locking bolts to maintain joint lengths during installation. Temporary welding tabs that are removed after installation in lieu of locking bolts are not acceptable.
- 5. End Connection Configuration: Flanged; one raised, fixed and one floating flange.
- E. Rubber Packless Expansion Joints:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Amber/Booth Company, Inc.; a VMC Group Company.
    - b. Flex-Hose Co., Inc.
    - c. Flexicraft Industries.
    - d. Flex-Weld, Inc.
    - e. Garlock Sealing Technologies.
    - f. General Rubber Corporation.
    - g. Mason Industries, Inc.
    - h. Metraflex Company (The).
  - 2. Standards: ASTM F 1123 and FSA's "Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors."
  - 3. Material: Fabric-reinforced rubber complying with FSA-PSJ-703.
  - 4. Arch Type: Single or multiple arches with external control rods.
  - 5. Spherical Type: Single or multiple spheres with external control rods.
  - 6. Minimum Pressure Rating for NPS 1-1/2 to NPS 4 (DN 40 to DN 100): 150 psig (1035 kPa) at 220 deg F (104 deg C).
  - 7. Minimum Pressure Rating for NPS 5 and NPS 6 (DN 125 and DN 150): 140 psig (966 kPa) at 200 deg F (93 deg C).
  - 8. Minimum Pressure Rating for NPS 8 to NPS 12 (DN 200 to DN 300): 140 psig (966 kPa) at 180 deg F (82 deg C).
  - 9. Material for Fluids Containing Acids, Alkalis, or Chemicals: Butyl rubber, Chlorosulfonyl-polyethylene rubber, or Ethylene-propylene-diene terpolymer rubber.
  - 10. Material for Fluids Containing Gas, Hydrocarbons, or Oil: Chlorosulfonated polyethylene synthetic rubber.
  - 11. Material for Water: Butyl rubber, Buna-N, Chlorosulfonated polyethylene synthetic rubber, Chlorosulfonyl-polyethylene rubber, Ethylene-propylene-diene terpolymer rubber, or Natural rubber.
  - 12. End Connections: Full-faced, integral steel flanges with steel retaining rings.

### 2.3 GROOVED-JOINT EXPANSION JOINTS

- 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. Anvil International.
  - 2. Shurjoint Piping Products USA Inc.
  - 3. Victaulic Company
- B. Description: Factory-assembled expansion joint made of several grooved-end pipe nipples, couplings, and grooved joints.
- C. Standard: AWWA C606, for grooved joints.
- D. Nipples: Galvanized, ASTM A 53/A 53M, Schedule 40, Type E or S, steel pipe with grooved ends.
- E. Couplings: Five, flexible type for steel-pipe dimensions. Include ferrous housing sections, Buna-N gasket suitable for diluted acid, alkaline fluids, and cold and hot water, and bolts and nuts.

### 2.4 ALIGNMENT GUIDES AND ANCHORS

- A. Alignment Guides:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Adscos Manufacturing LLC.
  - b. Advanced Thermal Systems, Inc.
  - c. Flex-Hose Co., Inc.
  - d. Flexicraft Industries.
  - e. Flex-Weld, Inc.
  - f. Hyspan Precision Products, Inc.
  - g. Mason Industries, Inc.
  - h. Metraflex Company (The).
  - i. Senior Flexonics Pathway.
  - j. U.S. Bellows, Inc.
2. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding slider for bolting to pipe.
- B. Anchor Materials:
1. Steel Shapes and Plates: ASTM A 36/A 36M.
  2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
  3. Washers: ASTM F 844, steel, plain, flat washers.
  4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.
    - a. Stud: Threaded, zinc-coated carbon steel.
    - b. Expansion Plug: Zinc-coated steel.
    - c. Washer and Nut: Zinc-coated steel.
  5. Chemical Fasteners: Insert-type stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.
    - a. Bonding Material: ASTM C 881/C 881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
    - b. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud, unless otherwise indicated.
    - c. Washer and Nut: Zinc-coated steel.

### PART 3 - EXECUTION

#### 3.1 EXPANSION JOINT INSTALLATION

- A. Install expansion joints of sizes matching sizes of piping in which they are installed.
- B. Install metal-bellows expansion joints according to EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."
- C. Install rubber packless expansion joints according to FSA-PSJ-703.
- D. Install grooved-joint expansion joints to grooved-end steel piping.

#### 3.2 PIPE LOOP AND SWING CONNECTION INSTALLATION

- A. Install pipe loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.
- B. Connect risers and branch connections to mains with at least five pipe fittings, including tee in main.
- C. Connect risers and branch connections to terminal units with at least four pipe fittings, including tee in riser.
- D. Connect mains and branch connections to terminal units with at least four pipe fittings, including tee in main.

#### 3.3 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

- A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.
- B. Install one guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.
- C. Attach guides to pipe, and secure guides to building structure.

- D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.
- E. Anchor Attachments:
  - 1. Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
  - 2. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24; U bolts bolted to anchor.
- F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.
  - 1. Anchor Attachment to Steel Structural Members: Attach by welding.
  - 2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.
- G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

**END OF SECTION 22 05 16**

**SECTION 22 05 17 - SLEEVES AND SLEEVE SEALS FOR PLUMBING 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.

## 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
  - 1. Product Data: For sealants, indicating VOC content.
  - 2. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.

## 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 collar.
- B. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, anticorrosion coated or galvanized, with plain ends and integral welded waterstop collar. The welded waterstop collar shall be welded prior to the galvanizing or anticorrosion process.
- C. Galvanized-Steel Sheet Sleeves: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
- D. PVC Pipe Sleeves: ASTM D 1785, Schedule 40, solid PVC.

## 2.2 STACK-SLEEVE FITTINGS

- 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. Jay R. Smith Mfg. Co.
  - 2. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.
- B. Description: Manufactured, galvanized, cast-iron sleeve with integral clamping flange for use in waterproof floors and roofs. Include clamping ring, bolts, and nuts for membrane flashing. The sleeve shall have all scratches in the galvanizing treated with corrosion resistant paint prior to installation.
  - 1. Underdeck Clamp: Clamping ring with setscrews.



## 2.3 SLEEVE-SEAL SYSTEMS

- 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. Advance Products & Systems, Inc.
  2. CALPICO, Inc.
  3. GPT; an EnPro Industries company.
  4. Metraflex Company (The).
- B. 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 (137 kPa) minimum.
  3. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  4. Pressure Plates: Stainless steel.
  5. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

## 2.4 SLEEVE-SEAL FITTINGS

- 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. Advance Products & Systems, Inc.
  2. CALPICO, Inc.
  3. GPT; an EnPro Industries company.
  4. Metraflex Company (The).
- B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall.
- C. 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 (34.5-MPa), 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 (25-mm) 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 (50 mm) above finished floor level.
  3. Using grout, seal the space outside of sleeves in slabs and walls above grade 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 (6.4-mm) 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 07 84 13 "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 (6.4-mm) 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 07 62 00 "Sheet Metal Flashing and Trim."
  3. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) 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 the space around 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- and smoke-stop materials. Comply with requirements for firestopping specified in Section 07 84 13 "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 water-stop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Use grout 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 (DN 150): Steel pipe sleeves.
    - b. Piping NPS 6 (DN 150) and Larger: Steel pipe sleeves.
  2. Exterior Concrete Walls below Grade:
    - a. Piping Smaller Than NPS 6 (DN 150): Cast-iron pipe sleeves with sleeve-seal system.
      - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
    - b. Piping NPS 6 (DN 150) and Larger: Steel pipe sleeves with sleeve-seal system.
      - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
  3. Concrete Slabs-on-Grade:
    - a. Piping Smaller Than NPS 6 (DN 150): Cast-iron pipe sleeves with sleeve-seal system.
      - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
    - b. Piping NPS 6 (DN 150) and Larger: Cast-iron pipe sleeves with sleeve-seal system.
      - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
  4. Concrete Slabs above Grade:
    - a. Piping Smaller Than NPS 6 (DN 150): Galvanized steel pipe sleeves.
    - b. Piping NPS 6 (DN 150) and Larger: Galvanized steel pipe sleeves.
  5. Interior Partitions:
    - a. Piping Smaller Than NPS 6 (DN 150): Galvanized steel pipe sleeves.
    - b. Piping NPS 6 (DN 150) and Larger: Galvanized steel sheet sleeves.

**END OF SECTION 22 05 17**

**SECTION 22 05 18 - ESCUTCHEONS FOR PLUMBING 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 and salvaged, or removed and reinstalled.

## 1.4 ACTION SUBMITTALS

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

## 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. BrassCraft Manufacturing Co.; a Masco company.
  - 2. Dearborn Brass.
  - 3. Jones Stephens Corp.
  - 4. Keeney Manufacturing Company (The).
  - 5. Mid-America Fittings, Inc.

## 2.2 ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With rough finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped steel with polished, chrome-plated finish and spring-clip fasteners.
- C. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.
- D. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed-rivet hinge; and spring-clip fasteners.

## 2.3 FLOOR PLATES

- A. Split Floor Plates: Cast brass 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 insulated piping and with OD that completely covers opening.
  - 1. Escutcheons for New Piping and Relocated Existing Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.
    - b. Chrome-Plated Piping: One-piece steel with polished, chrome-plated finish.
    - c. Insulated Piping: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
    - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish.
    - e. 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.
    - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
    - g. Bare Piping in Unfinished Service Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
    - h. Bare Piping in Equipment Rooms: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
  - 2. Escutcheons for Existing Piping to Remain:
    - a. Chrome-Plated Piping: Split-casting, stamped steel with concealed hinge with polished, chrome-plated finish.
    - b. Insulated Piping: Split-plate, stamped steel with concealed hinge with polished, chrome-plated finish
    - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
    - d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
    - e. Bare Piping in Unfinished Service Spaces: Split-plate, stamped steel with concealed-rivet hinge with polished, chrome-plated finish.
    - f. Bare Piping in Equipment Rooms: Split-plate, stamped steel with hinge with polished, chrome-plated finish.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with inside diameter 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 22 05 18**

**SECTION 22 05 19 - METERS AND GAGES FOR PLUMBING 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. Liquid-in-glass thermometers.
  - 2. Thermowells.
  - 3. Dial-type pressure gages.
  - 4. Gage attachments.
  - 5. Test plugs.
  - 6. Test-plug kits.
  - 7. Sight flow indicators.
- B. Related Requirements:
  - 1. Section 22 11 13 "Facility Water Distribution Piping" for domestic water meters and combined domestic and fire-protection water-service meters outside the building.
  - 2. Section 22 11 19 "Domestic Water Piping Specialties" for water meters.
  - 3. Section 22 15 13 "General-Service Compressed-Air Piping" for compressed air gages.

## 1.3 ACTION SUBMITTALS

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

## 1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of meter and gage.

## 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

## PART 2 - PRODUCTS

## 2.1 LIQUID-IN-GLASS THERMOMETERS

- A. Plastic-Case, Industrial-Style, Liquid-in-Glass Thermometers:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Ernst Flow Industries.
    - b. Watts; a Watts Water Technologies company.
    - c. Weiss Instruments, Inc.
    - d. Weksler Glass Thermometer Corp.
  - 2. Standard: ASME B40.200.
  - 3. Case: Plastic; 7-inch (178-mm) nominal size unless otherwise indicated.
  - 4. Case Form: Adjustable angle unless otherwise indicated.
  - 5. Tube: Glass with magnifying lens and blue or red organic liquid.
  - 6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F (deg C).
  - 7. Window: Glass or plastic.

8. Stem: Aluminum, brass, or stainless steel and of length to suit installation.
  - a. Design for Thermowell Installation: Bare stem.
9. Connector: 1-1/4 inches (32 mm), with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

## 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 or CSA.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1 (DN 15, DN 20, or NPS 25), ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch (13, 19, and 25 mm), 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, Plastic-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Miljoco Corporation.
  - b. Terice, H. O. Co.
  - c. Weiss Instruments, Inc.
  - d. Weksler Glass Thermometer Corp.
2. Standard: ASME B40.100.
3. Case: Sealed type; plastic; 4-1/2-inch (114-mm) nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2 (DN 8 or DN 15), ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi (kPa).
8. Pointer: Dark-colored metal.
9. Window: Glass or plastic.
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 (DN 8 or DN 15), ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.
- B. Valves: Brass or stainless-steel needle, with NPS 1/4 or NPS 1/2 (DN 8 or DN 15), ASME B1.20.1 pipe threads.

## 2.5 TEST PLUGS

- 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. Miljoco Corporation.
  2. Trerice, H. O. Co.
  3. WATTS.
  4. Weiss Instruments, Inc.
- B. Description: Test-station fitting made for insertion into piping tee fitting.
- C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
- D. Thread Size: NPS 1/4 (DN 8) or NPS 1/2 (DN 15), ASME B1.20.1 pipe thread.
- E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F (3450 kPa at 93 deg C).
- F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

## 2.6 TEST-PLUG KITS

- 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. Peterson Equipment Co., Inc.
  2. Trerice, H. O. Co.
  3. WATTS.
  4. Weiss Instruments, Inc.
- B. 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.
- C. Pressure Gage: Small, Bourdon-tube insertion type with 2- to 3-inch- (51- to 76-mm-) diameter dial and probe. Dial range shall be at least 0 to 200 psig (0 to 1380 kPa).
- D. Carrying Case: Metal or plastic, with formed instrument padding.

## 2.7 SIGHT FLOW INDICATORS

- 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. Ernst Flow Industries.
  2. OPW Engineered Systems; OPW Fluid Transfer Group; a Dover company.
  3. Pentair Valves & Controls; Penberthy Brand.
- B. Description: Piping inline-installation device for visual verification of flow.
- C. Construction: Bronze or stainless-steel body, with sight glass and ball, flapper, or paddle wheel indicator, and threaded or flanged ends.
- D. Minimum Pressure Rating: 125 psig (860 kPa).
- E. Minimum Temperature Rating: 200 deg F (93 deg C).
- F. End Connections for NPS 2 (DN 50) and Smaller: Threaded.
- G. End Connections for NPS 2-1/2 (DN 65) and Larger: Flanged.

## 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 remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.
- G. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.



- H. Install remote-mounted pressure gages on panel.
- I. Install valve and snubber in piping for each pressure gage for fluids.
- J. Install test plugs in piping tees.
- K. Install thermometers in the following locations:
  - 1. Inlet and outlet of each water heater.
  - 2. Inlets and outlets of each domestic water heat exchanger.
  - 3. Inlet and outlet of each domestic hot-water storage tank.
  - 4. Inlet and outlet of each remote domestic water chiller.
- L. Install pressure gages in the following locations:
  - 1. Building water service entrance into building.
  - 2. Inlet and outlet of each pressure-reducing valve.
  - 3. Suction and discharge of each domestic water 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. Adjust faces of meters and gages to proper angle for best visibility.

### 3.4 THERMOMETER SCHEDULE

- A. Thermometers at inlet and outlet of each domestic water heater shall be the following:
  - 1. Plastic case, industrial-style, liquid-in-glass type.
  - 2. Test plug with EPDM self-sealing rubber inserts.
- B. Thermometer stems shall be of length to match thermowell insertion length.

### 3.5 THERMOMETER SCALE-RANGE SCHEDULE

- A. Scale Range for Domestic Cold-Water Piping: 0 to 150 deg F (Minus 20 to plus 70 deg C).
- B. Scale Range for Domestic Hot-Water Piping: 0 to 250 deg F (0 to 150 deg C).

### 3.6 PRESSURE-GAGE SCHEDULE

- A. Pressure gages at discharge of each water service into building shall be the following:
  - 1. Sealed, direct-mounted, plastic case.
  - 2. Test plug with EPDM self-sealing rubber inserts.
- B. Pressure gages at inlet and outlet of each water pressure-reducing valve shall be the following:
  - 1. Sealed, direct-mounted, plastic case.
  - 2. Test plug with EPDM self-sealing rubber inserts.
- C. Pressure gages at suction and discharge of each domestic water pump shall be the following:
  - 1. Sealed, direct-mounted, plastic case.
  - 2. Test plug with EPDM self-sealing rubber inserts.

### 3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE

- A. Scale Range for Water Service Piping: 0 to 200 psi (0 to 1400 kPa).
- B. Scale Range for Domestic Water Piping: 0 to 200 psi (0 to 1400 kPa).

**END OF SECTION 22 05 19**

**SECTION 22 05 23 - GENERAL DUTY VALVES FOR PLUMBING 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. Brass ball valves.
  - 2. Bronze ball valves.
  - 3. Iron, single-flange butterfly valves.
  - 4. Bronze swing check valves.
  - 5. Bronze swing check valves, press ends.
  - 6. 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. Certification that products comply with NSF 61 and NSF 372.

**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 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.
- 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 B16.18 for solder-joint connections.
  - 6. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 and NSF 372 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. Gear Actuator: For quarter-turn valves NPS 4 (DN 100) and larger.
  - 2. Handlever: For quarter-turn valves smaller than NPS 4 (DN 100).
- H. Valves in Insulated Piping:
  - 1. Include 2-inch (50-mm) 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 BRASS BALL VALVES

- A. Brass Ball Valves, Two-Piece with Full Port and Stainless-Steel Trim, Threaded or Soldered Ends:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Apollo Flow Controls; Conbraco Industries, Inc.
    - b. KITZ Corporation.
    - c. Milwaukee Valve Company.
    - d. NIBCO INC.
  - 2. Description:
    - a. Standard: MSS SP-110 or MSS SP-145.
    - b. CWP Rating: 600 psig (4140 kPa).
    - c. Body Design: Two piece.
    - d. Body Material: Forged brass.
    - e. Ends: Threaded and soldered.
    - f. Seats: PTFE.
    - g. Stem: Stainless steel.
    - h. Ball: Stainless steel, vented.
    - i. Port: Full.
- B. Brass Ball Valves, Two-Piece with Full Port and Stainless-Steel Trim, Press Ends:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Apollo Flow Controls; Conbraco Industries, Inc.
    - b. Hammond Valve.
    - c. Milwaukee Valve Company.
    - d. NIBCO INC.
  - 2. Description:
    - a. Standard: MSS SP-110 or MSS SP-145.
    - b. CWP Rating: Minimum 200 psig (1380 kPa).
    - c. Body Design: Two piece.
    - d. Body Material: Forged brass.
    - e. Ends: Press.
    - f. Press Ends Connections Rating: Minimum 200 psig (1380 kPa).
    - g. Seats: PTFE or RPTFE.
    - h. Stem: Stainless steel.
    - i. Ball: Stainless steel, vented.
    - j. Port: Full.
    - k. O-Ring Seal: Buna-N or EPDM.

## 2.3 BRONZE BALL VALVES

- A. Bronze Ball Valves, Two-Piece with Full Port and Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Apollo Flow Controls; Conbraco Industries, Inc.
  - b. Hammond Valve.
  - c. Milwaukee Valve Company.
  - d. NIBCO INC.
2. Description:
  - a. Standard: MSS SP-110 or MSS-145.
  - b. CWP Rating: 600 psig (4140 kPa).
  - 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.

#### 2.4 IRON, SINGLE-FLANGE BUTTERFLY VALVES

- A. Iron, Single-Flange Butterfly Valves with Stainless-Steel Disc:
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Apollo Flow Controls; Conbraco Industries, Inc.
    - b. KITZ Corporation.
    - c. Milwaukee Valve Company.
    - d. NIBCO INC.
    - e. WATTS.
  2. Description:
    - a. Standard: MSS SP-67, Type I.
    - b. CWP Rating, NPS 12 (DN 300) and Smaller: 200 psig (1380 kPa).
    - 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: Stainless steel.

#### 2.5 BRONZE SWING CHECK VALVES

- A. Bronze Swing Check Valves with Bronze Disc, Class 125:
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Apollo Flow Controls; Conbraco Industries, Inc.
    - b. KITZ Corporation.
    - c. Milwaukee Valve Company.
    - d. NIBCO INC.
    - e. WATTS.
  2. Description:
    - a. Standard: MSS SP-80, Type 3.
    - b. CWP Rating: 200 psig (1380 kPa).
    - c. Body Design: Horizontal flow.
    - d. Body Material: ASTM B 62, bronze.
    - e. Ends: Threaded or soldered. See valve schedule articles.
    - f. Disc: Bronze.

## 2.6 IRON SWING CHECK VALVES

- A. Iron Swing Check Valves with Metal Seats, Class 125:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Apollo Flow Controls; Conbraco Industries, Inc.
    - b. KITZ Corporation.
    - c. Milwaukee Valve Company.
    - d. NIBCO INC.
    - e. WATTS.
  2. Description:
    - a. Standard: MSS SP-71, Type I.
    - b. CWP Rating: 200 psig (1380 kPa).
    - c. Body Design: Clear or full waterway.
    - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
    - e. Ends: Flanged or threaded. See valve schedule articles.
    - f. Trim: Bronze.
    - g. 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 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.
- F. Check Valves: Install check valves for proper direction of flow.
  1. Swing Check Valves: In horizontal position with hinge pin level.
- G. Install chainwheels on operators for butterfly valves NPS 4 (DN 100) and larger and more than 96 inches (2400 mm) above floor. Extend chains to 60 inches (1520 mm) above finished floor.

### 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 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 2 (DN 50) and Smaller: Threaded ends except where solder-joint valve-end option or press-end option is indicated in valve schedules below.
  - 2. For Copper Tubing, NPS 2-1/2 to NPS 3 (DN 65 to DN 80): Brazed or flanged ends except where threaded valve-end option is indicated in valve schedules below.
  - 3. For Copper Tubing, NPS 4 (DN 125) and Larger: Flanged ends.
  - 4. For Steel Piping, NPS 2 (DN 50) and Smaller: Threaded ends.
  - 5. For Steel Piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.

### 3.5 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 (DN 50) and Smaller:
  - 1. Brass ball valves, two-piece with full port and stainless steel trim. Provide with threaded, solder, or press connection-joint ends.
  - 2. Bronze ball valves, two-piece with full port and stainless steel trim. Provide with threaded, solder, or press connection-joint ends.
  - 3. Bronze swing check valves with bronze disc, Class 125, with soldered, threaded, or press-end end connections.
- B. Pipe NPS 2-1/2 (DN 65) to NPS 3 (DN 80):
  - 1. Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM seat, stainless-steel disc.
  - 2. Bronze swing check valves with bronze disc, Class 125, with brazed end connections.
- C. Pipe NPS 4 (DN 100) and Larger:
  - 1. Iron swing check valves with metal seats, Class 125, with flanged end connections.

**END OF SECTION 22 05 23**

**SECTION 22 05 29 - HANGERS AND SUPPORTS FOR PLUMBING 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. Pipe stands.
  - 7. Pipe-positioning systems.
  - 8. Equipment supports.
- B. Related Requirements:
  - 1. Section 05 50 00 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
  - 2. Section 22 05 16 "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.
  - 3. Section 22 05 48.13 "Vibration Controls for Plumbing Piping and Equipment" for vibration isolation devices.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:
  - 1. Trapeze pipe hangers.
  - 2. Metal framing systems.
  - 3. Fiberglass strut systems.
  - 4. Pipe stands.
  - 5. 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 01 40 00 "Quality Requirements," to design trapeze pipe hangers and equipment supports.
- B. [Structural Performance: Hangers and supports for plumbing 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.

## 2.2 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, hot-dip galvanized, or electro-galvanized.
  - 3. Nonmetallic Coatings: Plastic coated or epoxy powder coated.
  - 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. Stainless-Steel Pipe Hangers and Supports:
  - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
  - 2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
  - 3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
- C. Copper Pipe and Tube 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 stainless 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 MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

## 2.4 METAL FRAMING SYSTEMS

- A. Manufacturer Metal Framing Systems:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. B-line, an Eaton business.
    - b. Flex-Strut Inc.
    - c. G-Strut.
    - d. Unistrut; Part of Atkore International.
  - 2. Description: Shop- or field-fabricated pipe-support assembly, made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
  - 3. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.
  - 4. Channels: Continuous slotted carbon-steel channel with inturned lips.
  - 5. Channel Width: Selected for applicable load criteria.
  - 6. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
  - 7. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
  - 8. Metallic Coating: Hot-dip galvanized.



9. Paint Coating: Green epoxy, acrylic, or urethane.
10. Plastic Coating: PVC.

## 2.5 THERMAL HANGER-SHIELD INSERTS

- 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. Carpenter & Paterson, Inc.
  2. ERICO International Corporation.
  3. Pipe Shields Inc.
  4. Rilco Manufacturing Co., Inc.
  5. Value Engineered Products, Inc.
- B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa) or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) minimum compressive strength and vapor barrier.
- C. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa) or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) minimum compressive strength.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

## 2.6 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.
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Hilti, Inc.
    - b. MKT Fastening, LLC.
    - c. Simpson Strong-Tie Co., Inc.
- B. Mechanical-Expansion Anchors: 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. 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:
    - a. B-line, an Eaton business.
    - b. Hilti, Inc.
    - c. MKT Fastening, LLC.
  2. Indoor Applications: Zinc-coated or stainless steel.
  3. Outdoor Applications: Stainless steel.

## 2.7 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand:
  1. Description: Single base unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
  2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
  3. Hardware: Galvanized steel or polycarbonate.
  4. Accessories: Protection pads.
- C. Low-Profile, Single-Base, Single-Pipe Stand:
  1. Description: Single base with vertical and horizontal members, and pipe support, for roof installation without membrane protection.

2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
  3. Vertical Members: Two stainless-steel, continuous-thread, 1/2-inch (12-mm) rods.
  4. Horizontal Member: Adjustable horizontal, stainless-steel pipe support channels.
  5. Pipe Supports: Roller, Strut clamps, or Clevis hanger.
  6. Hardware: Stainless steel.
  7. Accessories: Protection pads.
  8. Height: 12 inches (300 mm) above roof.
- D. High-Profile, Single-Base, Single-Pipe Stand:
1. Description: Single base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
  2. Base: Single vulcanized rubber or molded polypropylene.
  3. Vertical Members: Two stainless-steel, continuous-thread, 1/2-inch (12-mm) rods.
  4. Horizontal Member: One adjustable-height, or stainless-steel, pipe-support slotted channel or plate.
  5. Pipe Supports: Roller or Clevis hanger.
  6. Hardware: Stainless steel.
  7. Accessories: Protection pads, 1/2-inch (12-mm), continuous-thread, stainless-steel rod.
  8. Height: 36 inches (900 mm) above roof.
- E. High-Profile, Multiple-Pipe Stand:
1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
  2. Bases: Two or more; vulcanized rubber or molded polypropylene.
  3. Vertical Members: Two or more, stainless-steel channels.
  4. Horizontal Members: One or more, adjustable-height, stainless-steel pipe support.
  5. Pipe Supports: Roller, Strut clamps, or Clevis hanger.
  6. Hardware: Stainless steel.
  7. Accessories: Protection pads, 1/2-inch (12-mm), continuous-thread rod.
  8. Height: 36 inches (900 mm) above roof.
- F. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

## 2.8 PIPE-POSITIONING SYSTEMS

- A. Description: IAPMO PS 42 positioning system composed of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

## 2.9 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-carbon-steel shapes.

## 2.10 MATERIALS

- A. Aluminum: ASTM B 221 (ASTM B 221M).
- 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 (34.5-MPa), 28-day compressive strength.

## PART 3 - EXECUTION

## 3.1 APPLICATION

- A. Comply with requirements in Section 07 84 13 "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 (90 kg).

## 3.2 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. 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 framing 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 (100 mm) 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.
- F. Pipe Stand Installation:
  - 1. Pipe Stand Types, except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
  - 2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 07 72 00 "Roof Accessories" for curbs.
- G. Pipe-Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.
- H. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- I. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- J. 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.
- K. Install lateral bracing with pipe hangers and supports to prevent swaying.
- L. 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 (DN 65) 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.
- M. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- N. 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.
- O. 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 (DN 100) 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 (DN 100) 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 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
  - b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
  - c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.
  - d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches (610 mm) long and 0.075 inch (1.91 mm) thick.
  - e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches (610 mm) long and 0.105 inch (2.67 mm) thick.
5. Pipes NPS 8 (DN 200) 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 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.

### 3.5 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 (40 mm).

### 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 (0.05 mm).
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded, shop-painted areas on miscellaneous metal are specified in Section 09 91 13 "Exterior Painting.", Section 09 91 23 "Interior Painting.", and/or Section 09 96 00 "High-Performance Coatings."
- 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 MSS SP-58 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 attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.
- H. Use padded hangers for piping that is subject to scratching.
- I. Use thermal hanger-shield inserts for insulated piping and tubing.
- J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated 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 (DN 15 to DN 750).
  - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F (566 deg C) pipes NPS 4 to NPS 24 (DN 100 to DN 600), requiring up to 4 inches (100 mm) of insulation.
  - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36 (DN 20 to DN 900), requiring clamp flexibility and up to 4 inches (100 mm) of insulation.
  - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 (DN 15 to DN 600) if little or no insulation is required.
  - 5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4 (DN 15 to DN 100), to allow off-center closure for hanger installation before pipe erection.
  - 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8 (DN 20 to DN 200).
  - 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
  - 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
  - 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
  - 10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8 (DN 10 to DN 200).
  - 11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3 (DN 10 to DN 80).
  - 12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
  - 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
  - 14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.

15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
  16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 (DN 65 to DN 900) if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
  17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30 (DN 25 to DN 750), from two rods if longitudinal movement caused by expansion and contraction occurs.
  18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24 (DN 65 to DN 600), from single rod if horizontal movement caused by expansion and contraction occurs.
  19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 (DN 50 to DN 1050) if longitudinal movement caused by expansion and contraction occurs but vertical adjustment is unnecessary.
  20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 (DN 50 to DN 600) if small horizontal movement caused by expansion and contraction occurs and vertical adjustment is unnecessary.
  21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 (DN 50 to DN 750) if vertical and lateral adjustment during installation, in addition to expansion and contraction, is required.
- K. 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 (DN 24 to DN 600).
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 (DN 20 to DN 600) if longer ends are required for riser clamps.
- L. 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 of up to 6 inches (150 mm) for heavy loads.
  2. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) 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 (49 to 232 deg C) piping installations.
- M. 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-joint 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 (340 kg).
  - b. Medium (MSS Type 32): 1500 lb (680 kg).
  - c. Heavy (MSS Type 33): 3000 lb (1360 kg).
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.
- N. 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.
- O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches (32 mm).
  2. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
  - 3.
  4. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
    - a. Horizontal (MSS Type 54): Mounted horizontally.
    - b. Vertical (MSS Type 55): Mounted vertically.
    - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- P. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- R. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- S. Use pipe-positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

**END OF SECTION 22 05 29**

**SECTION 22 05 48.13 - VIBRATION CONTROLS FOR PLUMBING 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. Open-spring isolators.
  - 5. Housed-spring isolators.
  - 6. Restrained-spring isolators.
  - 7. Housed-restrained-spring isolators.
  - 8. Pipe-riser resilient supports.
  - 9. Resilient pipe guides.
  - 10. Elastomeric hangers.
  - 11. Spring hangers.
- B. Related Requirement:
  - 1. Section 21 05 48.13 "Vibration Controls for Fire-Suppression Piping and Equipment" for devices for fire-suppression equipment and systems.

**1.3 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 type required.
- B. Shop Drawings:
  - 1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment.
- C. Delegated-Design Submittal: For each vibration isolation device.
  - 1. Include design calculations for selecting vibration isolators.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Show coordination of vibration isolation device installation for plumbing piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.
- B. Qualification Data: For testing agency.
- C. Welding certificates.
- D. Air-Mounting System Performance Certification: Include natural frequency, load, and damping test data.

**1.5 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 ELASTOMERIC ISOLATION PADS

## A. Elastomeric Isolation Pads:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Ace Mountings Co., Inc.
  - b. Vibration Eliminator Co., Inc.
  - c. Vibration Mountings & Controls, Inc.
2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
3. Size: Factory or field cut to match requirements of supported equipment.
4. Pad Material: Oil and water resistant with elastomeric properties.
5. Surface Pattern: Waffle pattern.
6. Infused nonwoven cotton or synthetic fibers.
7. Load-bearing metal plates adhered to pads.
8. Sandwich-Core Material: Resilient and elastomeric.
  - a. Surface Pattern: Waffle pattern.
  - b. Infused nonwoven cotton or synthetic fibers.

## 2.2 ELASTOMERIC ISOLATION MOUNTS

## A. Double-Deflection, Elastomeric Isolation Mounts:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Ace Mountings Co., Inc.
  - b. Vibration Eliminator Co., Inc.
  - c. Vibration Mountings & Controls, Inc.
2. 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.
3. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

## 2.3 RESTRAINED ELASTOMERIC ISOLATION MOUNTS

## A. Restrained Elastomeric Isolation Mounts:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Ace Mountings Co., Inc.
  - b. Vibration Eliminator Co., Inc.
  - c. Vibration Mountings & Controls, Inc.
2. Description: All-directional isolator with 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.

## 2.4 OPEN-SPRING ISOLATORS

## A. Freestanding, Laterally Stable, Open-Spring Isolators:

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

- a. Ace Mountings Co., Inc.
- b. Vibration Eliminator Co., Inc.
- c. Vibration Mountings & Controls, Inc.
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 rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to 500 psig (3447 kPa).
7. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

## 2.5 HOUSED-SPRING ISOLATORS

- A. Freestanding, Laterally Stable, Open-Spring Isolators in Two-Part Telescoping Housing:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Ace Mountings Co., Inc.
    - b. Vibration Eliminator Co., Inc.
    - c. Vibration Mountings & Controls, Inc.
  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 rated vertical stiffness.
  5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  6. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators.
    - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig (3447 kPa).
    - b. Top housing with threaded mounting holes and internal leveling device.

## 2.6 RESTRAINED-SPRING ISOLATORS

- A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Ace Mountings Co., Inc.
    - b. Vibration Eliminator Co., Inc.
    - c. Vibration Mountings & Controls, Inc.
  2. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.
    - a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig (3447 kPa).
    - b. Top plate with threaded mounting holes.
    - c. Internal leveling bolt that acts as blocking during installation.
  3. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
  4. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  5. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  6. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

## 2.7 HOUSED-RESTRAINED-SPRING ISOLATORS

- A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Ace Mountings Co., Inc.
    - b. Vibration Eliminator Co., Inc.
    - c. Vibration Mountings & Controls, Inc.
  2. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with adjustable snubbers to limit vertical movement.
    - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig (3447 kPa).
    - b. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.
  3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

## 2.8 PIPE-RISER RESILIENT SUPPORT

- A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch- (13-mm-) 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 (3.45 MPa) on isolation material providing equal isolation in all directions.

## 2.9 RESILIENT PIPE GUIDES

- A. Description: Telescopic arrangement of two steel tubes or post and sleeve arrangement separated by a minimum 1/2-inch- (13-mm-) 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.

## 2.10 ELASTOMERIC HANGERS

- A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Ace Mountings Co., Inc.
    - b. Vibration Eliminator Co., Inc.
    - c. Vibration Mountings & Controls, Inc.
  2. 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.
  3. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

## 2.11 SPRING HANGERS

- A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Ace Mountings Co., Inc.
  - b. Vibration Eliminator Co., Inc.
  - c. Vibration Mountings & Controls, Inc.
2. 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.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
7. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
8. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
9. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation 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 VIBRATION CONTROL 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 03 30 00 "Cast-in-Place Concrete." and/or Section 03 30 53 "Miscellaneous 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.

**END OF SECTION 22 05 48.13**

**SECTION 22 05 53 - IDENTIFICATION FOR PLUMBING 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. Valve tags.
  - 5. Warning tags.

## 1.3 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. Metal Labels for Equipment:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Brady Corporation.
    - b. Carlton Industries, LP.
    - c. Champion America.
    - d. Seton Identification Products.
  - 2. Material and Thickness: Brass, 0.032-inch (0.8-mm) or anodized aluminum, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
  - 3. Letter Color: White.
  - 4. Background Color: Black.
  - 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
  - 6. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), 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 or self-tapping screws.
  - 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Plastic Labels for Equipment:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Brady Corporation.

- b. Carlton Industries, LP.
  - c. Champion America.
  - d. Seton Identification Products.
2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, and having predrilled holes for attachment hardware.
  3. Letter Color: White.
  4. Background Color: Black.
  5. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
  6. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
  7. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
  8. Fasteners: Stainless-steel rivets or self-tapping screws.
  9. 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 (A4) 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. 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. Brady Corporation.
  2. Carlton Industries, LP.
  3. Champion America.
  4. Seton Identification Products.
- B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, and having predrilled holes for attachment hardware.
- C. Letter Color: White.
- D. Background Color: Black.
- E. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
- F. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
- G. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
- H. Fasteners: Stainless-steel rivets or self-tapping screws.
- I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- J. Label Content: Include caution and warning information plus emergency notification instructions.

## 2.3 PIPE LABELS

- 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. Brady Corporation.
  2. Champion America.
  3. Craftmark Pipe Markers.
  4. Seton Identification Products.

- B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- E. 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.

## 2.4 VALVE TAGS

- 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. Brady Corporation.
  - 2. Carlton Industries, LP.
  - 3. Champion America.
  - 4. Seton Identification Products.
- B. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) numbers.
  - 1. Tag Material: Brass, 0.032-inch (0.8-mm) or anodized aluminum, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
  - 2. Fasteners: Brass wire-link chain or S-hook.
- C. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) 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.

## 2.5 WARNING TAGS

- 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. Brady Corporation.
  - 2. Carlton Industries, LP.
  - 3. Champion America.
  - 4. Seton Identification Products.
- B. 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 (75 by 133 mm) minimum.
  - 2. Fasteners: Brass grommet and wire.
  - 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 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.

### 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: Painting of piping is specified in Section 09 91 23 "Interior Painting." And/or Section 09 96 00 "High-Performance Coatings."
- 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 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 (15 m) along each run. Reduce intervals to 25 feet (7.6 m) 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.
- E. Pipe Label Color Schedule:
  - 1. Domestic Water Piping
    - a. Background: Safety green.
    - b. Letter Colors: White.
  - 2. Sanitary Waste and Vent Piping:
    - a. Background Color: Safety green.
    - b. Letter Color: White.
  - 3. Natural Gas:
    - a. Background Color: Red.
    - b. Letter Color: White.

### 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. Cold Water: 1-1/2 inches (38 mm), round.



- a. Hot Water and Hot Water Circulating: 1-1/2 inches (38 mm), round Natural Gas: 1-1/2 inches, round.
2. Valve-Tag Colors:
  - a. Cold Water: Natural.
  - a. Hot Water and Hot Water Circulating: Natural.
3. Letter Colors:
  - a. Cold Water: White.
  - b. Hot Water and Hot Water Circulating: White.

### 3.6 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

**END OF SECTION 22 05 53**

**SECTION 22 07 19 - PLUMBING 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 plumbing piping services:
  - 1. Domestic cold-water piping.
  - 2. Domestic hot-water piping.
  - 3. Domestic recirculating hot-water piping.
  - 4. Supplies and drains for handicap-accessible lavatories and sinks.

**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).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  - 2. Detail attachment and covering of heat tracing inside insulation.
  - 3. Detail insulation application at pipe expansion joints for each type of insulation.
  - 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
  - 5. Detail removable insulation at piping specialties, equipment connections, and access panels.
  - 6. Detail application of field-applied jackets.
  - 7. Detail application at linkages of control devices.

**1.4 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.

**1.5 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 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.

3. For each mockup, fabricate cutaway sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.
  4. Notify Architect seven days in advance of dates and times when mockups will be constructed.
  5. Obtain Architect's approval of mockups before starting insulation application.
  6. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  7. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
  8. Demolish and remove mockups when directed.
- C. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Supply and Drain Protective Shielding Guards: ICC A117.1.

#### 1.6 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 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.

#### 1.8 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. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Fiber Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. 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:
    - a. Owens Corning Corporation; Foamglas.
    - b. Knauf.
    - c. Johns Manville.
  2. Block Insulation: ASTM C 552, Type I.
  3. Special-Shaped Insulation: ASTM C 552, Type III.
  4. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.

5. Preformed Pipe Insulation with Factory-Applied ASJ: Comply with ASTM C 552, Type II, Class 2.
6. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
- F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Aeroflex USA, Inc.
    - b. Armacell LLC.
- G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  1. 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:
    - a. CertainTeed Corporation.
    - b. Johns Manville; a Berkshire Hathaway company.
    - c. Knauf Insulation.
    - d. Manson Insulation Inc.
- H. Mineral-Fiber, Preformed Pipe Insulation:
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Johns Manville; a Berkshire Hathaway company.
    - b. Knauf Insulation.
    - c. Manson Insulation Inc.
  2. Type I, 850 Deg F (454 Deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ or FSK. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- I. Phenolic:
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Kingspan Tarec Industrial Insulation NV.
  2. Preformed pipe insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type III, Grade 1.
  3. Block insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type II, Grade 1.
  4. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
  5. Factory-Applied Jacket: ASJ. Requirements are specified in "Factory-Applied Jackets" Article.
- J. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials.
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Armacell LLC.

## 2.2 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
- B. Insulating Cement: Comply with ASTM C 196.
- C. 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. Fiber-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F (minus 73 to plus 93 deg C).

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Owens Corning Corporation; Foamglas.
    - b. Knauf.
    - c. Johns Manville.
  2. Adhesive: As recommended by cellular glass manufacturer and with a VOC content of 80 g/L or less.
  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."
- C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Aeroflex USA, Inc.
    - b. Armacell LLC.
    - c. Foster Brand; H. B. Fuller Construction Products.
  2. Adhesive: As recommended by flexible elastomeric and polyolefin manufacturer and with a VOC content of 80 g/L or less.
  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."
- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Eagle Bridges - Marathon Industries.
    - c. Mon-Eco Industries, Inc.
  2. Adhesive: As recommended by flexible elastomeric and polyolefin manufacturer and with a VOC content of 80 g/L or less.
  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."
- E. Phenolic Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F (minus 59 to plus 149 deg C).
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Foster Brand; H. B. Fuller Construction Products.
  2. Adhesive: As recommended by phenolic manufacturer and with a VOC content of 50 g/L or less.
  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."
- F. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Eagle Bridges - Marathon Industries.
    - c. Foster Brand; H. B. Fuller Construction Products.
  2. Adhesive: As recommended by phenolic manufacturer and with a VOC content of 50 g/L or less.
  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."
- G. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

- a. Dow Corning Corporation.
- b. Johns Manville; a Berkshire Hathaway company.
- c. Speedline Corporation.
2. Adhesive: As recommended by phenolic manufacturer and with a VOC content of 50 g/L or less.
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."

## 2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
  1. Mastics: As recommended by insulation manufacturer and with a VOC content of 50 g/L or less.
  2. Mastics 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."
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Foster Brand; H. B. Fuller Construction Products.
    - c. Knauf Insulation.
  2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
  3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
  4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
  5. Color: White.
- C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below-ambient services.
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Eagle Bridges - Marathon Industries.
    - c. Foster Brand; H. B. Fuller Construction Products.
  2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.03 metric perm) at 35-mil (0.9-mm) dry film thickness.
  3. Service Temperature Range: 0 to 180 deg F (Minus 18 to plus 82 deg C).
  4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
  5. Color: White.
- D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below-ambient services.
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Eagle Bridges - Marathon Industries.
    - c. Foster Brand; H. B. Fuller Construction Products.
  2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.033 metric perm) at 30-mil (0.8-mm) dry film thickness.
  3. Service Temperature Range: Minus 50 to plus 220 deg F (Minus 46 to plus 104 deg C).
  4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
  5. Color: White.
- E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Eagle Bridges - Marathon Industries.
    - c. Foster Brand; H. B. Fuller Construction Products.
    - d. Knauf Insulation.

2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms (1.2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

## 2.5 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.
1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  2. 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:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Foster Brand; H. B. Fuller Construction Products.
    - c. Vimasco Corporation.
  3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
  4. Service Temperature Range: 0 to plus 180 deg F (Minus 18 to plus 82 deg C).
  5. Color: White.

## 2.6 SEALANTS

- A. Joint Sealants for Cellular-Glass and Phenolic Products:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Eagle Bridges - Marathon Industries.
    - c. Foster Brand; H. B. Fuller Construction Products.
  2. Materials shall be compatible with insulation materials, jackets, and substrates.
  3. Permanently flexible, elastomeric sealant.
  4. Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).
  5. Color: White or gray.
  6. Sealant shall have a VOC content of 420 g/L or less.
  7. Sealant 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."
- B. FSK and Metal Jacket Flashing Sealants:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Eagle Bridges - Marathon Industries.
    - c. Foster Brand; H. B. Fuller Construction Products.
  2. Materials shall be compatible with insulation materials, jackets, and substrates.
  3. Fire- and water-resistant, flexible, elastomeric sealant.
  4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
  5. Color: Aluminum.
  6. Sealant shall have a VOC content of 420 g/L or less.
  7. Sealant 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."
- C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Childers Brand; H. B. Fuller Construction Products.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
5. Color: White.
6. Sealant shall have a VOC content of 420 g/L or less.
7. Sealant 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."

## 2.7 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
  2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
  3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

## 2.8 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. 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:
    - a. Johns Manville; a Berkshire Hathaway company.
    - b. P.I.C. Plastics, Inc.
    - c. Speedline Corporation.
  2. Adhesive: As recommended by jacket material manufacturer.
  3. Color: White.
  4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
    - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
- C. Metal Jacket:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. ITW Insulation Systems; Illinois Tool Works, Inc.
    - b. RPR Products, Inc.
  2. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005, Temper H-14.
    - a. Sheet and roll stock ready for shop or field sizing.
    - b. Finish and thickness are indicated in field-applied jacket schedules.
    - c. Moisture Barrier for Indoor Applications: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper.
    - d. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
    - e. Factory-Fabricated Fitting Covers:
      - 1) Same material, finish, and thickness as jacket.
      - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
      - 3) Tee covers.
      - 4) Flange and union covers.
      - 5) End caps.



- 6) Beveled collars.
  - 7) Valve covers.
  - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
- a. Sheet and roll stock ready for shop or field sizing.
  - b. Material, finish, and thickness are indicated in field-applied jacket schedules.
  - c. Moisture Barrier for Indoor Applications: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper.
  - d. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
  - e. Factory-Fabricated Fitting Covers:
    - 1) Same material, finish, and thickness as jacket.
    - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
    - 3) Tee covers.
    - 4) Flange and union covers.
    - 5) End caps.
    - 6) Beveled collars.
    - 7) Valve covers.
    - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

## 2.9 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Avery Dennison Corporation, Specialty Tapes Division.
    - b. Ideal Tape Co., Inc., an American Biltrite Company.
    - c. Knauf Insulation.
  2. Width: 3 inches (75 mm).
  3. Thickness: 11.5 mils (0.29 mm).
  4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
  5. Elongation: 2 percent.
  6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
  7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. 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:
    - a. Avery Dennison Corporation, Specialty Tapes Division.
    - b. Ideal Tape Co., Inc., an American Biltrite Company.
    - c. Knauf Insulation.
  2. Width: 3 inches (75 mm).
  3. Thickness: 6.5 mils (0.16 mm).
  4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
  5. Elongation: 2 percent.
  6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
  7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. 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:
    - a. Compac Corporation.
    - b. Ideal Tape Co., Inc., an American Biltrite Company.

- c. Venture Tape.
2. Width: 2 inches (50 mm).
3. Thickness: 6 mils (0.15 mm).
4. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.

## 2.10 SECUREMENTS

### A. Bands:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. ITW Insulation Systems; Illinois Tool Works, Inc.
  - b. RPR Products, Inc.
2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch (0.38 mm) thick, 1/2 inch (13 mm) wide with wing seal or closed seal.
3. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 1/2 inch (13 mm) wide with wing seal or closed seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

C. Wire: 0.080-inch (2.0-mm) nickel-copper alloy.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. C & F Wire.

## 2.11 PROTECTIVE SHIELDING GUARDS

### A. Protective Shielding Pipe Covers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. McGuire Manufacturing.
  - b. Plumberex Specialty Products, Inc.
  - c. Zurn Industries, LLC.
2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

### B. Protective Shielding Piping Enclosures:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Truebro.
  - b. Zurn Industries, LLC.
2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with 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. Before insulating, apply a corrosion coating to insulated surfaces as follows:
  - 1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils (0.127 mm) thick and an epoxy finish 5 mils (0.127 mm) thick if operating in a temperature range between 140 and 300 deg F (60 and 149 deg C). Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
  - 2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F (0 and 149 deg C) with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. 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- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
  - 3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). 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 (50 mm) 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 (100 mm) 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 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 (50 mm) below top of roof flashing.
  4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. 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 (50 mm).
  4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. 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.
- F. 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.
- 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 (50 mm) 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 CELLULAR-GLASS INSULATION

- A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.

2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
  3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
  4. For insulation with factory-applied jackets on below-ambient services, 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 cut sections of cellular-glass block insulation of same thickness as pipe insulation.
  4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
  2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of cellular-glass insulation to valve body.
  2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  3. Install insulation to flanges as specified for flange insulation application.

### 3.7 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
1. Install pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
  4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install mitered sections of pipe insulation.
  2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed valve covers manufactured of same material as pipe insulation when available.
  2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  3. Install insulation to flanges as specified for flange insulation application.
  4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### 3.8 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 (150 mm) 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 (25 mm), 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.

### 3.9 INSTALLATION OF PHENOLIC INSULATION

- A. General Installation Requirements:
1. Secure single-layer insulation with stainless-steel bands at 12-inch (300-mm) intervals and tighten bands without deforming insulation materials.
  2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches (75 mm). Secure inner layer with 0.062-inch (1.6-mm) wire spaced at 12-inch (300-mm) intervals. Secure outer layer with stainless-steel bands at 12-inch (300-mm) intervals.
- B. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
  2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
  3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
  4. For insulation with factory-applied jackets with vapor retarders on below-ambient services, 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.
- C. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.
- D. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.
- E. Insulation Installation on Valves and Pipe Specialties:
  1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.
  2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  3. Install insulation to flanges as specified for flange insulation application.

### 3.10 INSTALLATION OF POLYOLEFIN INSULATION

- A. Insulation Installation on Straight Pipes and Tubes:
  1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
  1. Install pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of same thickness as pipe insulation.
  4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
  1. Install mitered sections of polyolefin 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 cut sections of polyolefin pipe and sheet insulation to valve body.
  2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  3. Install insulation to flanges as specified for flange insulation application.
  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.

### 3.11 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 (50-mm) overlap at seams and joints.
  2. Embed glass cloth between two 0.062-inch- (1.6-mm-) 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 (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) 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 (25-mm) overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
  1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. Where metal jackets are indicated, install with 2-inch (50-mm) 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 (300 mm) o.c. and at end joints.

### 3.12 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."
  - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
    - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

### 3.13 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.

### 3.14 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.

### 3.15 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water: Insulation shall be the following:
  - 1. All Pipe Sizes:
    - a. Fiber Glass with ASJ: 1/2 inch (15 mm) thick.
- B. Domestic Hot and Recirculated Hot Water:
  - 1. NPS 1-1/4 (DN 32) and Smaller: Insulation shall be the following:
    - a. Fiber Glass with ASJ: 1 inch (25 mm) thick.
  - 2. NPS 1 1/2 (DN 40) and Larger: Insulation shall be the following:
    - a. Cellular Glass with ASJ: 1-1/2 inches (38 mm) 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 one of the following:
    - a. Flexible Elastomeric: 1/2 inch (13 mm) thick.

- D. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet (3 m) of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F (16 Deg C):
1. All Pipe Sizes: Insulation shall be one of the following:
    - a. Cellular Glass with ASJ: 1-1/2 inches (38 mm) thick.
    - b. Flexible Elastomeric: 3/4 inch (19 mm) thick.
    - c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
    - d. Phenolic: 1 inch (25 mm) thick.
    - e. Polyolefin: 3/4 inch (19 mm) thick.

**END OF SECTION 22 07 19**

**SECTION 22 11 16 - DOMESTIC WATER 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. Copper tube and fittings.
  - 2. Piping joining materials.
  - 3. Transition fittings.
  - 4. Dielectric fittings.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For transition fittings and dielectric fittings.

**1.4 INFORMATIONAL SUBMITTALS**

- A. System purging and disinfecting activities report.
- B. Field quality-control reports.

**1.5 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 Architect, Construction Manager, and Owner no fewer than two days in advance of proposed interruption of water service.
  - 2. Do not interrupt water service without Architect's, Construction Manager's, and 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.
- B. Potable-water piping and components shall comply with NSF 14, NSF 61, and NSF 372. Include marking "NSF-pw" on piping.

**2.2 COPPER TUBE AND FITTINGS**

- A. Hard Copper Tube: ASTM B 88, Type K (ASTM B 88M, Type A) and ASTM B 88, Type L (ASTM B 88M, Type B) water tube, drawn temper.
- B. Soft Copper Tube: ASTM B 88, Type K (ASTM B 88M, Type A) and ASTM B 88, Type L (ASTM B 88M, Type B) water tube, annealed temper.
  - 1. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
  - 2. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
  - 3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
5. Copper, Brass, or Bronze Pressure-Seal-Joint Fittings:
  - 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) Apollo Flow Controls; Conbraco Industries, Inc.
    - 2) Mueller Industries, Inc.
    - 3) NIBCO INC.
    - 4) Viega LLC.
  - b. Fittings: Cast-brass, cast-bronze or wrought-copper with EPDM O-ring seal in each end. Sizes NPS 2-1/2 (DN 65) and larger with stainless steel grip ring and EPDM O-ring seal.
  - c. Minimum 200-psig (1379-kPa) working-pressure rating at 250 deg F (121 deg C).
6. Appurtenances for Grooved-End Copper Tubing:
  - 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) Anvil International.
    - 2) Shurjoint Piping Products USA Inc.
    - 3) Victaulic Company.
  - b. Bronze Fittings for Grooved-End, Copper Tubing: ASTM B 75/B 75M copper tube or ASTM B 584 bronze castings.
  - c. Mechanical Couplings for Grooved-End Copper Tubing:
    - 1) Copper-tube dimensions and design similar to AWWA C606.
    - 2) Ferrous housing sections.
    - 3) EPDM-rubber gaskets suitable for hot and cold water.
    - 4) Bolts and nuts.
    - 5) Minimum Pressure Rating: 300 psig (2070 kPa).

### 2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials:
  1. AWWA C110/A21.10, rubber, flat face, 1/8 inch (3.2 mm) thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
  2. Full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys.
- D. Flux: ASTM B 813, water flushable.
- E. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

### 2.4 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.
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Jay R. Smith Mfg. Co.
    - b. Romac Industries, Inc.
    - c. Viking Johnson.
- D. Plastic-to-Metal Transition Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Charlotte Pipe and Foundry Company.
    - b. Georg Fischer.
    - c. Ipex USA LLC.
    - d. Nibco Inc.
  2. Description:
    - a. CPVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.
    - b. One end with threaded brass insert and one solvent-cement-socket or threaded end.
- E. Plastic-to-Metal Transition Unions:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Georg Fischer.
    - b. Ipex USA LLC.
    - c. NIBCO INC.
    - d. Spears Manufacturing Company.
  2. Description:
    - a. CPVC four-part union.
    - b. Brass or stainless-steel threaded end.
    - c. Solvent-cement-joint or threaded plastic end.
    - d. Rubber O-ring.
    - e. Union nut.

## 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. 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:
    - a. WATTS.
    - b. Wilkins.
    - c. Zurn Industries, LLC.
  2. Standard: ASSE 1079.
  3. Pressure Rating: 125 psig (860 kPa) minimum at 180 deg F (82 deg C).
  4. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric-Flange Insulating Kits:
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.
    - c. Pipeline Seal and Insulator, Inc.
  2. Nonconducting materials for field assembly of companion flanges.
  3. Pressure Rating: 150 psig (1035 kPa).
  4. Gasket: Neoprene or phenolic.
  5. Bolt Sleeves: Phenolic or polyethylene.
  6. Washers: Phenolic with steel backing washers.
- D. Dielectric Nipples:
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Grinnell Mechanical Products.
    - b. Precision Plumbing Products.
    - c. Victaulic Company.
  2. Standard: IAPMO PS 66.
  3. Electroplated steel nipple complying with ASTM F 1545.
  4. Pressure Rating and Temperature: 300 psig (2070 kPa) at 225 deg F (107 deg C).

5. End Connections: Male threaded or grooved.
6. Lining: Inert and noncorrosive, propylene.

## PART 3 - EXECUTION

### 3.1 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. Cover and protect all piping prior to installation. Do not store piping in direct exposure to UV radiation and environmental elements.
- C. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- D. Stress associated with expansion and contraction of piping systems shall be assessed and compensated for by the Contractor per plumbing drawings, details, and manufacturer's recommendations.
- E. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Section 22 05 19 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 22 11 19 "Domestic Water Piping Specialties."
- F. Install shutoff valve immediately upstream of each dielectric fitting.
- G. Install domestic water branch piping sloped toward mains to allow for system drainage.
- H. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- I. 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.
- J. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- K. Install piping to permit valve servicing.
- L. 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.
- M. Install piping free of sags and bends.
- N. Install fittings for changes in direction and branch connections.
- O. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- P. Install pressure gages on suction and discharge piping for each plumbing pump. Comply with requirements for pressure gages in Section 22 05 19 "Meters and Gages for Plumbing Piping."
- Q. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 22 11 23 "Domestic Water Pumps."
- R. Install thermometers on outlet piping from each water heater. Comply with requirements for thermometers in Section 22 05 19 "Meters and Gages for Plumbing Piping."
- S. 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."
- T. 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."
- U. 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."

### 3.2 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 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," "Braze 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. Joint Construction for Grooved-End Copper Tubing: Make joints according to AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten housing bolts.
- G. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- H. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

### 3.3 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
  - 1. Fittings for NPS 1-1/2 (DN 40) and Smaller: Fitting-type coupling.
  - 2. Fittings for NPS 2 (DN 50) and Larger: Sleeve-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 (DN 50) and Smaller: Plastic-to-metal transition fittings or unions.

### 3.4 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric couplings or nipples.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric flange kits.
- D. Dielectric Fittings for NPS 5 (DN 125) and Larger: Use dielectric flange kits.

### 3.5 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 (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
    - c. Longer Than 100 Feet (30 m) if Indicated: MSS Type 49, spring cushion rolls.
  - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  - 4. 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 (10 mm).
- D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 3/4 (DN 20) and Smaller: 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
  - 2. NPS 1 and NPS 1-1/4 (DN 25 and DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
  - 3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
  - 4. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
  - 5. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.
  - 6. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.
  - 7. NPS 8 (DN 200): 10 feet (3 m) with 3/4-inch (19-mm) rod.
- E. Install supports for vertical copper tubing every 10 feet (3 m).

### 3.6 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. Use flanges instead of unions for NPS 2-1/2 (DN 65) and larger.

### 3.7 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.

### 3.8 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 (345 kPa) 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.

### 3.9 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. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
  8. Check plumbing specialties and verify proper settings, adjustments, and operation.

### 3.10 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. Ensure all chemicals used are compatible with piping system being installed.
  3. 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 (50 mg/L) 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 (200 mg/L) 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. Clean non-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. Ensure all chemicals used are compatible with piping system being installed.
  3. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
    - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    - b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
- D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

### 3.11 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. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

- C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- D. Under-building-slab, domestic water, building-service piping, NPS 3 (DN 80) and smaller, shall be the following:
  - 1. Soft copper tube, ASTM B 88, Type K (ASTM B 88M, Type A); wrought-copper, solder-joint fittings; and brazed joints.
- E. Under-building-slab, domestic water piping, NPS 2 (DN 50) and smaller, shall be one of the following:
  - 1. Soft copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); wrought-copper, solder-joint fittings; and brazed joints.
- F. Aboveground domestic water piping within residential units, NPS 3/4 (DN 20) and smaller, shall be one of the following:
  - 1. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); cast- or wrought-copper, solder-joint fittings; and soldered joints.
  - 2. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); copper pressure-seal-joint fittings; and pressure-sealed joints.
- G. Aboveground domestic water piping, NPS 2 (DN 50) and smaller, shall be one of the following:
  - 1. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); cast- or wrought-copper, solder-joint fittings; and soldered joints.
  - 2. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); copper pressure-seal-joint fittings; and pressure-sealed joints.

**END OF SECTION 22 11 16**

**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. Vacuum breakers.
  - 2. Backflow preventers.
  - 3. Automatic water shutoff valves.
  - 4. Balancing valves.
  - 5. Temperature-actuated, water mixing valves.
  - 6. Strainers.
  - 7. Outlet boxes.
  - 8. Hose bibbs.
  - 9. Wall hydrants.
  - 10. Ground hydrants.
  - 11. Post hydrants.
  - 12. Drain valves.
  - 13. Water-hammer arresters.
  - 14. Trap-seal primer valves.
  - 15. Trap-seal primer systems.
- B. Related Requirements:
  - 1. Section 22 05 19 "Meters and Gauges for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
  - 2. Section 22 11 16 "Domestic Water Piping" for water meters.
  - 3. Section 22 47 13 "Drinking Fountains" for water filters for water coolers.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: For domestic water piping specialties.
  - 1. 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 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 and NSF 14.
- B. Comply with NSF 372 for low lead.

## 2.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 (860) psig (kPa) unless otherwise indicated.

## 2.3 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Ames Fire & Waterworks; A WATTS Brand.
  - b. Apollo Flow Controls; Conbraco Industries, Inc.
  - c. WATTS.
  - d. Zurn Industries, LLC.
2. Standard: ASSE 1001.
3. Size: NPS 1/4 to NPS 3 (DN 8 to DN 80), as required to match connected piping.
4. Body: Bronze.
5. Inlet and Outlet Connections: Threaded.
6. Finish: Rough bronze or Chrome plated.

B. Hose-Connection Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Apollo Flow Controls; Conbraco Industries, Inc.
  - b. WATTS.
  - c. Woodford Manufacturing Company.
  - d. Zurn Industries, LLC.
2. Standard: ASSE 1011.
3. Body: Bronze, nonremovable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
5. Finish: Chrome or nickel plated.

## 2.4 BACKFLOW PREVENTERS

A. Beverage-Dispensing-Equipment Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Apollo Flow Controls; Conbraco Industries, Inc.
  - b. WATTS.
  - c. Zurn Industries, LLC.
2. Standard: ASSE 1022.
3. Operation: Continuous-pressure applications.
4. Size: NPS 1/4 or NPS 3/8 (DN 8 or DN 10).
5. Body: Stainless steel.
6. End Connections: Threaded.

B. Carbonated-Beverage-Dispenser, Dual-Check-Valve Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Cash Acme, A Division of Reliance Worldwide Corporation.
  - b. Lancer Corporation.
  - c. WATTS.
2. Standard: ASSE 1032.
3. Operation: Continuous-pressure applications.
4. Size: NPS 1/4 or NPS 3/8 (DN 8 or DN 10).
5. Body: Stainless steel.
6. End Connections: Threaded.

C. Backflow-Preventer Test Kits:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Apollo Flow Controls; Conbraco Industries, Inc.
  - b. WATTS.
  - c. Zurn Industries, LLC.
2. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

## 2.5 BALANCING VALVES

### A. Copper-Alloy Automatic Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Armstrong International, Inc.
  - b. ITT Corporation.
  - c. NIBCO INC.
  - d. TACO Comfort Solutions, Inc.
  - e. WATTS.
2. Type: Factory installed pressure independent flow limited cartridge.
3. Body: Brass or bronze.
4. Size: Same as connected piping, but not larger than NPS 2 (DN 50).
5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

### B. Copper-Alloy Manual Balancing Valve

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Armstrong International, Inc.
  - b. ITT Corporation.
  - c. NIBCO INC.
  - d. TACO Comfort Solutions, Inc.
  - e. WATTS.
2. Type: Manually set pressure independent y-style regulating cartridge with flow rates indicated on handle.
3. Pressure Rating: 400-psig (2760-kPa) minimum CWP.
4. Size: NPS 2 (DN 50) or smaller.
5. Body: Copper alloy.
6. Seats and Seals: Replaceable.
7. End Connections: threaded.
8. Handle: Plastic with flow rates indicated.

## 2.6 TEMPERATURE-ACTUATED, WATER MIXING VALVES

### A. Primary, Thermostatic, Water Mixing Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Bradley Corporation.
  - b. Lawler Manufacturing Company, Inc.
  - c. Leonard Valve Company.
  - d. POWERS; A WATTS Brand.
  - e. Symmons Industries, Inc.
2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig (860 kPa) minimum unless otherwise indicated.
4. Type: Exposed-mounted, thermostatically controlled, water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded or union inlets and outlet.
7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.

8. Valve Finish: Rough bronze.
9. Piping Finish: Copper.
- B. Individual-Fixture, Water Tempering Valves:
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Bradley Corporation.
    - b. Lawler Manufacturing Company, Inc.
    - c. Leonard Valve Company.
    - d. POWERS; A WATTS Brand.
    - e. Symmons Industries, Inc.
  2. Standard: ASSE 1016, thermostatically controlled, water tempering valve.
  3. Pressure Rating: 125 psig (860 kPa) minimum unless otherwise indicated.
  4. Body: Bronze body with corrosion-resistant interior components.
  5. Temperature Control: Adjustable.
  6. Inlets and Outlet: Threaded.
  7. Finish: Rough or chrome-plated bronze.

## 2.7 STRAINERS FOR DOMESTIC WATER PIPING

- A. Y-Pattern Strainers:
  1. Pressure Rating: 125 psig (860 kPa) minimum unless otherwise indicated.
  2. Body: Bronze for NPS 2 (DN 50) and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 (DN 65) and larger.
  3. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 (DN 65) and larger.
  4. Screen: Stainless steel with round perforations unless otherwise indicated.
  5. Perforation Size:
    - a. Strainers NPS 2 (DN 50) and Smaller: 0.020 (0.51) inch (mm).
    - b. Strainers NPS 2-1/2 to NPS 4 (DN 65 to DN 100): 0.045 (1.14) inch (mm).
    - c. Strainers NPS 5 (DN 125) and Larger: 0.10 (2.54) inch (mm).
  6. Drain: Pipe plug.

## 2.8 OUTLET BOXES

- A. Fire Rated Icemaker Outlet Boxes:
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Acorn Engineering Company.
    - b. IPS Corporation.
    - c. Oatey.
    - d. Sioux Chief Manufacturing Company, Inc.
  2. Mounting: Recessed.
  3. Material and Finish: Enameled-steel or epoxy-painted-steel box and faceplate.
  4. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 (DN 15) or smaller copper tube outlet.
  5. Supply Shutoff Fitting: NPS 1/2 (DN 15) gate, globe, or ball valve and NPS 1/2 (DN 15) copper, water tubing.
- B. Icemaker Outlet Boxes:
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Acorn Engineering Company.
    - b. IPS Corporation.
    - c. Oatey.
    - d. Sioux Chief Manufacturing Company, Inc.
  2. Mounting: Recessed.
  3. Material and Finish: Plastic box and faceplate.

4. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 (DN 15) or smaller copper tube outlet.
5. Supply Shutoff Fitting: NPS 1/2 (DN 15) gate, globe, or ball valve and NPS 1/2 (DN 15) copper, water tubing.

## 2.9 HOSE BIBBS

### A. Hose Bibbs:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Jay R. Smith Mfg. Co.
  - b. WATTS.
  - c. Woodford Manufacturing Company.
  - d. Zurn Industries, LLC.
2. Standard: ASME A112.18.1 for sediment faucets.
3. Body Material: Bronze.
4. Seat: Bronze, replaceable.
5. Supply Connections: NPS 1/2 or NPS 3/4 (DN 15 or DN 20) threaded or solder-joint inlet.
6. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
7. Pressure Rating: 125 psig (860 kPa).
8. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
9. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
10. Finish for Service Areas: Chrome or nickel plated.
11. Finish for Finished Rooms: Chrome or nickel plated.
12. Operation for Equipment Rooms: Wheel handle or operating key.
13. Operation for Service Areas: Operating key.
14. Operation for Finished Rooms: Operating key.
15. Include operating key with each operating-key hose bibb.
16. Include integral wall flange with each chrome- or nickel-plated hose bibb.

## 2.10 POST HYDRANTS

### A. Nonfreeze, Nondraining-Type Post Hydrants:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Murdock-Super Secur; a member of Morris Group International.
  - b. Woodford Manufacturing Company.
  - c. Zurn Industries, LLC.
2. Operation: Lever-piston operating mechanism and nondraining water-storage reservoir, designed without drain.
3. Length: As required for burial of valve below frost line.
4. Inlet: NPS 1 (DN 25) threaded.
5. Outlet:
  - a. NPS 1 (DN 25) outlet and coupling plug for 1-inch (25-mm) hose.
  - b. NPS 1 by NPS 3/4 (DN 25 by DN 20) adapter with nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
  - c. Garden-hose thread complying with ASME B1.20.7 on outlet.
  - d. NPS 1 by NPS 3/4 (DN 25 by DN 20) adapter with nonremovable, drainable, hose-connection backflow preventer complying with ASSE 1052.
  - e. Garden-hose thread complying with ASME B1.20.7 on outlet.

## 2.11 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 (2760-kPa) minimum CWP.
3. Size: NPS 3/4 (DN 20).
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.

## 2.12 WATER-HAMMER ARRESTERS

### A. Water-Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Precision Plumbing Products.
  - b. Sioux Chief Manufacturing Company, Inc.
  - c. WATTS.
  - d. Zurn Industries, LLC.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

## 2.13 TRAP-SEAL PRIMER DEVICE

### A. Supply-Type, Trap-Seal Primer Device:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Precision Plumbing Products.
  - b. Sioux Chief Manufacturing Company, Inc.
  - c. WATTS.
  - d. Zurn Industries, LLC.
2. Standard: ASSE 1018.
3. Pressure Rating: 125 psig (860 kPa) minimum.
4. Body: Bronze.
5. Inlet and Outlet Connections: NPS 1/2 (DN 15) threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: NPS 1/2 (DN 15) threaded or solder joint.
7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.
8. Distribution Unit: Up to four trap primer lines. As needed when shown on plans.

### B. Drainage-Type, Trap-Seal Primer Device:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Jay R. Smith Mfg. Co.
  - b. Sioux Chief Manufacturing Company, Inc.
2. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 (DN 10) minimum, trap makeup connection.
3. Size: NPS 1-1/4 (DN 32) minimum.
4. Material: Chrome-plated, cast brass.

## 2.14 TRAP-SEAL PRIMER SYSTEMS

### A. Trap-Seal Primer Systems:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Precision Plumbing Products.
  - b. Sioux Chief Manufacturing Company, Inc.



- c. Zurn Industries, LLC.
- 2. Standard: ASSE 1044.
- 3. Piping: NPS 3/4, ASTM B 88, Type L (DN 20, ASTM B 88M, Type B); copper, water tubing.
- 4. Cabinet: Surface-mounted steel box with stainless-steel cover.
- 5. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120-V ac power.
  - 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.
- 6. Vacuum Breaker: ASSE 1001.
- 7. Number Outlets: Four.
- 8. Size Outlets: NPS 1/2 (DN 15).

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Water Control Valves: Install with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.
- B. Balancing Valves: Install in locations where they can easily be adjusted.
- C. Temperature-Actuated, Water Mixing Valves: Install 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. Y-Pattern Strainers: For water, install on supply side of each water pressure-reducing valve and pump.
- E. Outlet Boxes: Install boxes recessed in wall or surface mounted on wall. Install 2-by-4-inch (38-by-89-mm) 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."
- F. Nonfreeze, Draining-Type Post Hydrants: Install with 1 (0.75) cu. yd. (cu. m) of crushed gravel around drain hole. Set post hydrants in concrete paving or in 1 (0.03) cu. ft. (cu. m) of concrete block at grade.
- G. Water-Hammer Arresters: Install in water piping according to PDI-WH 201.
- H. 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.
- I. 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.
- J. Trap-Seal Primer Systems: 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 system for proper flow.

#### 3.2 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping specialties adjacent to equipment and machines, allow space for service and maintenance.
- C. Comply with requirements for grounding equipment in Section 26 05 26 "Grounding and Bonding for Electrical Systems."

#### 3.3 IDENTIFICATION

- A. Plastic Labels for Equipment: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
  - 1. Pressure vacuum breakers.
  - 2. Carbonated-beverage-machine backflow preventers.
  - 3. Dual-check-valve backflow preventers.
  - 4. Calibrated balancing valves.
  - 5. Primary, thermostatic, water mixing valves.
  - 6. Primary water tempering valves.
  - 7. Outlet boxes.
  - 8. Supply-type, trap-seal primer valves.

9. Trap-seal primer systems.

- 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."

### 3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

- 1. Test each pressure vacuum breaker, 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.

### 3.5 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 22 11 19**

**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, variable speed 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.

## 1.8 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

## PART 2 - PRODUCTS

## 2.1 IN-LINE, VARIABLE SPEED CENTRIFUGAL PUMPS

- 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. Bell & Gossett, Xylem.
  - 2. Grundfos Pumps Corp.
  - 3. TACO Comfort Solutions, Inc.

- B. Description: Factory-assembled and -tested, in-line, close-coupled, canned-motor, sealless, overhung-impeller centrifugal pumps.
- C. Pump Construction:
  - 1. Pump and Motor Assembly: Hermetically sealed, replaceable-cartridge type with motor and impeller on common shaft and designed for installation with pump and motor shaft horizontal or vertical.
  - 2. Casing: Bronze or cast iron, with threaded or companion-flange connections.
  - 3. Impeller: Plastic.
  - 4. Motor: High efficiency EMC permanent magnet motor. 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."
  - 5. Controller: Factory installed pump mounted variable speed drive with integral pressure and thermometer sensors. Motor shall have multiple controlling options including but not limited to: delta-t, temperature set point, and constant speed. Controller shall also have inputs for connection to the building management system.
- D. Refer to plans for capacities and characteristics.

## 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. Pressure Switches: Electric, adjustable for control of water-supply pump.
  - 1. Type: Water-immersion pressure sensor, for installation in piping.
  - 2. Enclosure: NEMA 250, Type 4X.
  - 3. Operation of Pump: On or off.
  - 4. Transformer: Provide if required.
  - 5. Power Requirement: 120 V, ac.
- B. Thermostats: Electric; adjustable for control of hot-water circulation pump.
  - 1. Type: Water-immersion temperature sensor, for installation in piping.
  - 2. Range: 50 to 125 deg F (10 to 52 deg C).
  - 3. Enclosure: NEMA 250, Type 4X.
  - 4. Operation of Pump: On or off.
  - 5. Transformer: Provide if required.
  - 6. Power Requirement: 120 V, ac.
- C. Timers: Electric, for control of hot-water circulation pump.
  - 1. Type: Programmable, seven-day clock with manual override on-off switch.
  - 2. Enclosure: NEMA 250, Type 1, suitable for wall mounting.
  - 3. Operation of Pump: On or off.
  - 4. Transformer: Provide if required.
  - 5. Power Requirement: 120-V ac.
  - 6. Programmable Sequence of Operation: Up to two on-off cycles each day for seven days.
- D. Time-Delay Relays: Electric, for control of hot-water circulation pump between water heater and connected hot-water storage tank.
  - 1. Type: Adjustable time-delay relay.
  - 2. Range: Up to five minutes.
  - 3. Setting: Five minutes.
  - 4. Enclosure: NEMA 250, Type 4X.
  - 5. Operation of Pump: On or off.
  - 6. Transformer: Provide if required.
  - 7. Power Requirement: 120-V ac.

8. Programmable Sequence of Operation: Limit pump operation to periods of burner operation plus maximum five minutes after the burner stops.

### 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. Pump Mounting: Install vertically mounted, in-line, close-coupled centrifugal pumps with cast-iron base mounted on concrete base using products specified in Section 03 30 00 "Cast-in-Place Concrete."
  1. Minimum Deflection: 1/4 inch (6 mm).
  2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) 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.
- C. Install continuous-thread hanger rods of size required to support pump weight.
  1. Comply with requirements for vibration isolation devices specified in Section 22 05 48.13 "Vibration Controls for Plumbing Piping and Equipment." Fabricate brackets or supports as required.
  2. Comply with requirements for hangers and supports specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."
- D. Install pressure switches in water supply piping.
- E. 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.
  1. Install flexible connectors adjacent to pumps in suction and discharge piping of the following pumps:
    - a. Horizontally mounted, in-line, separately coupled centrifugal pumps.
    - b. Horizontally mounted, in-line, close-coupled centrifugal pumps.
    - c. Vertically mounted, in-line, close-coupled centrifugal pumps.
    - d. Comply with requirements for flexible connectors specified in Section 22 11 16 "Domestic Water Piping."
- D. Install shutoff valve and strainer on suction side of each pump, and check, shutoff, and throttling valves on discharge side of each pump. Install valves same size as connected piping.
  1. Comply with requirements for valves specified in Section 22 05 23 "General Duty Valves for Plumbing Piping."
  2. Comply with requirements for strainers specified in Section 22 11 19 "Domestic Water Piping Specialties."
  3. Install pressure gage at suction of each pump and pressure gage at discharge of each pump. Install at integral pressure-gage tappings where provided or install pressure-gage connectors in suction

and discharge piping around pumps. Comply with requirements for pressure gages and snubbers specified in Section 22 05 19 "Meters and Gages for Plumbing Piping."

- E. Connect pressure switches, thermostats, time-delay relays, and/or timers to pumps that they control.
- F. Interlock pump between water heater and hot-water storage tank with water heater burner and time-delay relay.

### 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. Set pump mounted controller, pressure switches, thermostats, timers, and/or time-delay relays for automatic starting and stopping operation of pumps.
  - 5. 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.
  - 6. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
  - 7. Start motor.
  - 8. Open discharge valve slowly.
  - 9. Adjust temperature settings on thermostats.
  - 10. 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 22 11 23**

**SECTION 22 13 16 - SANITARY WASTE AND VENT 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. Hubless, cast-iron soil pipe and fittings.
  - 2. PVC pipe and fittings.
  - 3. Specialty pipe fittings.
- B. Related Requirement:
  - 1. the building.
  - 2. Section 22 13 29 "Sanitary Sewerage Pumps" for effluent and sewage pumps.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: For hubless, single-stack drainage system. Include plans, elevations, sections, and details.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Field quality-control reports.

**1.5 FIELD CONDITIONS**

- A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
  - 1. Notify Architect, Construction Manager, and Owner no fewer than two days in advance of proposed interruption of sanitary waste service.
  - 2. Do not proceed with interruption of sanitary waste service without Architect's, Construction Manager's, and Owner's written permission.

**PART 2 - PRODUCTS****2.1 PERFORMANCE REQUIREMENTS**

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
  - 1. Soil, Waste, and Vent Piping: 10-foot head of water (30 kPa).
  - 2. Waste, Force-Main Piping: 50 psig (345 kPa).
- B.

**2.2 PIPING MATERIALS**

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. 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.

## 2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. Heavy-Duty, Hubless-Piping Couplings:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. ANACO-Husky.
    - b. Charlotte Pipe and Foundry Company.
    - c. Mission Rubber Company, LLC; a division of MCP Industries.
    - d. Tyler Pipe; a subsidiary of McWane Inc.
  - 2. Standards: ASTM C 1277 and ASTM C 1540.
  - 3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
- C. Cast-Iron, Hubless-Piping Couplings:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Charlotte Pipe and Foundry Company.
    - b. MG Piping Products Company.
  - 2. Standard: ASTM C 1277.
  - 3. Description: Two-piece ASTM A 48/A 48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.

## 2.4 COPPER TUBE AND FITTINGS

- A. Copper Type DWV Tube: ASTM B 306, drainage tube, drawn temper.
- B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
- C. Hard Copper Tube: ASTM B 88, Type L and Type M (ASTM B 88M, Type B and Type C), water tube, drawn temper.
- D. Copper Pressure Fittings:
  - 1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
  - 2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
- E. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
  - 1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
  - 2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- F. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

## 2.5 PVC PIPE AND FITTINGS

- A. Comply with NSF 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.
- B. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
- C. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- D. Adhesive Primer: ASTM F 656.

## 2.6 SPECIALTY PIPE FITTINGS

- A. Transition Couplings:
  - 1. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.



2. Shielded, Nonpressure Transition Couplings:
  - 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) Cascade Waterworks Mfg. Co.
    - 2) Mission Rubber Company, LLC; a division of MCP Industries.
  - b. Standard: ASTM C 1460.
  - c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
  - d. End Connections: Same size as and compatible with pipes to be joined.
- B. Dielectric Fittings:
  1. Dielectric Unions:
    - 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) WATTS.
      - 2) Wilkins.
      - 3) Zurn Industries, LLC.
    - b. Description:
      - 1) Standard: ASSE 1079.
      - 2) Pressure Rating: 125 psig (860 kPa) minimum at 180 deg F (82 deg C).
      - 3) End Connections: Solder-joint copper alloy and threaded ferrous.
  2. Dielectric-Flange Insulating Kits:
    - 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) Advance Products & Systems, Inc.
      - 2) Central Plastics Company.
      - 3) Pipeline Seal and Insulator, Inc.
    - b. Description:
      - 1) Nonconducting materials for field assembly of companion flanges.
      - 2) Pressure Rating: 150 psig (1035 kPa).
      - 3) Gasket: Neoprene or phenolic.
      - 4) Bolt Sleeves: Phenolic or polyethylene.
      - 5) Washers: Phenolic with steel backing washers.

### 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.
  1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
  2. 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. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.
  - 1. 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.
  - 2. 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.
    - a. Straight tees, elbows, and crosses may be used on vent lines.
  - 3. Do not change direction of flow more than 90 degrees.
  - 4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
    - a. Reducing size of waste piping in direction of flow is prohibited.
- K. Lay buried building waste piping beginning at low point of each system.
  - 1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
  - 2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
  - 3. Maintain swab in piping and pull past each joint as completed.
- L. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:
  - 1. Building Sanitary Waste: 2 percent downward in direction of flow for piping NPS 2 (DN 50) and smaller; 1 percent downward in direction of flow for piping NPS 3 (DN 80) and larger.
  - 2. Vent Piping: 0.5 percent down toward vertical fixture vent or toward vent stack.
- M. 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."
- N. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."
- O. Install underground PVC piping according to ASTM D 2321.
- P. Install force-main piping according to AWWA C600.
  - 1. Install buried piping inside building between wall and floor penetrations and connection to sanitary sewer piping outside building with restrained joints.
  - 2. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.
  - 3. Install encasement on piping according to ASTM A 674 or AWWA C105/A 21.5.
- Q. Install force mains at elevations indicated.
- R. Plumbing Specialties:
  - 1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.
    - a. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping.
    - b. Comply with requirements for cleanouts specified in Section 22 13 19 "Sanitary Waste Piping Specialties."
  - 2. Install drains in sanitary waste gravity-flow piping.
    - a. Comply with requirements for drains specified in Section 22 13 19 "Sanitary Waste Piping Specialties."
- S. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- T. Install sleeves for piping penetrations of walls, ceilings, and floors.
  - 1. Comply with requirements for sleeves specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."
- U. Install sleeve seals for piping penetrations of concrete walls and slabs.
  - 1. Comply with requirements for sleeve seals specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."
- V. Install escutcheons for piping penetrations of walls, ceilings, and floors.
  - 1. Comply with requirements for escutcheons specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

### 3.3 JOINT CONSTRUCTION

- A. 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.
- B. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1.
  - 1. Cut threads full and clean using sharp dies.
  - 2. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
    - a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
    - b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
    - c. Do not use pipe sections that have cracked or open welds.
- C. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.
- D. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.
- E. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.
- F. 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. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 appendixes.
  - 3. 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 ODs.
  - 2. In Waste Drainage Piping: Shielded, nonpressure transition couplings.
  - 3. In Aboveground Force Main Piping: Fitting-type transition couplings.
    - a. NPS 1-1/2 (DN 40) and Smaller: Fitting-type transition couplings.
    - b. NPS 2 (DN 50) and Larger: Pressure transition couplings.
- B. Dielectric Fittings:
  - 1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
  - 2. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric unions.
  - 3. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric flange kits.
  - 4. Dielectric Fittings for NPS 5 (DN 125) and Larger: Use dielectric flange kits.

### 3.5 VALVE INSTALLATION

- A. Comply with requirements in Section 22 05 23 "General Duty Valves For Plumbing Piping,"
- B. Shutoff Valves:
  - 1. Install shutoff valve on each sewage pump discharge.
  - 2. Install gate or full-port ball valve for piping NPS 2 (DN 50) and smaller.
  - 3. Install gate valve for piping NPS 2-1/2 (DN 65) and larger.
- C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.

### 3.6 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" and/or Section 22 05 48.13 "Vibration Controls 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 (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
  - b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
  - c. Longer Than 100 Feet (30 m) if Indicated: MSS Type 49, spring cushion rolls.
5. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
6. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Support horizontal piping and tubing within 12 inches (300 mm) of each fitting, valve, 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 (10-mm) 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 (DN 40 and DN 50): 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 and NPS 5 (DN 100 and DN 125): 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. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
  1. NPS 1-1/4 (DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
  2. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
  3. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
  4. NPS 3 and NPS 5 (DN 80 and DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.
  5. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.
  6. NPS 8 (DN 200): 10 feet (3 m) with 3/4-inch (19-mm) rod.
- H. Install supports for vertical copper tubing every 10 feet (3 m).
- I. Support piping and tubing not listed above according to MSS SP-58 and manufacturer's written instructions.

### 3.7 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 waste and vent piping to the following:
  1. Plumbing Fixtures: Connect waste 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 waste 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 waste piping as indicated.
    - a. Provide shutoff valve if indicated and union for each connection.
    - b. Use flanges instead of unions for connections NPS 2-1/2 (DN 65) and larger.
- D. Connect force-main piping to the following:
  1. Sewage Pump: To sewage pump discharge.
- E. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- F. 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.

### 3.8 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping.
- B. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

### 3.9 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 waste 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.
    - a. 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 waste and vent piping until it has been tested and approved.
    - a. Expose work that was covered or concealed before it was tested.
  3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.
    - a. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa).
    - b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
    - c. 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.
    - a. 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).
    - b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
    - c. Air pressure must remain constant without introducing additional air throughout period of inspection.
    - d. 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.
- E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
  1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved.
    - a. Expose work that was covered or concealed before it was tested.
  2. Cap and subject piping to static-water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials.

- a. Isolate test source and allow to stand for four hours.
- b. Leaks and loss in test pressure constitute defects that must be repaired.
3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
4. Prepare reports for tests and required corrective action.

### 3.10 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect sanitary waste and vent piping 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.
- D. Repair damage to adjacent materials caused by waste and vent piping installation.

### 3.11 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 4 (DN 100) and smaller shall be any of the following:
  1. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.
  2. Stainless-steel pipe and fittings, sealing rings, and gasketed joints.
  3. Copper Type DWV tube, copper drainage fittings, and soldered joints.
  4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
  5. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- C. Aboveground, vent piping all sizes shall be any of the following:
  1. Hubless, cast-iron soil pipe and fittings; CISPI or heavy-duty hubless-piping couplings; and coupled joints.
  2. Stainless-steel pipe and fittings gaskets, and gasketed joints.
  3. Copper Type DWV tube, copper drainage fittings, and soldered joints.
  4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- D. Underground, soil, waste, and vent piping all sizes shall be any of the following:
  1. Extra Heavy class, cast-iron soil piping; gaskets; and gasketed joints.
  2. Stainless-steel pipe and fittings, gaskets, and gasketed joints.
  3. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
  4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- E. Aboveground sanitary-sewage force mains NPS 1-1/2 and NPS 2 (DN 40 and DN 50) shall be the following:
  1. Hard copper tube, Type L (Type B); copper pressure fittings; and soldered joints.

**END OF SECTION 22 13 16**

**SECTION 22 13 19 - SANITARY WASTE PIPING SPECIALTIES****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Cleanouts.
  - 2. Roof flashing assemblies.
  - 3. Through-penetration firestop assemblies.
  - 4. Miscellaneous sanitary drainage piping specialties.

**1.3 DEFINITIONS**

- A. ABS: Acrylonitrile-butadiene-styrene.
- B. FOG: Fats, oils, and greases.
- C. PVC: Polyvinyl chloride.

**1.4 ACTION SUBMITTALS**

- A. Shop Drawings:
  - 1. Show fabrication and installation details for frost-resistant vent terminals.
  - 2. Wiring Diagrams: Power, signal, and control wiring.

**1.5 INFORMATIONAL SUBMITTALS**

- A. Field quality-control reports.

**1.6 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For sanitary waste piping specialties to include in emergency, operation, and maintenance manuals.

**1.7 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. Cultures: Provide 1-gal. (3.8-L) bottles of bacteria culture recommended by manufacturer of FOG disposal systems equal to 200 percent of amount installed, but no fewer than 2 1-gal. (3.8-L) bottles.

**PART 2 - PRODUCTS****2.1 ASSEMBLY DESCRIPTIONS**

- A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14 for plastic sanitary waste piping specialty components.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing, and marked for intended location and application.

## 2.2 CLEANOUTS

### A. Cast-Iron Exposed Cleanouts:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Jay R. Smith Mfg. Co.
  - b. Josam Company.
  - c. Tyler Pipe; a subsidiary of McWane Inc.
  - d. Zurn Industries, LLC.
2. Standard: ASME A112.36.2M.
3. Size: Same as connected drainage piping
4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk or raised-head, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

### B. Cast-Iron Exposed Floor Cleanouts:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Jay R. Smith Mfg. Co.
  - b. Josam Company.
  - c. Tyler Pipe; a subsidiary of McWane Inc.
  - d. Zurn Industries, LLC.
2. Standard: ASME A112.36.2M for adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Threaded, adjustable housing.
5. Body or Ferrule: Cast iron.
6. Clamping Device: Required.
7. Outlet Connection: Spigot.
8. Closure: Brass plug with straight threads and gasket.
9. Adjustable Housing Material: Cast iron with threads.
10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
11. Frame and Cover Shape: Round.
12. Top Loading Classification: Heavy Duty.
13. Riser: ASTM A 74, Extra-Heavy Service class, cast-iron drainage pipe fitting and riser to cleanout.

### C. Cast-Iron Wall Cleanouts:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Jay R. Smith Mfg. Co.
  - b. Josam Company.
  - c. Tyler Pipe; a subsidiary of McWane Inc.
  - d. Zurn Industries, LLC.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure Plug:
  - a. Brass.
  - b. Countersunk head.
  - c. Drilled and threaded for cover attachment screw.
  - d. Size: Same as or not more than one size smaller than cleanout size.
6. Wall Access: Round, deep, chrome-plated bronze cover plate with screw.

## 2.3 ROOF FLASHING ASSEMBLIES

### A. Roof Flashing Assemblies:



1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Acorn Engineering Company.
  - b. Thaler Metal Industries Ltd.
  - c. Zurn Industries, LLC.
2. Description: Manufactured assembly made of 4.0-lb/sq. ft. (20-kg/sq. m), 0.0625-inch- (1.6-mm-) thick, lead flashing collar and skirt extending at least from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.
  - a. Open-Top Vent Cap: Without cap.
  - b. Low-Silhouette Vent Cap: With vandal-proof vent cap.
  - c. Extended Vent Cap: With field-installed, vandal-proof vent cap.

#### 2.4 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

##### A. Through-Penetration Firestop Assemblies:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. ProSet Systems Inc.
2. Standard: UL 1479 assembly of sleeve-and-stack fitting with firestopping plug.
3. Size: Same as connected soil, waste, or vent stack.
4. 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.
5. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
6. Special Coating: Corrosion resistant on interior of fittings.

#### 2.5 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

##### A. Open Drains:

1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564 rubber gaskets.
2. Size: Same as connected waste piping with increaser fitting of size indicated.

##### B. 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 (DN 50): 4-inch- (100-mm-) minimum water seal.
  - b. NPS 2-1/2 (DN 65) and Larger: 5-inch- (125-mm-) minimum water seal.

##### 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 (DN 15) side inlet.

##### D. 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.

##### E. 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 1 inch (25 mm) 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.
- F. 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.
- G. 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.
- H. Expansion Joints:
  1. Standard: ASME A112.6.4.
  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.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Equipment Mounting:
  1. Comply with requirements for vibration-isolation devices specified in Section 22 05 48.13 "Vibration Controls for Plumbing Piping and Equipment."
- B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
  1. Size same as drainage piping up to NPS 4 (DN 100). Use NPS 4 (DN 100) for larger drainage piping unless larger cleanout is indicated.
  2. Locate at each change in direction of piping greater than 45 degrees.
  3. Locate at minimum intervals of 50 feet (15 m) for piping NPS 4 (DN 100) and smaller and 100 feet (30 m) for larger piping.
  4. Locate at base of each vertical soil and waste stack.
- 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 roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof. Comply with requirements in Section 07 62 00 "Sheet Metal Flashing and Trim."
- F. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof. Comply with requirements in Section 07 62 00 "Sheet Metal Flashing and Trim."
- G. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.
  1. Comply with requirements in Section 07 84 13 "Penetration Firestopping."
- H. Assemble open drain fittings and install with top of hub 1 inch (25 mm) above floor unless otherwise specified on the plans.
- I. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- J. 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.
- K. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- L. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.
- M. Install vent caps on each vent pipe passing through roof.
- N. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- O. Install wood-blocking reinforcement for wall-mounting-type specialties.
- P. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

### 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.
- 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."

### 3.3 FLASHING INSTALLATION

- A. Comply with requirements in Section 07 62 00 "Sheet Metal Flashing and Trim."
- B. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required.
- C. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
  - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches (250 mm), and skirt or flange extending at least 8 inches (200 mm) around pipe.
  - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around sleeve.
  - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around specialty.
- D. Set flashing on floors and roofs in solid coating of bituminous cement.
- E. Secure flashing into sleeve and specialty clamping ring or device.
- F. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Section 07 62 00 "Sheet Metal Flashing and Trim."
- G. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

### 3.4 LABELING AND IDENTIFYING

- A. 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.
  - 1. Nameplates and signs are specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

### 3.5 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.

### 3.6 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 22 13 19**

**SECTION 22 13 29 - SANITARY SEWERAGE AND EFFLUENT 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. Submersible effluent pumps.

**1.3 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:
  - 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. 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.
  - 4. Include diagrams for power, signal, and control wiring.

**1.4 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For pumps and controls, to include in operation and maintenance manuals.

**1.5 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 manufacturer's written instructions for handling.

**1.6 COORDINATION**

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

**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. UL Compliance: Comply with UL 778 for motor-operated water pumps.

**2.2 SUBMERSIBLE EFFLUENT PUMPS**

- A. Submersible, Fixed-Position, Single-Seal Effluent Pumps:
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

- a. Grundfos Pumps Corp.
- b. Pentair Pump Group.
- c. Stancor, Inc.
- d. Zoeller Company.
2. Description: Factory-assembled and -tested effluent-pump unit.
3. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal effluent pump as defined in HI 1.1-1.2 and HI 1.3.
4. Pump Casing: Cast iron, with open inlet, legs that elevate pump to permit flow into impeller, and vertical discharge for piping connection.
5. Impeller: Statically and dynamically balanced, ASTM B 584, cast bronze or stainless steel, closed or semi-open design for clear wastewater, and keyed and secured to shaft.
6. Pump and Motor Shaft: Stainless steel or steel, with factory-sealed, grease-lubricated ball bearings.
7. Seal: Mechanical.
8. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.
  - a. Motor Housing Fluid: Oil.
9. Controls:
  - a. Enclosure: NEMA 250, Type 4X.
  - b. Switch Type: Pedestal-mounted float switch with float rods and rod buttons.
  - c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
  - d. Float Guides: Pipe or other restraint for floats and rods in basins of depth greater than 60 inches (1500 mm).
  - e. High-Water Alarm: Cover-mounted, compression-probe alarm, with electric bell; 120 V ac, with transformer and contacts for remote alarm bell.
  - f. Oil detecting probe located in the sump pit to shut off pumps when hydrocarbons are detected.
10. Control-Interface Features:
  - a. Remote Alarm Contacts: For remote alarm interface.
  - b. Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:
    - 1) On-off status of pump.
    - 2) Alarm status.

### 2.3 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.
- B. Motors for submersible pumps shall be hermetically sealed.

## PART 3 - EXECUTION

### 3.1 EARTHWORK

- A. Excavation and filling are specified in Section 31 20 00 "Earth Moving."

### 3.2 EXAMINATION

- A. Examine roughing-in for plumbing piping to verify actual locations of sanitary drainage and vent piping connections before sewage pump installation.

### 3.3 INSTALLATION

- A. Pump Installation Standards:
  - 1. Comply with HI 1.4 for installation of centrifugal pumps.
  - 2. Comply with HI 3.1-3.5 for installation of progressing-cavity sewage pumps.
- B. Equipment Mounting:
  - 1. Comply with requirements for vibration isolation devices specified in Section 22 05 48.13 "Vibration Controls for Plumbing Piping and Equipment."
- C. Wiring Method: Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

### 3.4 CONNECTIONS

- A. Comply with requirements for piping specified in Section 22 13 16 "Sanitary Waste and Vent Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to equipment, allow space for service and maintenance.

### 3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test, inspect, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform the following tests and inspections:
  - 1. Perform each visual and mechanical inspection.
  - 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 motor rotation and unit 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. Perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.

### 3.7 ADJUSTING

- A. Adjust pumps to function smoothly, and lubricate as recommended by manufacturer.
- B. Adjust control set points.

### 3.8 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps.

**END OF SECTION 22 13 29**

**SECTION 22 33 00 - ELECTRIC, DOMESTIC-WATER HEATERS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Commercial, electric, domestic-water booster heaters.
  - 2. Domestic-water heater accessories.

**1.3 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:
  - 1. Include diagrams for power, signal, and control wiring.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Equipment room drawing or BIM model, drawn to scale, on which the items described in this Section are shown and coordinated with all building trades.
- B. Product Certificates: For each type of commercial, electric, domestic-water heater.
- C. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.
- D. Source quality-control reports.
- E. Field quality-control reports.
- F. Sample Warranty: For special warranty.

**1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For electric, domestic-water heaters to include emergency, operation, and maintenance manuals.

**1.6 COORDINATION**

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

**1.7 WARRANTY**

- A. Special Warranty: Manufacturer agrees to repair or replace components of electric, 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, Electric, Storage, Domestic-Water Heaters:
      - 1) Storage Tank: Three years.
      - 2) Controls and Other Components: Three years.

- b. Expansion Tanks: Three years.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and use.
- B. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1.
- C. ASME Compliance: 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.
- D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 and NSF 372.

### 2.2 COMMERCIAL, ELECTRIC, DOMESTIC-WATER HEATERS

- A. Commercial, Electric, Storage, Domestic-Water Heaters:
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. A. O. Smith Corporation.
    - b. Bock Water Heaters, Inc.
    - c. Lochinvar, LLC.
    - d. PVI; A WATTS Brand.
  - 2. Source Limitations: Obtain domestic-water heaters from single source from single manufacturer.
  - 3. Standard: UL 1453.
  - 4. Storage-Tank Construction: Non-ASME-code, steel vertical arrangement.
    - a. Tappings: Factory fabricated of materials compatible with tank and piping connections. Attach tappings to tank before testing.
      - 1) NPS 2 (DN 50) and Smaller: Threaded ends in accordance with ASME B1.20.1.
      - 2) NPS 2-1/2 (DN 65) and Larger: Flanged ends in accordance with ASME B16.5 for steel and stainless steel flanges, and in accordance with ASME B16.24 for copper and copper-alloy flanges.
    - b. Pressure Rating: 150 psig (1035 kPa).
    - c. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending lining material into tappings.
    - d. Lining: Glass complying with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending lining into and through tank fittings and outlets.
  - 5. Factory-Installed, Storage-Tank Appurtenances:
    - a. Anode Rod: Replaceable magnesium.
    - b. Drain Valve: Corrosion-resistant metal with hose-end connection.
    - c. Insulation: Comply with ASHRAE/IES 90.1.
    - d. Jacket: Steel with enameled finish or high-impact composite material.
    - e. Heating Elements: Electric, screw-in or bolt-on immersion type arranged in multiples of three.
    - f. Temperature Control: Adjustable thermostat.
    - g. Safety Controls: High-temperature-limit and low-water cutoff devices or systems.
    - h. Relief Valves: ASME rated and stamped for combination temperature-and-pressure relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select one relief valve with sensing element that extends into storage tank.
  - 6. Special Requirements: NSF 5 construction.
- B. Capacity and Characteristics:
  - 1. Refer to schedules on Drawings for characteristics.
- C. Electrical Characteristics:
  - 1. Volts: 208V.



2. Phases: Single.
3. Hertz: 60 Hz.

### 2.3 DOMESTIC-WATER HEATER ACCESSORIES

- A. Domestic-Water Expansion Tanks:
  1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. A. O. Smith Corporation.
    - b. AMTROL, Inc.
    - c. State Industries.
    - d. TACO Comfort Solutions, Inc.
  2. Source Limitations: Obtain domestic-water expansion tanks from single source from single manufacturer.
  3. 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.
  4. 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 and NSF 372 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
    - c. Air-Charging Valve: Factory installed.
  5. Capacity and Characteristics:
    - a. Refer to schedules on Drawings for characteristics.
- B. Drain Pans: Corrosion-resistant metal with raised edge. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than NPS 3/4 (DN 20) with ASME B1.20.1 pipe threads.
- C. Piping-Type Heat Traps: Field-fabricated piping arrangement in accordance with ASHRAE/IES 90.1.
  1. Comply with requirements for ball-, butterfly-, or gate-type shutoff valves specified in Section 22 05 23.12 "Ball Valves for Plumbing Piping," Section 22 05 23.13 "Butterfly Valves for Plumbing Piping," and Section 22 05 23.15 "Gate Valves for Plumbing Piping."
  2. Comply with requirements for balancing valves specified in Section 22 11 19 "Domestic Water Piping Specialties."
- D. Pressure-Reducing Valves: ASSE 1003 for water. Set at 25-psig- (172.5-kPa-) maximum outlet pressure unless otherwise indicated.
- E. Combination Temperature-and-Pressure Relief Valves: ASME rated and stamped. Include relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select relief valves with sensing element that extends into storage tank.
- F. Pressure Relief Valves: ASME rated and stamped. Include pressure setting less than working-pressure rating of domestic-water heater.
- G. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.
- H. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester.
- I. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.

### 2.4 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect domestic-water heaters specified to be ASME-code construction, in accordance with ASME Boiler and Pressure Vessel Code.
- B. Hydrostatically test domestic-water heaters to minimum of one and one-half times pressure rating before shipment.
- C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

## PART 3 - EXECUTION

## 3.1 DOMESTIC-WATER HEATER INSTALLATION

- A. Commercial, Electric, Domestic-Water Heater Mounting: Install commercial, electric, domestic-water heaters on concrete base. Comply with requirements for concrete bases specified in Section 03 30 00 "Cast-in-Place Concrete." Section 03 30 53 "Miscellaneous Cast-in-Place Concrete."
1. Exception: Omit concrete bases for commercial, electric, 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 (450-mm) 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 electric, domestic-water heaters level and plumb, in accordance with 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," Section 22 05 23.13 "Butterfly Valves for Plumbing Piping," and Section 22 05 23.15 "Gate Valves for Plumbing Piping."
- C. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend domestic-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.
- D. 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 electric, 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."
- E. Install thermometers on outlet piping of electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 22 05 19 "Meters and Gages for Plumbing Piping."
- F. Install thermometers on inlet and outlet piping of residential, solar, electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 22 05 19 "Meters and Gages for Plumbing Piping."
- G. Install pressure-reducing valve with integral bypass relief valve in electric, domestic-water booster-heater inlet piping and water hammer arrester in booster-heater outlet piping. Set pressure-reducing valve for outlet pressure of 25 psig (172 kPa). Comply with requirements for pressure-reducing valves and water hammer arresters specified in Section 22 11 19 "Domestic Water Piping Specialties."
- H. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.
- I. Fill electric, domestic-water heaters with water.
- J. Charge domestic-water expansion tanks with air to required system pressure.
- K. Install dielectric fittings in all locations where piping of dissimilar metals is to be joined. The wetted surface of the dielectric fitting contacted by potable water shall contain less than 0.25 percent of lead by weight.

## 3.2 PIPING 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. Where installing piping adjacent to electric, 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. 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. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
  - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- F. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections.
- G. 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, electric, domestic-water heaters.

**END OF SECTION 22 33 00**

**SECTION 22 42 13 - COMMERCIAL PLUMBING FIXTURES****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Wall mounted water closet
  - 2. Water closet flushometer valves.
  - 3. Toilet seats.
  - 4. Water closet supports.
  - 5. Urinals.
  - 6. Urinal flushometer valves.
  - 7. Urinal supports.
  - 8. Lavatories.
  - 9. Lavatory faucets.
  - 10. Lavatory accessories.
  - 11. Sinks.
  - 12. Sink faucets.
  - 13. Mop basins.
  - 14. Mop basin faucets.
  - 15. Grout.

**1.3 DEFINITIONS**

- A. Effective Flush Volume: Average of two reduced flushes and one full flush per fixture.
- B. Remote Water Closet: Located more than 30 feet (9.1 m) from other drain line connections or fixture and where less than 1.5 drainage fixture units are upstream of the drain line connection.

**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 water closets.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: Include diagrams for power, signal, and control wiring.

**1.5 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

**1.6 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For flushometer valves and electronic sensors to include in operation and maintenance manuals.
- B. 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.

## 1.7 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. Flushometer-Valve Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than one of each type.
  2. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
  3. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.

## PART 2 - PRODUCTS

### 2.1 WALL-MOUNTED WATER CLOSETS

- A. Water Closets: Wall Mounted, Top Spud, Accessible.
  1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. American Standard.
    - b. Kohler Co.
    - c. Sloan Valve Company.
    - d. TOTO USA, INC.
    - e. Zurn Industries, LLC.
  2. Bowl:
    - a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
    - b. Material: Vitreous china.
    - c. Type: Siphon jet.
    - d. Style: Flushometer valve.
    - e. Water-Closet Mounting Height: Standard & Handicapped/elderly according to ICC/ANSI A117.1.
    - f. Rim Contour: Elongated.
    - g. Water Consumption: 1.28 gal. (4.8 L) per flush.
    - h. Spud Size and Location: NPS 1-1/2 (DN 40); top.

### 2.2 WATER CLOSET FLUSHOMETER VALVES

- A. Sensor Activated, Flushometer Valves.
  1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. American Standard.
    - b. Delany Products.
    - c. Kohler Co.
    - d. Sloan Valve Company.
    - e. TOTO USA, INC.
    - f. Zurn Industries, LLC.
  2. Standard: ASSE 1037.
  3. Minimum Pressure Rating: 125 psig (860 kPa).
  4. Features: Include integral check stop and backflow-prevention device.
  5. Material: Brass body with corrosion-resistant components.
  6. Flushing Mechanism: Piston
  7. Style: Exposed.
  8. Exposed Flushometer-Valve Finish: Chrome plated.
  9. Actuator: Solenoid 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.

10. Trip Mechanism: Battery-powered 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.
11. Consumption: 1.28 gal. (4.8 L) per flush.
12. Minimum Inlet: NPS 1 (DN 25).
13. Minimum Outlet: NPS 1-1/4 (DN 32).

### 2.3 TOILET SEATS

#### A. Toilet Seats.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Standard.
  - b. Bemis Manufacturing Company.
  - c. Church Seats; Bemis Manufacturing Company.
  - d. Kohler Co.
  - e. TOTO USA, INC.
  - f. Zurn Industries, LLC.
2. Standard: IAPMO/ANSI Z124.5.
3. Material: Plastic.
4. Type: Commercial (Heavy duty).
5. Shape: Elongated rim, open front.
6. Hinge: Self-sustaining, check.
7. Hinge Material: Noncorroding metal.
8. Seat Cover: Not required.
9. Color: White.

### 2.4 WATER CLOSET SUPPORTS

#### A. Water Closet Carrier.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - a. Zurn Industries, LLC.
  - b. Jay R. Smith MFG. CO.
  - c. Josam Company
2. Standard: ASME A112.6.1M.
3. Description: Waste-fitting assembly, as required to match drainage piping material and arrangement with faceplates, couplings gaskets, and feet; bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.

### 2.5 URINALS

#### A. Urinals: Wall Hung, Back Outlet.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. American Standard.
  - b. Kohler Co.
  - c. Sloan Valve Company.
  - d. TOTO USA, INC.
  - e. Zurn Industries, LLC.
2. Fixture:
  - a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
  - b. Material: Vitreous china.
  - c. Strainer or Trapway: Manufacturer's standard strainer with integral trap.
  - d. Water Consumption: Water saving.
  - e. Spud Size and Location: NPS 1-1/4 (DN 32); top.
  - f. Outlet Size and Location: NPS 2 (DN 50); back.

- g. Color: White.
- h. Urinal Mounting Height: Standard & Handicapped/elderly according to ICC A117.1.
- 3. Waste Fitting:
  - a. Standard: ASME A112.18.2/CSA B125.2 for coupling.
  - b. Size: NPS 2 (DN 50).

## 2.6 URINAL FLUSHOMETER VALVES

### A. Sensor Activated, Flushometer Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. American Standard.
  - b. Delany Products.
  - c. Kohler Co.
  - d. Sloan Valve Company.
  - e. TOTO USA, INC.
  - f. Zurn Industries, LLC.
2. Standard: ASSE 1037.
3. Minimum Pressure Rating: 125 psig (860 kPa).
4. Features: Include integral check stop and backflow-prevention device.
5. Material: Brass body with corrosion-resistant components.
6. Flushing Mechanism: Piston
7. Style: Exposed.
8. Exposed Flushometer-Valve Finish: Chrome plated.
9. Actuator: Solenoid 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.
10. Trip Mechanism: Battery-powered 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.
11. Consumption: 0.125 gal. (0.47 L) per flush.
12. Minimum Inlet: NPS 3/4 (DN 20).
13. Minimum Outlet: NPS 3/4 (DN 20).

## 2.7 URINAL SUPPORTS

### A. Type I Urinal Carrier:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Jay R. Smith Mfg. Co.
  - b. Josam Company.
  - c. Zurn Industries, LLC.
2. Standard: ASME A112.6.1M.

## 2.8 LAVATORIES

### A. Lavatory: Oval, Vitreous China, Undercounter Mounted.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. American Standard.
  - b. Kohler Co.
  - c. Sloan Valve Company.
  - d. TOTO USA, INC.
  - e. Zurn Industries, LLC.
2. Fixture:
  - a. Standard: ASME A112.19.2/CSA B45.1.
  - b. Type: For undercounter mounting.

- c. Nominal Size: See schedules on drawings for basis of design.
  - d. Faucet-Hole Punching: No holes.
  - e. Faucet-Hole Location: On countertop.
  - f. Color: White.
  - g. Mounting Material: Sealant and undercounter mounting kit.
- B. Lavatory: Vitreous China, Wall Mounted, with Back.
- 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. American Standard.
    - b. Kohler Co.
    - c. Sloan Valve Company.
    - d. TOTO USA, INC.
    - e. Zurn Industries, LLC.
  - 2. Fixture:
    - a. Standard: ASME A112.19.2/CSA B45.1.
    - b. Type: For wall hanging.
    - c. Nominal Size: Oval, 19 by 16 inches (483 by 406 mm).
    - d. Faucet-Hole Punching: One hole.
    - e. Faucet-Hole Location: Top.
    - f. Color: White.
    - g. Mounting Material: Chair carrier.
    - h. Lavatory Mounting Height: Handicapped/elderly according to ICC A117.1.

## 2.9 LAVATORY FAUCETS

- A. NSF Standard: Comply with NSF 372 for faucet materials that will be in contact with potable water.
- B. Solid-Brass, Manually Operated Lavatory Faucets.
  - 1. Single-control mixing, commercial, solid-brass valve.
  - 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. American Standard.
    - b. Elkay Manufacturing Co.
    - c. Kohler Co.
    - d. Zurn Industries, LLC.
  - 3. Standard: ASME A112.18.1/CSA B125.1.
  - 4. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.
- C. Solid-Brass, Sensor Operated Lavatory Faucets.
  - 1. Automatic-type, battery-powered, electronic-sensor-operated, mixing, commercial, solid-brass valve.
  - 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. American Standard.
    - b. Kohler Co.
    - c. Sloan Valve Company.
    - d. TOTO USA, INC.
    - e. Zurn Industries, LLC.
  - 3. Standards: ASME A112.18.1/CSA B125.1 and UL 1951.
  - 4. 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.
  - 5. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.
  - 6. Body Type: Single hole.
  - 7. Body Material: Commercial, solid brass.
  - 8. Finish: Polished chrome plate.
  - 9. Maximum Flow Rate: 0.5 gpm (1.5 L/min.).



10. Mounting Type: Deck, concealed .
11. Spout: Rigid type.
12. Spout Outlet: Laminar flow.
13. Drain: Not part of faucet.

## 2.10 LAVATORY ACCESSORIES

- A. Lavatory Supply Fittings.
  1. NSF Standard: Comply with NSF 372 for supply-fitting materials that will be in contact with potable water.
  2. Standard: ASME A112.18.1/CSA B125.1.
  3. 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.
  4. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
  5. Operation: Loose key.
  6. Risers:
    - a. NPS 3/8 (DN 10).
    - b. ASME A112.18.6, braided- or corrugated-stainless-steel, flexible hose riser.
- B. Lavatory Waste Fittings.
  1. Standard: ASME A112.18.2/CSA B125.2.
  2. Drain: Grid type with NPS 1-1/4 (DN 32) offset and straight tailpiece.
  3. Trap:
    - a. Size: NPS 1-1/4 (DN 32).
    - b. Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032- inch- (0.83-mm-) thick brass tube to wall; and chrome-plated, brass or steel wall flange.
- C. Lavatory Supports.
  1. Type II & III Lavatory Carrier:
    - a. Standard: ASME A112.6.1M.

## 2.11 SINKS

- A. Stainless Steel, Counter Mounted.
  1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. Advance Tabco.
    - b. Elkay Manufacturing Co.
    - c. Griffin Products, Inc.
    - d. Just Manufacturing.
  2. Fixture: Refer to plumbing fixture schedule on plans.
    - a. Standard: ASME A112.19.3/CSA B45.4.
    - b. Type: Ledge back.
    - c. Metal Thickness: 0.050 inch (1.3 mm).
    - d. Compartment:
      - 1) Drain: Flat grid with NPS 1-1/2 (DN 40) tailpiece.
      - 2) Drain Location: Centered in compartment.
    - e. Each Compartment:
      - 1) Drains: Flat grid with NPS 1-1/2 (DN 40) tailpiece.
      - 2) Drain Location: .
    - f. Faucet-Hole Punching: One hole or Three holes, 8-inch (200-mm) centers.
    - g. Faucet-Hole Location: Top.
  3. Sink Supply Fittings.
    - a. NSF Standard: Comply with NSF 372 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: NPS 1/2 (DN 15). ASME A112.18.6, braided or corrugated stainless-steel flexible hose.
4. Sink Waste Fittings.
- a. Standard: ASME A112.18.2/CSA B125.2.
  - b. Drain: Grid type with NPS 1-1/2 (DN 40) offset and straight tailpiece.
  - c. Trap: NPS 1-1/2 (DN 40). Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch- (0.83-mm-) thick brass tube to wall; and chrome-plated brass or steel wall flange.
5. Continuous Waste:
- a. Size: NPS 1-1/2 (DN 40).
  - b. Material: Chrome-plated, 0.032-inch- (0.83-mm-) thick brass tube.

## 2.12 SINK FAUCETS

- A. NSF Standard: Comply with NSF 372 for faucet-spout materials that will be in contact with potable water.
- B. Sink Faucets: Manual type, single-control mixing valve.
  - 1. Commercial, Solid-Brass Faucets.
  - 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. American Standard.
    - b. Elkay Manufacturing Co.
    - c. Kohler Co.
    - d. Sloan Valve Company.
    - e. Zurn Industries, LLC.
  - 3. Standard: ASME A112.18.1/CSA B125.1.
  - 4. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.
  - 5. Body Type: Widespread or Single hole.
  - 6. Body Material: Commercial, solid brass.
  - 7. Finish: Chrome plated.
  - 8. Maximum Flow Rate: 2.2 gpm (8.3 L/min.).
  - 9. Handle(s): Lever.
  - 10. Mounting Type: Deck, exposed.
  - 11. Vacuum Breaker: Not required.

## 2.13 MOP BASIN

- A. Terrazzo, floor mounted.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. Acorn Engineering Company.
    - b. Fiat Products.
    - c. Florestone Products Co., Inc.
    - d. Stern-Williams Co., Inc.
  - 2. Fixture:
    - a. Standard: IAPMO PS 99.
    - b. Shape: Square.
    - c. Nominal Size: 24 by 24 inches (610 by 610 mm).
    - d. Height: 12 inches (305 mm) with dropped front.
    - e. Tiling Flange: On two sides.

- f. Rim Guard: Stainless steel caps on all top surfaces.
- g. Color: Not applicable.
- h. Drain: Grid with NPS 3 (DN 80) outlet.
- 3. Mounting: On floor and flush to wall.
- 4. Wall Guards.
  - a. Stainless steel, one guard supplied for each wall fixture comes in contact with.
- 5. Mop Hanger Bracket.
  - a. Stainless steel bracket with rubber grip.
- 6. Hose/Bracket Combination.
  - a. Stainless steel bracket with rubber grip, 30" long flexible rubber hose.

#### 2.14 MOP BASIN FAUCET

- A. NSF Standard: Comply with NSF 372 for faucet-spout materials that will be in contact with potable water.
- B. Sink Faucets: Manual type, two-lever-handle mixing valve.
  - 1. Commercial, Solid-Brass Faucets.
  - 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. Acorn Engineering Company.
    - b. Fiat Products.
    - c. Florestone Products Co., Inc.
    - d. Stern-Williams Co., Inc.
  - 3. Standard: ASME A112.18.1/CSA B125.1.
  - 4. General: Include hot- and cold-water indicators.
  - 5. Body Type: 8" Centerset.
  - 6. Body Material: Commercial, solid brass.
  - 7. Finish: Chrome plated.
  - 8. Maximum Flow Rate: 2.2 gpm (8.3 L/min.).
  - 9. Handle(s): Lever or four arm handles.
  - 10. Mounting Type: Wall, exposed with wall bracket support.
  - 11. Spout Type: Rigid, solid brass.
  - 12. Vacuum Breaker: Required for hose outlet.
  - 13. Spout Outlet: Threaded.

### 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 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. Water-Closet Installation:
  - 1. Install level and plumb according to roughing-in drawings.
  - 2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.
  - 3. Install accessible, wall-mounted water closets at mounting height for handicapped/elderly, according to ICC/ANSI A117.1.
  - 4. Install toilet seats on water closets.
- B. 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.
- C. Flushometer-Valve Installation:
1. Install flushometer-valve, water-supply fitting on each supply to each water closet and urinal.
  2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
  3. Install lever-handle flushometer valves for accessible water closets and urinals with handle mounted on open side of water closet.
  4. Install actuators in locations that are easy for people with disabilities to reach.
  5. Install fresh batteries in battery-powered, electronic-sensor mechanisms.
- D. Lavatory Installation:
1. Install lavatories level and plumb according to roughing-in drawings.
  2. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, according to ICC/ANSI A117.1.
  3. 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 escutcheon requirements specified in Section 22 05 18 "Escutcheons for Plumbing Piping."
  4. Install fresh batteries in battery-powered, electronic-sensor mechanisms.
- E. Sink Installation:
1. Install sinks level and plumb according to roughing-in drawings.
  2. Install supports, affixed to building substrate, for wall-hung sinks.
  3. Set floor-mounted sinks in leveling bed of cement grout.
  4. Install water-supply piping with stop on each supply to each sink faucet.
    - a. Exception: Use ball or gate 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" and Section 22 05 23.15 "Gate Valves for Plumbing Piping."
    - b. Install stops in locations where they can be easily reached for operation.
  5. 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 escutcheon requirements specified in Section 22 05 18 "Escutcheons for Plumbing Piping."
  6. 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."
- F. Support Installation:
1. Use carrier supports with waste-fitting assembly and seal.
  2. Install wall-mounted, water-closet and urinal supports with waste-fitting assembly and waste-fitting seals; and affix to building substrate.
  3. Install supports, affixed to building substrate, for wall-mounted lavatories.
- G. Wall Flange and Escutcheon Installation:
1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
  2. Install deep-pattern escutcheons if required to conceal protruding fittings.
  3. Comply with escutcheon requirements specified in Section 22 05 18 "Escutcheons for Plumbing Piping."
- H. Joint Sealing:
1. Seal joints between plumbing fixtures and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
  2. Match sealant color to plumbing fixture color.
  3. Comply with sealant requirements specified in Section 07 92 00 "Joint Sealants."

### 3.3 CONNECTIONS

- A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.
- B. Connect urinals with water supplies and soil, waste, and vent piping. Use size fittings required to match urinals.

- C. Connect lavatories and sinks with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- D. Comply with water piping requirements specified in Section 22 11 16 "Domestic Water Piping."
- E. Comply with soil and waste piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."
- F. Where installing piping adjacent to water closets and urinals, allow space for service and maintenance.

#### 3.4 ADJUSTING

- A. Operate and adjust water closet and urinal controls. Replace damaged and malfunctioning water closets, urinals, fittings, and controls.
- B. Operate and adjust lavatory & sink controls. Replace damaged and malfunctioning lavatories, fittings, and controls.
- C. Adjust lever and wrist blade faucet handles to be parallel with back wall.
- D. Adjust water pressure at flushometer valves and faucets to produce proper flow.

#### 3.5 CLEANING AND PROTECTION

- A. Clean plumbing fixtures and fittings with manufacturers' recommended cleaning methods and materials.
- B. After completing installation of plumbing fixtures, inspect and repair damaged finishes. Replace fixtures that cannot be repaired.
- C. Install protective covering for installed plumbing fixtures and fittings.
- D. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

**END OF SECTION 22 42 13**

**SECTION 22 47 13 - DRINKING FOUNTAINS****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 drinking fountains and related components.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of drinking fountain.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
  - 2. Include operating characteristics, and furnished specialties and accessories.

**1.4 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For drinking fountains 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. Filter Cartridges: Equal to 10 percent of quantity installed for each type and size indicated, but no fewer than 2 of each.

**PART 2 - PRODUCTS****2.1 REFRIGERATED DRINKING FOUNTAIN**

- A. Pressure Water Coolers: Wall mounted, exposed receptor and cooler, wheelchair accessible, bottle filler, vandal resistant.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. Elkay Manufacturing Co.
    - b. Halsey Taylor.
    - c. Haws Corporation.
    - d. Oasis International.
    - e. Stern-Williams Co., Inc.
  - 2. Standards:
    - a. Comply with NSF 61 and NSF 372.
    - b. Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants," for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant unless otherwise indicated.
    - c. Comply with ICC A117.1.
  - 3. Cabinet: Bi-level with two attached cabinets and with a bi-level skirt kit, vinyl-covered steel with stainless-steel top.
  - 4. Bubbler: One, with adjustable stream regulator, located on each cabinet deck.
  - 5. Control: Push bar.
  - 6. Bottle Filler: Sensor activation automatic shutoff.
  - 7. Drain: Grid with NPS 1-1/4 (DN 32) tailpiece.

8. Supply: NPS 3/8 (DN 10) with shutoff valve.
9. Waste Fitting: ASME A112.18.2/CSA B125.2, NPS 1-1/4 (DN 32) brass P-trap.
10. 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.
11. Cooling System: Electric, with hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.
  - 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.
12. Capacities and Characteristics:
  - a. Cooled Water: 5 gph (0.0053 L/s).
  - b. Electrical Characteristics:
    - 1) Volts: 120-V ac.
    - 2) Phase: Single.
    - 3) Hertz: 60.
13. Water Cooler Mounting Height: Standard & Handicapped/elderly according to ICC A117.1.

## 2.2 SUPPORTS

- A. Water Cooler Carrier:
  1. Basis-of-Design Product: Subject to compliance with requirements, provide Jay R. Smith Mfg. Co.; or a comparable product by one of the following:
    - a. Josam Company.
    - b. Wade Drains.
    - c. WATTS.
    - d. Zurn Industries, LLC.
  2. Standard: ASME A112.6.1M.

## 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. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.
- C. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball and install valves in locations where they can be easily reached for operation. Valves are specified in Section 22 05 23 "General Duty Valves for Plumbing Piping".
- D. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- E. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 22 05 18 "Escutcheons for Plumbing Piping."
- F. Seal joints between fixtures 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. Install ball shutoff valve on water supply to each fixture, upstream of filter where installed. Comply with valve requirements specified in Section 22 05 23 "General Duty 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 fixtures, 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 22 47 13**



**SECTION 22 71 13 - FACILITY NATURAL-GAS 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. Pipes, tubes, and fittings.
  - 2. Piping specialties.
  - 3. Piping and tubing joining materials.
  - 4. Manual gas shutoff valves.
  - 5. Dielectric fittings.

**1.3 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.

**1.4 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. Shop Drawings: For facility natural-gas piping layout. Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.
  - 1. Shop Drawing Scale: 1/4 inch per foot (1:50).
  - 2. Detail mounting, supports, and valve arrangements for pressure regulator assembly.
- C. 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. Coordination Drawings: Plans and details, drawn to scale, on which natural-gas piping is shown and coordinated with other installations, using input from installers of the items involved.
- B. Site Survey: Plans, drawn to scale, on which natural-gas piping is shown and coordinated with other services and utilities.
- C. Qualification Data: For qualified professional engineer.

- D. Welding certificates.
- E. Field quality-control reports.

#### 1.6 QUALITY ASSURANCE

- A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- 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.

#### 1.7 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.

#### 1.8 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.

#### 1.9 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces. Comply with requirements in Section 08 31 13 "Access Doors and Frames."

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Minimum Operating-Pressure Ratings:
  - 1. Piping and Valves: 100 psig (690 kPa) minimum unless otherwise indicated.
  - 2. Pressure Regulators: 65 psig (450 kPa) minimum unless otherwise indicated.
  - 3. Minimum Operating Pressure of Sub-Meter: 2 psig (13.8 kPa).
- B. Natural-Gas System Pressure within Buildings: 0.5 psig (3.45 kPa) or less.
- C. Delegated Design: Design restraints and anchors for natural-gas piping and equipment, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

#### 2.2 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.
  5. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.
    - a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.
  6. Mechanical Couplings:
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) GE Oil & Gas.
      - 2) Smith-Blair, Inc.
    - b. Stainless-steel flanges and tube with epoxy finish.
    - c. Buna-nitrile seals.
    - d. Stainless-steel bolts, washers, and nuts.
    - e. Coupling shall be capable of joining PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
    - f. Steel body couplings installed underground on plastic pipe shall be factory equipped with anode.
  7. Mechanical Joints:
    - a. Manufacturers: Subject to compliance with requirements, provide products by the following:
      - 1) Viega LLC.
    - b. Sealing Element: HNBR elastomeric sealing element rated to 125 psi (max) with a temperature range of -40 to 180 degrees (F). Sealing element shall be uniform in size/thickness and shall be free from manufactured deformities or indentations.
    - c. 420 stainless steel grip ring.
    - d. 304 stainless steel separator ring for 1/2" to 2", graphite separator ring for 2-1/2" to 4".
    - e. Approved for use with ASTM A53 Schedule 10 to 40 carbon steel pipe.
    - f. Shall be listed to CSA 6.32 / ANSI LC-4.
- B. Polyethylene (PE) Pipe: ASTM D 2513, SDR 11.
1. PE Fittings: ASTM D 2683, socket-fusion type or ASTM D 3261, butt-fusion type with dimensions matching PE pipe.
  2. PE Transition Fittings: Factory-fabricated fittings with PE pipe complying with ASTM D 2513, SDR 11; and steel pipe complying with ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
  3. Anodeless Service-Line Risers: Factory fabricated and leak tested.
    - a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet.
    - b. Casing: Steel pipe complying with ASTM A 53/A 53M, Schedule 40, black steel, Type E or S, Grade B, with corrosion-protective coating covering. Vent casing aboveground.
    - c. Aboveground Portion: PE transition fitting.
    - d. Outlet shall be threaded or flanged or suitable for welded connection.
    - e. Tracer wire connection.
    - f. Ultraviolet shield.
    - g. Stake supports with factory finish to match steel pipe casing or carrier pipe.
  4. Transition Service-Line Risers: Factory fabricated and leak tested.
    - a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet connected to steel pipe complying with ASTM A 53/A 53M, Schedule 40, Type E or S, Grade B, with corrosion-protective coating for aboveground outlet.
    - b. Outlet shall be threaded or flanged or suitable for welded connection.
    - c. Bridging sleeve over mechanical coupling.
    - d. Factory-connected anode.
    - e. Tracer wire connection.
    - f. Ultraviolet shield.

- g. Stake supports with factory finish to match steel pipe casing or carrier pipe.
5. Plastic Mechanical Couplings, NPS 1-1/2 (DN 40) and Smaller: Capable of joining PE pipe to PE pipe.
- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 1) Lyall, R. W. & Company, Inc.
  - 2) Mueller Co.
  - 3) Perfection Corporation.
- b. PE body with molded-in, stainless-steel support ring.
- c. Buna-nitrile seals.
- d. Acetal collets.
- e. Electro-zinc-plated steel stiffener.
6. Plastic Mechanical Couplings, NPS 2 (DN 50) and Larger: Capable of joining PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 1) Lyall, R. W. & Company, Inc.
  - 2) Mueller Co.
  - 3) Perfection Corporation.
- b. Fiber-reinforced plastic body.
- c. PE body tube.
- d. Buna-nitrile seals.
- e. Acetal collets.
- f. Stainless-steel bolts, nuts, and washers.
7. Steel Mechanical Couplings: Capable of joining plain-end PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 1) GE Oil & Gas.
  - 2) Smith-Blair, Inc.
- b. Stainless-steel flanges and tube with epoxy finish.
- c. Buna-nitrile seals.
- d. Stainless-steel bolts, washers, and nuts.
- e. Factory-installed anode for steel-body couplings installed underground.

### 2.3 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. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
  4. Corrugated stainless-steel tubing with polymer coating.
  5. Operating-Pressure Rating: 0.5 psig (3.45 kPa).
  6. End Fittings: Zinc-coated steel.
  7. Threaded Ends: Comply with ASME B1.20.1.
  8. Maximum Length: 72 inches (1830 mm.)
- 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 (DN 50) and smaller; flanged ends for NPS 2-1/2 (DN 65) and larger.

3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig (862 kPa).
- D. Basket Strainers:
  1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
  2. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged ends for NPS 2-1/2 (DN 65) and larger.
  3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
  4. CWP Rating: 125 psig (862 kPa).
- E. 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 (5170 kPa).
- F. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

#### 2.4 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 (540 deg C) complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

#### 2.5 MANUAL GAS SHUTOFF VALVES

- A. See "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.
- B. General Requirements for Metallic Valves, NPS 2 (DN 50) and Smaller: Comply with ASME B16.33.
  1. CWP Rating: 125 psig (862 kPa).
  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 (25 mm) and smaller.
  6. Service Mark: Valves 1-1/4 inches (32 mm) to NPS 2 (DN 50) shall have initials "WOG" permanently marked on valve body.
- C. General Requirements for Metallic Valves, NPS 2-1/2 (DN 65) and Larger: Comply with ASME B16.38.
  1. CWP Rating: 125 psig (862 kPa).
  2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
  3. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
  4. Service Mark: Initials "WOG" shall be permanently marked on valve body.
- D. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. A.Y. McDonald Mfg. Co.
    - b. Apollo Flow Controls; Conbraco Industries, Inc.
    - c. BrassCraft Manufacturing Co.; a Masco company.
  2. Body: Bronze, complying with ASTM B 584.

3. Ball: Chrome-plated bronze.
  4. Stem: Bronze; blowout proof.
  5. Seats: Reinforced TFE; blowout proof.
  6. Packing: Threaded-body packnut design with adjustable-stem packing.
  7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
  8. CWP Rating: 600 psig (4140 kPa).
  9. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
  10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- E. Bronze Plug Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. A.Y. McDonald Mfg. Co.
    - b. Lee Brass Company.
  2. Body: Bronze, complying with ASTM B 584.
  3. Plug: Bronze.
  4. Ends: Threaded, socket, or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
  5. Operator: Square head or lug type with tamperproof feature where indicated.
  6. Pressure Class: 125 psig (862 kPa).
  7. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
  8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- F. PE Ball Valves: Comply with ASME B16.40.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Kerotest Manufacturing Corp.
    - b. Lyall, R. W. & Company, Inc.
    - c. Perfection Corporation.
  2. Body: PE.
  3. Ball: PE.
  4. Stem: Acetal.
  5. Seats and Seals: Nitrile.
  6. Ends: Plain or fusible to match piping.
  7. CWP Rating: 80 psig (552 kPa).
  8. Operating Temperature: Minus 20 to plus 140 deg F (Minus 29 to plus 60 deg C).
  9. Operator: Nut or flat head for key operation.
  10. Include plastic valve extension.
  11. Include tamperproof locking feature for valves where indicated on Drawings.

## 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 Unions:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. A.Y. McDonald Mfg. Co.
    - b. HART Industrial Unions, LLC.
    - c. WATTS.
    - d. Wilkins.
    - e. Zurn Industries, LLC.
  2. Description:
    - a. Standard: ASSE 1079.
    - b. Pressure Rating: 125 psig (860 kPa) minimum at 180 deg F (82 deg C).

- c. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Capitol Manufacturing Company.
    - b. WATTS.
    - c. Wilkins.
  - 2. Description:
    - a. Standard: ASSE 1079.
    - b. Factory-fabricated, bolted, companion-flange assembly.
    - c. Pressure Rating: 125 psig (860 kPa) minimum at 180 deg F (82 deg C).
    - d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Insulating Kits:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Advance Products & Systems, Inc.
    - b. Central Plastics Company.
    - c. Pipeline Seal and Insulator, Inc.
  - 2. Description:
    - a. Nonconducting materials for field assembly of companion flanges.
    - b. Pressure Rating: 150 psig (1035 kPa).
    - c. Gasket: Neoprene or phenolic.
    - d. Bolt Sleeves: Phenolic or polyethylene.
    - e. Washers: Phenolic with steel backing washers.

## 2.7 LABELING AND IDENTIFYING

- A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored yellow.

## 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 and the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.
- C. Comply with NFPA 54 and the International Fuel Gas Code requirements for prevention of accidental ignition.

### 3.3 OUTDOOR PIPING INSTALLATION

- A. Comply with NFPA 54 and the International Fuel Gas Code for installation and purging of natural-gas piping.

- B. Install underground, natural-gas piping buried at least 36 inches (900 mm) below finished grade. Comply with requirements in Section 31 20 00 "Earth Moving" for excavating, trenching, and backfilling.
  - 1. If natural-gas piping is installed less than 36 inches (900 mm) below finished grade, install it in containment conduit.
- C. Install underground, PE, natural-gas piping according to ASTM D 2774.
- D. Steel Piping with Protective Coating:
  - 1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
  - 2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
  - 3. Replace pipe having damaged PE coating with new pipe.
- E. Install fittings for changes in direction and branch connections.
- F. Install pressure gage upstream and downstream from each line regulator. Pressure gages are specified in Section 22 05 19 – "Meters and Gages for Plumbing Piping."

### 3.4 INDOOR PIPING INSTALLATION

- A. Comply with NFPA 54 and the International 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 natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Verify final equipment locations for roughing-in.
- L. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
- M. 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 (75 mm) long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
- N. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
- O. 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.
- P. 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 Floors: Install natural-gas piping with welded or brazed joints and protective coating in cast-in-place concrete floors. Cover piping to be cast in concrete slabs with minimum of 1-1/2 inches (38 mm) of concrete. Piping may not be in physical contact with other metallic structures such as



reinforcing rods or electrically neutral conductors. Do not embed piping in concrete slabs containing quick-set additives or cinder aggregate.

3. In Floor Channels: Install natural-gas piping in floor channels. Channels must have cover and be open to space above cover for ventilation.
4. 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.
5. 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.
- Q. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- R. Connect branch piping from top or side of horizontal piping.
- S. Install unions in pipes NPS 2 (DN 50) and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.
- T. Do not use natural-gas piping as grounding electrode.
- U. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.
- V. Install pressure gage downstream from each line regulator. Pressure gages are specified in Section 22 05 19 – “Meters and Gages for Plumbing Piping.”
- 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 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."
- Y. 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 underground valves with valve boxes.
- C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.
- D. Install anode for metallic valves in underground PE piping.

### 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. Welded Joints:
  1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
  2. Bevel plain ends of steel pipe.
  3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.
- E. Brazed Joints: Construct joints according to AWS's "Braze Handbook," "Pipe and Tube" Chapter.
- F. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.

- G. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not overtighten.
- H. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
  - 1. Plain-End Pipe and Fittings: Use butt fusion.
  - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.

### 3.7 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hangers and supports specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Install hangers for steel piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- C. Support horizontal piping within 12 inches (300 mm) of each fitting.
- D. Support vertical runs of steel piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

### 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 (1800 mm) 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 (300 mm) below finished grade, except 6 inches (150 mm) 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, service meters and meter bars, earthquake valves, 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 (semigloss).
    - d. Color: Gray.
- C. Paint exposed, interior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.
  - 1. Latex Over Alkyd Primer System: MPI INT 5.1Q.
    - a. Prime Coat: Alkyd anticorrosive metal primer.
    - b. Intermediate Coat: Interior latex matching topcoat.
    - c. Topcoat: Interior latex (semigloss).
    - d. Color: Gray.

2. Alkyd System: MPI INT 5.1E.
  - a. Prime Coat: metal primer.
  - b. Intermediate Coat: Interior alkyd matching topcoat.
  - c. Topcoat: Interior alkyd (semigloss).
  - d. Color: Gray.
- D. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

### 3.11 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base.
  1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.
  2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.
  3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
  4. Place and secure anchorage devices. Use supported equipment manufacturer's 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.
  6. Use 3000-psig (20.7-MPa), 28-day, compressive-strength concrete and reinforcement as specified in Section 03 30 00 "Cast-in-Place Concrete." Section 03 30 53 "Miscellaneous Cast-in-Place Concrete."

### 3.12 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  1. Test, inspect, and purge natural gas according to NFPA 54 and the International 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.

### 3.13 OUTDOOR PIPING SCHEDULE

- A. Underground natural-gas piping shall be one of the following:
  1. PE pipe and fittings joined by heat fusion, or mechanical couplings; service-line risers with tracer wire terminated in an accessible location.
- B. Aboveground natural-gas piping shall be one of the following:
  1. Steel pipe with malleable-iron fittings and threaded joints.
  2. Steel pipe with wrought-steel fittings and welded joints.
- C. Branch Piping in Cast-in-Place Concrete to Single Appliance: Annealed-temper copper tube with wrought-copper fittings and brazed joints. Install piping embedded in concrete with no joints in concrete.
- D. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

### 3.14 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES 0.5 PSIG (3.45 kPa) AND LESS

- A. Aboveground, branch piping NPS 1 (DN 25) and smaller shall be the following:
  1. Steel pipe with malleable-iron fittings and threaded joints.
- B. Aboveground, distribution piping NPS 1 1/4 (DN 32) to NPS 3 (DN 80) shall be the following:
  1. Steel pipe with malleable-iron fittings and threaded joints.
  2. Steel pipe with wrought-steel fittings and welded joints.
- C. Aboveground, distribution piping NPS 4 (DN 100) and larger shall be the following:
  1. Steel pipe with wrought-steel fittings and welded joints.

- D. Underground, below building, piping shall be the following:
  - 1. Steel pipe with malleable-iron fittings and threaded joints.
  - 2. Steel pipe with wrought-steel fittings and welded joints.
- E. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.
- F. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.

### 3.15 UNDERGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

- A. Connections to Existing Gas Piping: Use valve and fitting assemblies made for tapping utility's gas mains and listed by an NRTL.
- B. Underground:
  - 1. PE valves.
  - 2. NPS 2 (DN 50) and Smaller: Bronze plug valves.
  - 3. NPS 2-1/2 (DN 65) and Larger: Cast-iron, nonlubricated plug valves.

### 3.16 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

- A. Valves for pipe sizes NPS 2 (DN 50) and smaller at service meter shall be one of the following:
  - 1. Two-piece, full-port, bronze ball valves with bronze trim.
  - 2. Bronze plug valve.
- B. Distribution piping valves for pipe sizes NPS 2 (DN 50) and smaller shall be one of the following:
  - 1. Two-piece, full-port, bronze ball valves with bronze trim.
  - 2. Bronze plug valve.
- C. Valves in branch piping for single appliance shall be one of the following:
  - 1. Two-piece, full-port, bronze ball valves with bronze trim.
  - 2. Bronze plug valve.

**END OF SECTION 22 71 13**

**SECTION 23 05 13 - COMMON MOTOR REQUIREMENTS FOR HVAC 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 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.

**1.3 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.
- C. Variable Frequency Drives (VFDs) shall be required on all motors 5 HP and larger.
- D. For 3-phase motors between 1 HP and 5 HP, a motor starter shall be provided.
- E. Refer to drawings for exceptions on VFD requirements for motors listed above.

**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 POLYPHASE MOTORS**

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Energy efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Rotor: Random-wound, squirrel cage.
- E. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- F. Temperature Rise: Match insulation rating.
- G. Insulation: Class F.
- H. 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.
- I. 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 Variable Frequency Drives: 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.

## 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.
  5. Electronically Commutated (ECM).
- B. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- C. Motors 1/20 HP and Smaller: Shaded-pole type.
- D. 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.
- E. Electronically Commutated Motors (ECM): Shall be designed for use with a single-phase electrical input and shall be provided with a single-phase integrated speed controller/inverter. Speed shall be adjustable manually, or via an external 0-10v signal. Controller shall have built in soft start/speed ramps with permanently lubricated ball bearings.

PART 3 - EXECUTION (Not Applicable)

**END OF SECTION 23 05 13**

**SECTION 23 05 17 - SLEEVES AND SLEEVE SEALS 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. Sleeves.
  - 2. Grout.

**1.3 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.
- B. Galvanized-Steel-Sheet Sleeves: 0.0239 inch (0.60706 mm) minimum thickness; round tube closed with welded longitudinal joint.

**2.2 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 (25.4 mm) 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 (50.8 mm) above finished floor level.
  - 3. 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 ¼ inch (6.35 mm) 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-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

### 3.2 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
  1. Concrete Slabs above Grade:
    - a. Galvanized-steel-pipe sleeves.
  2. Interior Partitions:
    - a. Galvanized-steel-sheet sleeves.

**END OF SECTION 23 05 17**



**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. Thermal-hanger shield inserts.
  - 3. Fastener systems.
  - 4. Pipe stands.
  - 5. Equipment supports.
- B. Related Requirements:
  - 1. Section 23 05 48 "Vibration and Seismic Controls for HVAC" for vibration isolation devices.
  - 2. Section 23 31 13 "Metal Ducts" for duct hangers and supports.

**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: including Product Data for components:
  - 1. Pipe stands.
  - 2. Equipment supports.

**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, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code, Section IX.

**PART 2 - PRODUCTS****2.1 PERFORMANCE REQUIREMENTS**

- A. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity, wind 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.

**2.2 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, hot-dip galvanized, or electro-galvanized.
  3. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
- B. Copper Pipe and Tube Hangers:
1. Description: MSS SP-58, Types 1 through 58, copper-plated steel, factory-fabricated components.
  2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-plated steel or stainless steel.

### 2.3 THERMAL-HANGER SHIELD INSERTS

- A. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100 psi (689.476 kPa) minimum compressive strength and vapor barrier.
- 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 (50.8 mm) 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 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.

### 2.5 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand:
  1. Description: Single base unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
  2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
  3. Hardware: Galvanized steel or polycarbonate.
  4. Accessories: Protection pads.

### 2.6 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

### 2.7 MATERIALS

- A. Aluminum: ASTM B 221 (ASTM B 221M).
- B. Carbon Steel: ASTM A 1011/A 1011M.
- C. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; galvanized.
- D. Stainless Steel: ASTM A 240/A 240M.
- E. Threaded Rods: Continuously threaded. Zinc-plated or galvanized steel for indoor applications and stainless steel for outdoor applications. Mating nuts and washers of similar materials as rods.
- F. 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 (34.473 MPa), 28-day compressive strength.

## PART 3 - EXECUTION

## 3.1 APPLICATION

- A. 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 lbs. (90.718 kg).

## 3.2 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. 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-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. 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 (101.6 mm) 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. Pipe Stand Installation:
1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
- 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 ½ (DN 65) 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 below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    - b. 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 (DN 100) 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 (DN 100) and larger if pipe is installed on rollers.
4. Shield Dimensions for Pipe: Not less than the following:
  - a. NPS ¼ to NPS 3 ½ (DN 8 to DN 90): 12 inches (304.8 mm) long and 0.048 inch (1.219 mm) thick.
5. Thermal-Hanger Shields: Install with insulation 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 [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.

### 3.5 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 ½ inches (38.1 mm).

### 3.6 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 (0.0508 mm).
- B. 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 MSS SP-58 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 attachments for general service applications.
- F. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.
- G. Use thermal-hanger shield inserts for insulated piping and tubing.

- H. 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 ½ to NPS 30 (DN 15 to DN 750).
  2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS ¾ to NPS 36 (DN 20 to DN 900), requiring clamp flexibility and up to 4 inches (101.6 mm) of insulation.
  3. Pipe Hangers (MSS Type 5): For suspension of pipes NPS ½ to NPS 4 (DN 15 to DN 100), to allow off-center closure for hanger installation before pipe erection.
  4. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2 ½ to NPS 36 (DN 65 to DN 900) if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
  5. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30 (DN 25 to DN 750), from two rods if longitudinal movement caused by expansion and contraction might occur.
- I. 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 ¾ to NPS 24 (DN 24 to DN 600).
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS ¾ to NPS 24 (DN 20 to DN 600) if longer ends are required for riser clamps.
- J. 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 (152.4 mm) for heavy loads.
  2. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
  3. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
- K. 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. (340.194 kg).
    - b. Medium (MSS Type 32): 1500 lb. (680.388 kg).
    - c. Heavy (MSS Type 33): 3000 lb. (1360.777 kg).
  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.

- L. 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.
- M. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- N. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

**END OF SECTION 23 05 29**

**SECTION 23 05 48 – VIBRATION ISOLATION AND SEISMIC RESTRAINTS FOR MECHANICAL COMPONENTS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The work under this section is subject to the requirements of the Contract Documents, including General and Supplementary Conditions and Division 01 General Requirements.
- B. Specifications throughout all Divisions are directly applicable to this Section, and this Section is directly applicable to them. In the event that this section conflicts with the requirements of other Sections, the more stringent criteria shall apply.

**1.2 DESCRIPTION**

- A. This section includes requirements for vibration isolation and seismic restraint of nonstructural components in Risk Category I, II and III structures, including, but not limited to:
  - 1. Mechanical Components: heating, ventilating, and air-conditioning systems; hot/chilled water systems; boiler equipment and components; tanks and vessels, etc.
- B. Work in this section includes the restraint design and/or equipment/product certifications to be submitted for review by the registered design professional.

**1.3 DEFINITIONS**

- A. Active Equipment: Equipment with dynamic moving or rotating parts or parts that are energized.
- B. Attachments / Anchorage: Means by which nonstructural components or supports for nonstructural components are secured or connected to the seismic-force resisting system of the structure. Such attachments may include anchor bolts, welded connections, mechanical fasteners or other approved attachment devices. Friction attachments do not constitute positive attachments.
- C. Bracing: Struts, braces, cables, anchors or other structural elements providing restraint for nonstructural components to prevent excessive movement.
- D. Certificate of Compliance: A certificate, supplied by the component manufacturer, stating that materials and products meet specified standards and project specific requirements.
- E. Component Importance Factor ( $I_p$ ): Factor applied to a component that defines the criticality of that component. This factor can be 1.0 or 1.5 in accordance with ASCE 7, Section 13.1.3.
- F. Structure: The load-bearing building elements designed by the Structural Engineer of Record. Non-load bearing partition walls, unreinforced slabs or other building elements that do not provide direct load transfer to the load-bearing building elements shall not be defined as part of the Structure and cannot be used for attachment of seismic restraints.
- G. Supports: Those members, assemblies of members, or manufactured elements, including braces, frames, legs, snubbers, curbs, rails, hangers, saddles or struts, and associated fasteners that transmit loads between non-structural components and their attachments to the structure.

**1.4 REGULATORY REQUIREMENTS**

- A. Comply with the 2012 International Building Code (IBC) and applicable local adopted amendments, and the 2010 Edition on ASCE 7 (ASCE 7-10).

**1.5 SUBMITTALS**

- A. Submit under the provisions of Division 1. Submittals shall include Product Data, Shop Drawings and the required Certificates of Compliance as described below.
- B. Shop drawings shall be prepared and sealed by a professional engineer licensed in the state of the project, with a minimum of 5 years of experience in the design of vibration isolation.

- C. Vibration Isolation: submit the following, at a minimum, as applicable.
1. Detailed schedules of equipment requiring isolation, including clearly identified equipment identification or tag and equipment weight, and corresponding isolator type, manufacturer and model number.
  2. Detailed drawings showing equipment, isolator bases and isolator spacing.
  3. Descriptive data or cut sheets for each type of isolation mounting, including:
    - a. Dimensional Data
    - b. Materials and Finish
    - c. Rated Loads
    - d. Rated Deflection
    - e. Isolator Free and Operating Heights
    - f. Detailed installation instructions

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. All materials and devices shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.
- B. Refer to the "Selection Guide" table in Section 4 to correlate the specification references listed below with the appropriate components.

### 2.2 MANUFACTURERS

- A. Isolators shall be from the following manufacturers, or approved equals. Unless otherwise noted, the isolators listed in the following sections are as manufactured by The VMC Group.
  1. The VMC Group
  2. Mason Industries
  3. Kinetics Noise Control
  4. Cooper B-Line
  5. Hilti
  6. Imperial Metals

### 2.3 VIBRATION ISOLATION

- A. Specification V-4 (Elastomer Hanger Isolator): A hanger consisting of a rectangular steel box capable of 200% minimum overload without visible deformation and an elastomeric isolation element designed for approximately 1/2" deflection. Hangers shall be VMC Group Type HR.
- B. Specification V-6 (Combination Spring/Elastomer Hanger Isolator): A hanger consisting of a rectangular steel box capable of 200% minimum overload without visible deformation, 30 degree rod misalignment, and a combination of elastomeric and spring isolation elements designed for approximately 1" deflection. Hangers shall be VMC Group Type HRSA.

### 2.4 VIBRATION ISOLATION WITH RESTRAINT

- A. Specification SV-1 (Restrained Spring Isolator): A unitized adjustable, stable open spring isolator with a restraint housing which serves as a blocking device during equipment installation. The spring package shall include an elastomeric pad for high frequency absorption at the base of the spring. The springs shall be designed for a minimum  $k_x/k_y$  (horizontal-to-vertical spring rate) of 1.0. Nuts, adjusting bolts and washers shall be zinc-electroplated to prevent corrosion. The spring assembly shall be removable with equipment in place and shall fit within a welded steel enclosure consisting of a top plate and rigid lower housing. Isolated restraint bolts shall connect top plate to lower housing to resist wind forces in all directions and limit motion to a maximum of 1/4 inch movement before engaging. Surfaces that engage under motion shall be cushioned with a resilient elastomeric pad or grommet to protect equipment. Top plate shall have adequate means for fastening to the equipment, and baseplate shall have adequate means



for bolting to structure. Entire assembly shall be rated to exceed the applied seismic loads. Isolator shall be VMC Group Type MS.

## 2.5 FLEXIBLE PIPE CONNECTIONS

### A. Specification F-1 (Water Service Flexible Connection):

1. For Flanged Connections – A double sphere arch rubber expansion joint constructed of molded reinforced neoprene with integral steel floating flanges, and designed to be suitable for pressures up to 225 PSI (4 to 1 safety factor) and temperatures up to 225°F (107.22°C). Connectors shall have minimum movement capabilities of 1.77 inch compression, 1.18 inch lateral and 1.18 inch extension. Connectors shall provide a minimum 35-degree angular movement up to 6 inches, minimum 30 degrees up to 12 inches and minimum 20 degrees up to 24 inches. Spring loaded control units shall be furnished to limit movement to within allowable. Flex connector shall be VMC Group Type 2600.
2. For Threaded Type – A double spherical rubber hose connector, minimum 8 inch long, constructed of molded neoprene, nylon cord reinforced, with female pipe unions each end. Connectors shall have a minimum movement capability of 7/8 inch compression, 7/8 inch lateral, ¼ inch extension and 20 degrees angular through 1 ¼ inches, 13 degrees through 2 inches, and 9 degrees through 3 inches. Connectors shall be suitable for a maximum working pressure (4 to 1 safety factor) of 150 psi and 225°F. Connectors shall have cable control units to limit extension to ¼ inch. Flex connector shall be VMC Group Type 2655.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. All areas that will receive components requiring vibration isolation shall be thoroughly examined for deficiencies that will affect the installation or performance of the installed devices. Such deficiencies shall be corrected prior to the installation.

### 3.2 INSTALLATION, GENERAL

- A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
- B. All installation shall be in accordance with the requirements set forth in the project drawings and specifications, as well as the manufacturer's published instructions and all approved submittal data.
- C. Do not anchor components to gypsum wallboard, plaster or other wall or ceiling finish that has not been engineered to resist imposed loads.

### 3.3 POST-INSTALLED ANCHORS

- A. Install all anchors in accordance with the manufacturer's written instructions for seismic applications.
- B. Post-installed anchors in concrete shall be seismically prequalified for use in cracked concrete based on seismic testing in accordance with ACI 355.2 for mechanical anchors or ACI 355.4 for adhesive anchors.

### 3.4 HOUSEKEEPING PADS

- A. Housekeeping pads shall be designed by the vibration isolation vendor with adequate reinforcing and doweling to the building structure, so as to withstand calculated wind forces. Frictional resistance due to the effects of gravity shall be neglected.
- B. The size & thickness of the housekeeping pad shall be determined to ensure adequate edge distances & embedment depths in order to obtain the desired equipment anchor capacities.
1. If cast-in-place anchors are used, the housekeeping pads shall be sized to accommodate the ACI requirements for bolt coverage and embedment.

2. If post-installed anchors are used, the minimum edge distances, embedment depths and concrete/masonry member thicknesses specified by the anchor manufacturer shall be maintained.

### 3.5 MECHANICAL COMPONENTS

- A. Floor and base-mounted components, vibration isolated equipment and associated system vibration and seismic controls for connections.
  1. Design equipment anchorage to resist seismic design force in any direction.
  2. Design vibration for equipment to include base and isolator requirements.
  3. Provide flexible connections between equipment and interconnected piping to account for relative displacements.
  4. Where equipment is mounted on vibration isolators, use isolators designed for amplified code forces per ASCE 7 and with demonstrated ability to resist required forces including gravity and operational forces.
  5. Provide supplemental steel or concrete base as required for mounting equipment on isolators. Where equipment is not designed to be point loaded, provide base capable of transferring gravity demands from equipment to isolator base plate anchorage.
  6. Where concrete floor thickness is less than required for expansion anchor installation per ICC-ESR, install through bolt in lieu of expansion anchor. Where timber/wood floor or other substrate is inadequate for installation of lag bolts, screws or other mechanical fasteners, furnish and install supplemental framing or blocking to transfer loads to structural elements.
  7. Housekeeping pads shall be coordinated with the seismic restraint vendor based on the equipment anchorage specified in the seismic design.
- B. Suspended Mechanical Equipment
  1. Design support and bracing to resist design force in any direction.
  2. Provide flexible connections between equipment and interconnected piping.
- C. Wall-Mounted Mechanical Equipment
  1. Design attachments to resist seismic design force in any direction.
  2. Install backing plates or blocking as required to deliver load to primary wall framing members. Do not anchor to gypsum wallboard, plaster or other wall finish that has not been engineered to resist imposed loads.
- D. Piping
  1. Provide supports, braces and anchors to resist gravity forces.
  2. Brace every run (5 feet or more in length) with two transverse and one longitudinal bracing locations. For pipes and connections constructed of ductile materials (copper, ductile iron, steel or aluminum and brazed, welded or screwed connections) provide transverse bracing at not more than 40 feet on center and longitudinal bracing at spacing not more than 80 feet on center. For pipes and their connections constructed of nonductile materials (cast iron, no-hub pipe and plastic or non-UL listed grooved coupling pipe), provide transverse bracing at not more than 20 feet on center and longitudinal bracing at spacing not more than 40 feet on center.
- E. Ductwork
  1. Provide supports, braces and anchors to resist gravity forces.
  2. Provide independent support and bracing for all in-line devices weighing more than 75 pounds.

### 3.6 QUALITY CONTROL

- A. Do not install vibration isolators until submittals have been reviewed and approved by the registered design professional in responsible charge.
- B. Verify that multiple systems installed in the same vicinity can be installed without conflict.
- C. Coordinate with the Structural Engineer of Record for confirming that the structure is capable of supporting the loads imposed by nonstructural components.
- D. No work shall be concealed by the Contractor prior to the required inspections being performed and all discrepancies resolved. The Contractor shall be responsible for all repairs required to uncover uninspected or unapproved work.

- E. Where Special Inspections are required per Sections 1704 and 1705 of the 2012 IBC, the owner shall engage a qualified agency to perform the required inspections for components listed in the project-specific Statement of Special Inspections.

**PART 4 - EQUIPMENT ISOLATION AND SEISMIC RESTRAINT SCHEDULE**

**4.1 MECHANICAL EQUIPMENT**

EQUIPMENT TAG	Ip	ISOLATION SPEC.	ISOLATION DEFL.
AIR HANDLING UNITS (FLOOR)	1.0	INTERNAL BY MANUF.	2"
AIR HANDLING UNITS (SUSP)	1.0	SPEC V-6 SPEC F-1	1.5"
VAV (NON-FAN) TERM. < 20 LB	1.0	NONE	N/A
VAV (NON-FAN) TERM. ≥ 20 LB	1.0	NONE	N/A
FAN VAV TERMINAL	1.0	SPEC V-4	.5"
ROOF EXHAUST FANS	1.0	NONE	N/A
DUCT	1.0	NOTE 6	N/A

**NOTES**

1. Seismic restraint to be provided only where required in the project drawings.
2. Anchor bolts for non-isolated and internally isolated equipment shall be sized by the seismic engineer. If required, Spec. S-1 snubbers or Spec. S-2 cable kits shall be provided.
3. Diffusers weighing less than 20 lbs. must be mechanically attached to ceiling grid, but require no additional restraint.
4. Anchors and guides to be designed to accommodate thermal expansion and seismic loads.
5. Roof curbs provided by others must be certified by a professional engineer for the required seismic loads.
6. Provide Type V-6 isolator for the first three hangers from all equipment specified with spring isolation.

END OF SECTION 23 05 48

**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. Warning signs and labels.
  - 3. Pipe labels.
  - 4. Duct labels.
  - 5. Ceiling Grid labels.
  - 6. Valve tags.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- C. Valve numbering scheme.
- D. Valve Schedules: For each piping system to include in maintenance manuals.

**1.4 COORDINATION**

- 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.

**PART 2 - PRODUCTS****2.1 EQUIPMENT LABELS**

- A. Metal Labels for Equipment:
  - 1. Material and Thickness: Brass, 0.032 inch (0.8128 mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
  - 2. Minimum Label Size: Length and width vary for required label content, but not less than 2 ½ (63.5 mm) by ¾ inch (19.05 mm).
  - 3. Minimum Letter Size: ¼ inch (6.35 mm) for name of units if viewing distance is less than 24 inches (609.6 mm), ½ inch (12.7 mm) for viewing distances up to 72 inches (1828.8 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
  - 4. 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, 0.125 inch (3.175 mm) 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°F (71.11°C).

5. Minimum Label Size: Length and width vary for required label content, but not less than 2 ½ inches (63.5 mm) by ¾ inch (19.05 mm).
  6. Minimum Letter Size: ¼ inch (6.35 mm) for name of units if viewing distance is less than 24 inches (609.6 mm), ½ inch (12.7 mm) for viewing distances up to 72 inches (1828.8 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
  7. 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), plus the Specification Section number and title where equipment is specified.
- D. Equipment Label Schedule: For each item of equipment to be labeled, on 8 ½ inch (215.9 mm) by 11 inch (279.4 mm) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus 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, 1/8 inch (3.175 mm) thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Black.
- C. Background Color: Yellow.
- D. Maximum Temperature: Able to withstand temperatures up to 160°F (71.11°C).
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2 ½ inches (63.5 mm) by ¾ inch (19.05 mm).
- F. Minimum Letter Size: ¼ inch (6.35 mm) for name of units if viewing distance is less than 24 inches (609.6mm), ½ inch (12.7 mm) for viewing distances up to 72 inches (1828.8 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- H. 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.
- 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 ½ inches (38.1 mm) high.

## 2.4 DUCT LABELS

- A. Self-Adhesive Duct Labels: Printed plastic with contact-type, permanent-adhesive backing.
- B. Maximum Temperature: Able to withstand temperatures up to 160°F (71.11°C).
- C. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.
  1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
  2. Lettering Size: At least 1 ½ inches (38.1 mm) high.

## 2.5 CEILING GRID LABELS

- A. Self-Adhesive Labels: Printed plastic with contact type, permanent-adhesive backing.
- B. Maximum Temperature: Able to withstand temperatures up to 160°F (71.11°C).
- C. Duct Label Contents: Include identification of equipment above ceiling using same designations or abbreviations as used on Drawings.
  - 1. Lettering Size: At least  $\frac{3}{4}$  the width of the ceiling grid.
  - 2. Background Color: Match ceiling grid color. See architectural drawings and specifications.
  - 3. Text Color: Black for light backgrounds. White for dark backgrounds.

## 2.6 VALVE TAGS

- A. Valve Tags: Stamped or engraved with  $\frac{1}{4}$  inch (6.35 mm) letters for piping system abbreviation and  $\frac{1}{2}$  inch (12.7 mm) numbers.
  - 1. Tag Material: Brass, 0.032 inch (0.8128 mm) 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  $\frac{1}{2}$  inches (215.9 mm) by 11 inches (279.4 mm) 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 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.
- C. Install metal equipment labels on all equipment exposed to the outdoors.

### 3.3 PIPE LABEL INSTALLATION

- A. 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 (15.24 m) along each run. Reduce intervals to 25 feet (7.62 m) in areas of congested piping and equipment.
  - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- B. Pipe Label Color Schedule:
  - 1. Chilled-Water Piping:
    - a. Background Color: Green.
    - b. Letter Color: White.
  - 2. Refrigerant Piping:

- a. Background Color: Green.
- b. Letter Color: White.

### 3.4 DUCT LABEL INSTALLATION

- A. Install self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
  1. Blue: For cold-air supply ducts.
  2. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
  3. ASME A13.1 Colors and Designs: For hazardous material exhaust.
- B. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet (15.24 m) in each space where ducts are exposed or concealed by removable ceiling system.

### 3.5 CEILING GRID LABEL INSTALLATION

- A. Install self-adhesive ceiling labels with permanent adhesive on ceiling grid directly adjacent to the tile used for unit access. Bottom of text shall be adjacent to access tile.

### 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: Chilled Water: 1 ½ inches (38.1 mm), round.
  2. Valve-Tag Color: Chilled Water: Natural.
  3. Letter Color: Chilled Water: Black.

### 3.7 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

**END OF SECTION 23 05 53**

**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.
    - b. Variable-air-volume systems.
  - 2. Testing, Adjusting, and Balancing Equipment:
    - a. Motors.
    - b. Condensing units.
    - c. Heat-transfer coils.
  - 3. 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 ACTION SUBMITTALS**

- A. Sustainable Design Submittals:
  - 1. TAB Report: Documentation indicating that Work complies with ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."

**1.6 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 30 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. 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.

### 1.7 QUALITY ASSURANCE

- A. TAB Specialists Qualifications: Certified by AABC.
  - 1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC.
  - 2. TAB Technician: Employee of the TAB specialist and certified by AABC as a TAB technician.
- B. TAB Specialists Qualifications: Certified by NEBB or TABB.
  - 1. TAB Field Supervisor: Employee of the TAB specialist and certified by NEBB or TABB.
  - 2. TAB Technician: Employee of the TAB specialist and certified by NEBB or TABB as a TAB technician.
- C. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."
- D. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.7.2.3, "System Balancing."

### 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 ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
- F. 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.

- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. 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.
- J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- K. Examine strainers. Verify that startup screens have been replaced by permanent screens with indicated perforations.
- L. Examine control valves for proper installation for their intended function of throttling, diverting, or mixing fluid flows.
- M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- N. Examine system pumps to ensure absence of entrained air in the suction piping.
- O. Examine operating safety interlocks and controls on HVAC equipment.
- P. 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", ASHRAE 111, NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems", SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" 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.
  - 2. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 23 33 00 "Air Duct Accessories."
  - 3. 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 Architect for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
  5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- 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. 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.
  4. 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.

5. 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.
6. 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.
7. 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.
8. 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.
9. 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 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.

### 3.8 PROCEDURES FOR CONDENSING UNITS

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record fan and motor operating data.

### 3.9 PROCEDURES FOR HEAT-TRANSFER COILS

- A. 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.
- B. 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.

### 3.10 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.

### 3.11 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: Plus or minus 10 percent.
- B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

### 3.12 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.

### 3.13 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 (mm), and bore.
    - i. Center-to-center dimensions of sheave and amount of adjustments in inches (mm).
    - 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 (mm), and bore.
    - f. Center-to-center dimensions of sheave and amount of adjustments in inches (mm).
  3. Test Data (Indicated and Actual Values):
    - a. Total airflow rate in cfm (L/s).
    - b. Total system static pressure in inches wg (Pa).
    - c. Fan rpm.
    - d. Discharge static pressure in inches wg (Pa).
    - e. Filter static-pressure differential in inches wg (Pa).
    - f. Preheat-coil static-pressure differential in inches wg (Pa).
    - g. Cooling-coil static-pressure differential in inches wg (Pa).
    - h. Heating-coil static-pressure differential in inches wg (Pa).
    - i. Outdoor airflow in cfm (L/s).
    - j. Return airflow in cfm (L/s).
    - k. Outdoor-air damper position.
    - l. Return-air damper position.
    - m. Vortex damper position.
- 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 (mm) o.c.
    - f. Make and model number.
    - g. Face area in sq. ft. (sq. m).
    - h. Tube size in NPS (DN).
    - i. Tube and fin materials.
    - j. Circuiting arrangement.
  2. Test Data (Indicated and Actual Values):
    - a. Airflow rate in cfm (L/s).
    - b. Average face velocity in fpm (m/s).
    - c. Air pressure drop in inches wg (Pa).
    - d. Outdoor-air, wet- and dry-bulb temperatures in deg F (deg C).
    - e. Return-air, wet- and dry-bulb temperatures in deg F (deg C).
    - f. Entering-air, wet- and dry-bulb temperatures in deg F (deg C).
    - g. Leaving-air, wet- and dry-bulb temperatures in deg F (deg C).
    - h. Refrigerant expansion valve and refrigerant types.
    - i. Refrigerant suction pressure in psig (kPa).
    - j. Refrigerant suction temperature in deg F (deg C).
    - k. Inlet steam pressure in psig (kPa).
- G. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:
1. Unit Data:
    - a. System identification.
    - b. Location.
    - c. Coil identification.
    - d. Capacity in Btu/h (kW).
    - e. Number of stages.
    - f. Connected volts, phase, and hertz.
    - g. Rated amperage.
    - h. Airflow rate in cfm (L/s).



- i. Face area in sq. ft. (sq. m).
      - j. Minimum face velocity in fpm (m/s).
    2. Test Data (Indicated and Actual Values):
      - a. Heat output in Btu/h (kW).
      - b. Airflow rate in cfm (L/s).
      - c. Air velocity in fpm (m/s).
      - d. Entering-air temperature in deg F (deg C).
      - e. Leaving-air temperature in deg F (deg C).
      - f. Voltage at each connection.
      - g. Amperage for each phase.
  - H. 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 (mm), and bore.
      - h. Center-to-center dimensions of sheave and amount of adjustments in inches (mm).
    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 (mm), and bore.
      - f. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).
      - g. Number, make, and size of belts.
    3. Test Data (Indicated and Actual Values):
      - a. Total airflow rate in cfm (L/s).
      - b. Total system static pressure in inches wg (Pa).
      - c. Fan rpm.
      - d. Discharge static pressure in inches wg (Pa).
      - e. Suction static pressure in inches wg (Pa).
  - 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. (sq. m).
    2. Test Data (Indicated and Actual Values):
      - a. Airflow rate in cfm (L/s).
      - b. Air velocity in fpm (m/s).
      - c. Preliminary airflow rate as needed in cfm (L/s).
      - d. Preliminary velocity as needed in fpm (m/s).
      - e. Final airflow rate in cfm (L/s).
      - f. Final velocity in fpm (m/s).
      - g. Space temperature in deg F (deg C).
  - 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 (L/s).
  - b. Entering-air temperature in deg F (deg C).
  - c. Leaving-air temperature in deg F (deg C).
- K. Instrument Calibration Reports:
  - 1. Report Data:
    - a. Instrument type and make.
    - b. Serial number.
    - c. Application.
    - d. Dates of use.
    - e. Dates of calibration.

### 3.14 VERIFICATION OF TAB REPORT

- A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of commissioning authority.
- B. Commissioning authority shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
- C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
- D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
- E. If TAB work fails, proceed as follows:
  - 1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
  - 2. If the second final inspection also fails, Owner may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.
  - 3. If the second verification also fails, design professional may contact AABC Headquarters regarding the AABC National Performance Guaranty.
- F. Prepare test and inspection reports.

### 3.15 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 23 05 93**

**SECTION 23 07 13 - DUCT 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 duct services:
  - 1. Indoor, concealed supply and outdoor air.
  - 2. Indoor, exposed supply and outdoor air.
  - 3. Indoor, concealed return located in unconditioned space.
  - 4. Indoor, exposed return located in unconditioned space.
- B. Related Sections:
  - 1. Section 23 07 19 "HVAC Piping Insulation."
  - 2. Section 23 31 13 "Metal Ducts" for duct liners.

**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).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  - 2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
  - 3. Detail application of field-applied jackets.
  - 4. Detail application at linkages of control devices.

**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.
  - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 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 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 "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum 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 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.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. CertainTeed Corp.; SoftTouch Duct Wrap.
    - b. Johns Manville; Microlite.
    - c. Knauf Insulation; Friendly Feel Duct Wrap.
    - d. Owens Corning; SOFTR All-Service Duct Wrap.
- G. 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.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. CertainTeed Corp.; Commercial Board.
    - b. Johns Manville; 800 Series Spin-Glas.
    - c. Knauf Insulation; Insulation Board.
    - d. Owens Corning; Fiberglas 700 Series.

### 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. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.

- b. Eagle Bridges - Marathon Industries; 225.
- c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.Mon-Eco Industries, Inc.; 22-25.

### 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: Water based; suitable for indoor use on below ambient services.
  - 1. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
  - 2. Service Temperature Range: Minus 20 to plus 180 deg F.
  - 3. Solids Content: ASTM D 1644, 58 percent by volume and 70 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: -20°F (-28.88°C) to 180°F (82.22°C).
  - 3. Solids Content: 60 percent by volume and 66 percent by weight.
  - 4. Color: White.

### 2.4 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
  - 1. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
  - 2. Service Temperature Range: 0°F (-17.77°C) to 180°F (82.22°C).
  - 3. Color: White.

### 2.5 SEALANTS

- A. FSK and Metal Jacket Flashing Sealants:
  - 1. Materials shall be compatible with insulation materials, jackets, and substrates.
  - 2. Fire- and water-resistant, flexible, elastomeric sealant.
  - 3. Service Temperature Range: -40°F (-40°C) to 250°F (121.11°C).
  - 4. Color: Aluminum.

### 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. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

### 2.7 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Fabric: Approximately 6 oz/yd<sup>2</sup> with a thread count of 5 strands by 5 strands/inch<sup>2</sup> for covering ducts.

## 2.8 FIELD-APPLIED CLOTHS

- A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and pre-sized a minimum of 8 oz/yd<sup>2</sup>.

## 2.9 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. Self-Adhesive Outdoor Jacket: 60 mil (1.5 mm) thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a cross-laminated polyethylene film covered with stucco-embossed aluminum-foil facing.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Polyguard Products, Inc.; Alumaguard 60.

## 2.10 TAPES

- A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
  - 1. Width: 3 inches (76.2 mm).
  - 2. Thickness: 6.5 mils.
  - 3. Adhesion: 90 ounces force/inch in width.
  - 4. Elongation: 2 percent.
  - 5. Tensile Strength: 40 lbf/inch in width.
  - 6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- B. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
  - 1. Width: 2 inches (50.8 mm).
  - 2. Thickness: 3.7 mils.
  - 3. Adhesion: 100 ounces force/inch in width.
  - 4. Elongation: 5 percent.
  - 5. Tensile Strength: 34 lbf/inch in width.

## 2.11 SECUREMENTS

- A. Bands:
  - 1. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch (0.381 mm) thick, ½ inch (12.7 mm) wide with wing seal.
  - 2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.508 mm) thick, ½ inch (12.7 mm) wide with wing seal.
- B. Insulation Pins and Hangers:
  - 1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106 inch (2.6924 mm) diameter shank, length to suit depth of insulation indicated.
  - 2. 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”<sup>2</sup>.
    - b. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106 inch (2.6924 mm) 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.

3. Insulation-Retaining Washers: Self-locking washers formed from 0.016 inch (0.4064 mm) thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1 ½ inches (38.1 mm) in diameter.
  - a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
- C. Staples: Outward-clinching insulation staples, nominal ¾ inch (19.05 mm) wide, stainless steel or Monel.
- D. Wire: 0.062 inch (1.57 mm) soft-annealed, stainless steel.

## 2.12 CORNER ANGLES

- A. PVC Corner Angles: 30 mils thick, minimum 1 inch (25.4 mm) by 1 inch (25.4 mm), PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
- B. Aluminum Corner Angles: 0.040 inch (1.016 mm) thick, minimum 1 inch (25.4 mm) by 1 inch (25.4 mm), aluminum according to ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

## 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 (76.2 mm) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (101.6 mm) o.c.
  3. Overlap jacket longitudinal seams at least 1 ½ inches (38.1 mm). Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches (50.8 mm) 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 (101.6 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

### 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: 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 (50.8 mm).
- C. 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 (50.8 mm).
  2. Seal penetrations through fire-rated assemblies.

### 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 duct and plenum surfaces.
  2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  3. Install capacitor-discharge-weld pins and speed washers on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    - a. On duct sides with dimensions 18 inches (457.2 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (76.2 mm) maximum from insulation end joints, and 16 inches (406.4 mm) o.c.
    - b. On duct sides with dimensions larger than 18 inches (457.2 mm), place pins 16 inches (406.4 mm) o.c. each way, and 3 inches (76.2 mm) 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 over compress 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.
  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 (50.8 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation section with ½ inch (12.7 mm) outward-clinching staples, 1 inch (25.4 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.



- a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
- b. Install vapor stops for ductwork and plenums operating below 50°F (10°C) 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 (76.2 mm).
5. Overlap unfaced blankets a minimum of 2 inches (50.8 mm) on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches (457.2 mm) o.c.
6. 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.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6 inch (152.4 mm) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (152.4 mm) 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 duct and plenum surfaces.
  2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  3. Install capacitor-discharge-weld pins and speed on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    - a. On duct sides with dimensions 18 inches (457.2 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (76.2 mm) maximum from insulation end joints, and 16 inches (406.4 mm) o.c.
    - b. On duct sides with dimensions larger than 18 inches (457.2 mm), space pins 16 inches (406.4 mm) o.c. each way, and 3 inches (76.2 mm) 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 over compress 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 (50.8 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation section with ½ inch (12.7 mm) outward-clinching staples, 1 inch (25.4 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
    - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    - b. Install vapor stops for ductwork and plenums operating below 50°F (10°C) 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 (76.2 mm).
  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 (152.4 mm) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (152.4 mm) o.c.

### 3.6 FIELD-APPLIED JACKET INSTALLATION

- A. Where metal jackets are indicated, install with 2 inch (50.8 mm) 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 (304.8 mm) o.c. and at end joints.

### 3.7 FINISHES

- A. Do not field paint aluminum or stainless-steel jackets.

### 3.8 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:
  - 1. Indoor, concealed supply and outdoor air.
  - 2. Indoor, exposed supply and outdoor air.
  - 3. Indoor, concealed return located in unconditioned space.
  - 4. Indoor, exposed return located in unconditioned space.
  - 5. Indoor, concealed exhaust air plenum
  - 6. Indoor, exposed exhaust air plenum
- B. Items Not Insulated:
  - 1. Fibrous-glass ducts.
  - 2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
  - 3. Factory-insulated flexible ducts.
  - 4. Factory-insulated plenums and casings.
  - 5. Flexible connectors.
  - 6. Vibration-control devices.
  - 7. Factory-insulated access panels and doors.
  - 8. Return air ductwork located in conditioned spaces.
  - 9. Exhaust air ductwork located within the building envelope.

### 3.9 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. All insulation thicknesses indicated in the schedules below represent minimum R-Values for interior (R-6) and exterior (R-8) applications. R-Value is based on installed thickness after compression (25%).
- B. Concealed, supply-air, return air, and outside air duct insulation shall be the following:
  - 1. Mineral-Fiber Blanket: 2 inches (50.8 mm) thick and 1.0 lb./cu. ft nominal density.
- C. Concealed, supply-air, return-air, outdoor air, and exhaust air plenum insulation shall be the following:
  - 1. Mineral-Fiber Blanket: 2 inches (50.8 mm) thick and 1.0 lb./cu. ft. nominal density.
  - 2. Mineral-Fiber Board: 1 ½ inches (38.1 mm) thick and 3 lb./cu. ft. nominal density.
- D. Exposed, supply-air, return air, and outdoor air duct insulation shall be one of the following:
  - 1. Mineral-Fiber Blanket: 2 inches (50.8 mm) thick and 1.0 lb./cu. ft. nominal density.
  - 2. Mineral-Fiber Board: 1 ½ inches (38.1 mm) thick and 3 lb./cu. ft. nominal density.
- E. Exposed, supply-air, return-air, outdoor-air, and exhaust-air plenum insulation shall be one of the following:
  - 1. Mineral-Fiber Blanket: 2 inches (50.8 mm) thick and 1.0 lb./cu. ft. nominal density.
  - 2. Mineral-Fiber Board: 1 ½ inches (38.1 mm) thick and 3 lb./cu. ft. nominal density.

### 3.10 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. Ducts and Plenums, Concealed:
  - 1. None.
- D. Ducts and Plenums, Exposed:
  - 1. Jackets are only required in mechanical rooms for exposed ductwork.
  - 2. Aluminum, Smooth: 0.024 inch (0.6096 mm) thick.

## END OF SECTION 23 07 13

**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 and outdoors.
  - 2. Refrigerant suction and hot-gas piping, indoors and outdoors.
- B. Related Section:
  - 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 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.

**1.5 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.

**1.6 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. 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. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. Block Insulation: ASTM C 552, Type I.
  - 2. Special-Shaped Insulation: ASTM C 552, Type III.
  - 3. Board Insulation: ASTM C 552, Type IV.
  - 4. Preformed Pipe Insulation with Factory-Applied ASJ-SSL: Comply with ASTM C 552, Type II, Class 2.
  - 5. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
- G. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

## 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. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200°F.
  - 1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
  - 1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. ASJ Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
  - 1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- E. PVC Jacket Adhesive: Compatible with PVC jacket.
  - 1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## 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: Water based; suitable for indoor use on below-ambient services.
  - 1. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43 mil dry film thickness.
  - 2. Service Temperature Range: Minus 20 to plus 180°F.
  - 3. Solids Content: ASTM D 1644, 58 percent by volume and 70 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°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°F.
  - 3. Solids Content: 60 percent by volume and 66 percent by weight.
  - 4. Color: White.

## 2.4 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.
    - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
    - c. Vimasco Corporation; 713 and 714.
  - 2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
  - 3. Service Temperature Range: 0 to plus 180°F.
  - 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°F.
  - 4. Color: White or gray.
- B. Metal Jacket Flashing Sealants:
  - 1. Materials shall be compatible with insulation materials, jackets, and substrates.
  - 2. Fire- and water-resistant, flexible, elastomeric sealant.
  - 3. Service Temperature Range: Minus 40 to plus 250°F.
  - 4. Color: Aluminum.
- C. ASJ Flashing Sealants, and PVC Jacket Flashing Sealants:
  - 1. Materials shall be compatible with insulation materials, jackets, and substrates.
  - 2. Fire- and water-resistant, flexible, elastomeric sealant.
  - 3. Service Temperature Range: Minus 40 to plus 250°F.

## 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: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
  - 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

## 2.7 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Fabric: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in. for covering pipe and pipe fittings.

## 2.8 FIELD-APPLIED CLOTHS

- A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and pre-sized a minimum of 8 oz./sq. yd..

## 2.9 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: White.
  - 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.
- C. Metal Jacket:
  - 1. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
    - a. Sheet and roll stock ready for shop or field sizing.
    - b. Finish and thickness are indicated in field-applied jacket schedules.
    - c. Moisture Barrier for Indoor Applications: 1-mil thick, heat-bonded polyethylene and kraft paper.
    - d. Moisture Barrier for Outdoor Applications: 3-mil thick, heat-bonded polyethylene and kraft paper.
    - e. Factory-Fabricated Fitting Covers:
      - 1) Same material, finish, and thickness as jacket.
      - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
      - 3) Tee covers.
      - 4) Flange and union covers.
      - 5) End caps.
      - 6) Beveled collars.
      - 7) Valve covers.
      - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

## 2.10 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
  - 1. Width: 3 inches.

2. Thickness: 11.5 mils.
  3. Adhesion: 90 ounces force/inch in width.
  4. Elongation: 2 percent.
  5. Tensile Strength: 40 lbf/inch in width.
  6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. 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.
- C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Width: 2 inches.
  2. Thickness: 3.7 mils.
  3. Adhesion: 100 ounces force/inch in width.
  4. Elongation: 5 percent.
  5. Tensile Strength: 34 lbf/inch in width.

## 2.11 SECUREMENTS

- A. Bands:
1. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304; ½ inch wide with wing seal.
- B. Staples: Outward-clinching insulation staples, nominal ¾ inch- wide, stainless steel or Monel.
- C. Wire: 0.062 inch soft-annealed, stainless steel.

## 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 ½ 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 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 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 CELLULAR-GLASS INSULATION

- A. Insulation Installation on Straight Pipes and Tubes:
  1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
  2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
  3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches o.c.
  4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. 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 cut sections of cellular-glass block insulation of same thickness as pipe insulation.
  4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
  1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
  2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
  1. Install preformed sections of cellular-glass insulation to valve body.
  2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  3. Install insulation to flanges as specified for flange insulation application.

### 3.7 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
  1. Install pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.

4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
  1. Install mitered sections of pipe insulation.
  2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
  1. Install preformed valve covers manufactured of same material as pipe insulation when available.
  2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  3. Install insulation to flanges as specified for flange insulation application.
  4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### 3.8 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 manufacturer's recommended adhesive.
  1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- B. Where metal jackets are indicated, install with 2 inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

### 3.9 FINISHES

- A. Pipe Insulation with ASJ or Other Paintable Jacket Material: Paint jacket with paint system identified below:
  1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
    - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed work.
- D. Do not field paint aluminum or stainless-steel jackets.

### 3.10 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.
- C. Insulation thickness indicated in the following schedules is based on a conductivity range of 0.21-0.27 Btu-in/(h-ft<sup>2</sup>-°F) with a mean temperature rating of 75°F for condensate, chilled water and condenser water, and 0.25-0.29 Btu-in/(h-ft<sup>2</sup>-°F) with a mean temperature rating of 125°F for hot water applications between 141-200°F. For conductivity levels falling outside these levels, the contractor shall provide documentation on the submitted insulation verifying compliance with the latest applicable Energy Conservation Code.

**3.11 INDOOR PIPING INSULATION SCHEDULE**

- A. Condensate and Equipment Drain Water below 60°F:
  - 1. All Pipe Sizes: Insulation shall be one of the following:
    - a. Cellular Glass: 1 ½ inches thick.
    - b. Flexible Elastomeric: ¾ inch thick.
- B. Refrigerant Suction and Hot-Gas Piping:
  - 1. All Pipe Sizes: Insulation shall be one of the following:
    - a. Cellular Glass: 1 ½ inches thick.
    - b. Flexible Elastomeric: 1 inch thick.

**3.12 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE**

- A. Refrigerant Suction and Hot-Gas Piping:
  - 1. All Pipe Sizes: Insulation shall be one of the following:
    - a. Cellular Glass: 1 ½ inches thick.
    - b. Flexible Elastomeric: 1 inch thick.

**3.13 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, Exposed:
  - 1. Jackets shall be required in mechanical rooms only or as noted on construction documents.
  - 2. PVC or Aluminum jackets are acceptable for indoor exposed pipe jackets.
  - 3. PVC: 30 mils thick.
  - 4. Aluminum, Smooth: 0.024 inch thick.

**3.14 OUTDOOR, 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. Piping, Exposed:
  - 1. Aluminum, Smooth: 0.032 inch thick.

**END OF SECTION 23 07 19**

**SECTION 23 09 00 - INSTRUMENTATION AND CONTROL FOR HVAC****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. All work of this Division shall be coordinated and provided by the single Building Automation System (BAS) Contractor.
- B. The work of this Division shall be scheduled, coordinated, and interfaced with the associated work of other trades.
- C. The work of this Division shall be as required by the Specifications, Point Schedules and Drawings.
- D. If the BAS Contractor believes there are conflicts or missing information in the project documents, the Contractor shall promptly request clarification and instruction from the design team.
- E. The BAS Contractor is responsible to provide and install all control and monitoring devices to provide a complete BAS system. The BAS Contractor shall provide a complete system consisting of Direct Digital Control Panels (DDCP's), field I/O devices, power supplies and supportive software, to meet the written sequence of operations (Specification Section 23 09 93), The system shall support communications to the DDCP's, provide operator interaction for global control functions for the BAS and data consolidation via Local Area Network (LAN) or Wide Area Network (WAN) communication link backbone.

**1.2 DEFINITIONS**

- A. Analog: A continuously variable system or value not having discrete levels. Typically exists within a defined range of limiting values.
- B. BACnet: The Building Automation and Control Network open protocol communication standard developed by ASHRAE which is now an ISO and ANSI standard. BACnet can operate over multi-media including Ethernet, ARCnet and MSTP. BACnet components shall be UL listed; and shall be fully compliant with ASHRAE Standard SSPC/135 and all other applicable codes.
- C. BACnet Object: A physical or virtual point with a set of associated properties such as a temperature sensor that has properties including – name, current value, maximum/minimum values, high/low alarm levels, etc.
- D. BACnet Interoperability Building Blocks (BIBBs): A BIBB defines a small portion of BACnet functionality needed to perform a particular task. BIBBs come in pairs, A and B, which reflect the client/server nature. The “A” BIBB represents the client, i.e. the device furnishing the information. The “B” BIBB represents the server, i.e. the device furnishing the information or executing the command. For 2 devices to be interoperable, the “A” BIBB and “B” BIBB must be the same.
- E. BACnet/IP: The Building Automation and Control Network open protocol communication standard using Internet Protocol (IP) complying with Annex J of the ASHRAE SSPC/135 standard.
- F. BAS Contractor: The single Contractor to provide the work of this Division. This Contractor shall be the primary manufacturer, installer, commissioner and ongoing service provider for the BAS work.
- G. BAS Network: The total digital on-line real-time interconnected configuration of BAS digital processing units, workstations, panels, sub-panels, controllers, devices and associated elements individually known as network nodes. May exist as one or more fully interfaced and integrated sub-networks, LAN, WAN or the like.
- H. Binary: A two-state system where an “ON” condition is represented by one discrete signal level and an “OFF” condition is represented by a second discrete signal level.
- I. Building Automation System (BAS): The entire system of hardware and software specifically designed to centrally manage building HVAC and related utilities. The BAS includes the DDC subsystem, open system ports, and open protocol bus or integrators and network routers for connection to information networks. It includes components at the Field, Automation and Management Levels.
- J. Control Process: The software required to perform a complete control loop from input signal to interlock logic, process calculation to final output signal control.
- K. Control Sequence: A BAS pre-programmed arrangement of software algorithms, logical computation, target values and limits as required to attain the defined operational control objectives.
- L. Control Wiring: Includes conduit, wire and wiring devices to install a complete Control System including motor control circuits, interlocks, thermostats, PE and EP switches and like devices. Includes all wiring

- from controllers to all sensors and points specified herein and required to execute the sequence of operation. This does not include line voltage power wiring.
- M. Diagnostic Problem: Machine executable instructions used to detect and isolate system and component malfunctions.
  - N. Direct Digital Control (DDC): The digital algorithms and pre-defined arrangements included in the BAS software to provide direct closed-loop control for the designated equipment and controlled variables. Inclusive of Proportional, Derivative and integral control algorithms together with target values, limits, logical functions, arithmetic functions, constant values, timing considerations and the like.
  - O. Distributed Control: A system whereby all control processing is decentralized and independent of a central computer. The control system is built up of stand-alone controllers. A single controller failure shall not impact more than one system.
  - P. Furnish: The term “Furnish” and its derivatives when used in this Division shall mean supply at the BAS Contractor’s cost to the designated third party trade contractor for installation. BAS Contractor shall connect furnished items to the BAS, calibrate, test, commission, warrant and document.
  - Q. Gateway - Bi-directional protocol translator connection control systems that use different communication protocols.
  - R. Install: The term “Install” and its derivatives when used in this Division shall mean receive at the jobsite and mount.
  - S. Integration: The ability of control system components from different manufacturers to connect together while providing coordinated control via real-time data exchange through a common communications data exchange protocol. Integrations shall extend to the operators workstation software, which shall support user interaction with all control system components. Methods of integration include industry standard protocols such as: BACnet, LonMark/LonTalk, Modbus and OLE for Process Controls (OPC) or integrator interfaces between cooperating manufacturer’s systems.
  - T. Interoperability: The ability of systems from different manufacturers and of different types to share information with each other without losing any of their independent functional capabilities and without the need for complex programming.
  - U. LonTalk: A proprietary communication protocol standard developed by the Echelon Corporation.
  - V. Native BACnet: This term is used to imply that BACnet devices (i.e. the BAS controllers and workstation) only communicate in BACnet protocol and do not require an intermediate gateway for protocol conversion. The BACnet devices shall be connected on a peer-to-peer network using one of the approved LAN technologies such as Ethernet, MS/TP or BACnet/IP.
  - W. Network: A system of distributed control units that are linked together on a communication highway. A network allows sharing of point information between all control units. Additionally, a network provides central monitoring and control of the entire system from any distributed control unit location. First tier (Management Level) networks shall provide “Peer-to-Peer” communications. Second tier (Automation Level) networks shall provide either “Peer-to-Peer,” Master-Slave or Supervised Token Passing Communications.
  - X. Node: A digitally programmable entity existing on the BAS network.
  - Y. Operating System (OS): Software that controls the execution of computer programs and which provides scheduling, debugging, input/output controls, accounting, compilation, storage assignment, data management and related services.
  - Z. Operator Interface Workstation (OIW): The OIW consists of a high level processing personal computer and peripheral I/O devices that enable access to the PC and to the entire Management Level Network. The OIW allows an operator to command, monitor, and program the system.
  - AA. Peer-to-Peer Communications: Communications directly between devices that operate on the same communications level of a network, without intervention from any intermediary devices such as a host computer or server.
  - BB. Peripheral: Input/Output equipment used to communicate with the computer and make copies of system outputs; peripherals include VDU’s, printers, hard drives, disk drives and modems, etc.
  - CC. PID Control Loop: A mathematical calculation used to evaluate a control input and determine the control output value required to maintain the input value at set point. The PID (Proportional, Integral, and Derivative) control loop shall have operator adjustable maximum rate of change, P and D gains and loop response time delay. The loop shall be self-integrating so that no integral constant is required and the loop shall not be subject to “Integral Windup”.

- DD. Programmable Device: A device that does not have a pre-established built-in application. An application creation software tool is required for an application to be created and downloaded to the device.
- EE. Provide: The term “Provide” and its derivatives when used in this Division shall mean to furnish, install in place, connect, calibrate, test, commission, warrant, document and supply the associated required services ready for operation.
- FF. Protocol: The term “protocol” and its derivatives when used in this Division shall mean a defined set of rules and standards governing the on-line exchange of data between BAS network nodes.
- GG. Router: A device that routes messages destined for another segment sub-net or domain of the control network. The device controls message traffic based on node address and priority. Media converters which serve as communication links between power line, twisted pair, fiber optic, coax and RF media are sometimes referred to as Routers.
- HH. Software: The term “software” and its derivatives when used in this Division shall mean all of programmed digital processor software, preprogrammed firmware and project specific digital process programming and database entries and definitions as generally understood in the BAS industry for real-time, on-line, integrated BAS configurations.
- II. Unitary Controller: A controller generally designed for a specific application and for a single piece of equipment. Fully programmable unitary controllers shall be provided for this project.
- JJ. The use of words in the singular in these Division documents shall not be considered as limiting when other indications in these documents denote that more than one such item is being referenced.
- KK. Headings, paragraph numbers, titles, shading, bolding, underscores, clouds and other symbolic interpretation aids included in the Division documents are for general information only and are to assist in the reading and interpretation of these Documents.
- LL. The following abbreviations and acronyms may be used in describing the work of this Division:

A/C	Air Conditioning
AI	Analog Input
ANSI	American National Standards Institute
AO	Analog Output
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
BAS	Building Automation System
BIBB	BACnet Interoperability Building Block
CCP	Communications Control Panel
CD-RW	Compact Disk with Read and Write Capability
CPU	Central Processing Unit
DAC	Digital to Analog Converter
DDCP	Direct Digital Control Panel
DDC	Direct Digital Control
DI	Digital Input
DO	Digital Output
EEPROM	Electrically Erasable Programmable Read Only Memory
EMI	Electromagnetic Interference
FAS	Fire Alarm Detection and Annunciation System
GUI	Graphical User Interface
HOA	Hand-Off-Auto
HVAC	Heating, Ventilating and Air Conditioning
HT	Humidity Transmitter
ID	Identification

IEEE	Institute of Electrical and Electronics Engineers
I/O	Input/Output
IP	Internet Protocol
LAN	Local Area Network
LCD	Liquid Crystal Display
LED	Light Emitting Diode
MCC	Motor Control Center
NEMA	National Electric Manufacturer's Association
NC	Normally Closed
NIC	Not In Contract
NFPA	National Fire Protection Association
NO	Normally Open
OEM	Original Equipment Manufacturer
OIW	Operator Interface Workstation
OPC	Open Process Control
OSHA	Occupational Safety and Health Administration
PC	Personal Computer
PICS	Protocol Implementation Conformance Statement
PIM	I/O Point Interface Module
POT	Portable Operator Terminal
PT	Pressure Transmitter
RAM	Random Access Memory
RFI	Radio Frequency Interference
RH	Relative Humidity
RTD	Resistance Temperature Device
SPDT	Single Pole Double Throw
SPST	Single Pole Single Throw
XVGA	Extended Video Graphics Adapter
TBA	To Be Advised
TCP/IP	Transmission Control Protocol/Internet Protocol
TT	Temperature Transmitter
UC	Unitary Controller
UL	Underwriters Laboratories
UPS	Uninterruptible Power Supply
VAC	Volts, Alternating Current
VDC	Volts, Direct Current
VDU	Video Display Unit
VPN	Virtual Private Network
VFD	Variable Frequency Drive
WAN	Wide Area Network



### 1.3 BAS DESCRIPTION

- A. The Building Automation System (BAS) shall be a complete system designed for use with the enterprise IT systems. This functionality shall extend into the equipment rooms. Devices residing on the automation network located in equipment rooms and similar shall be fully IT compatible devices that mount and communicate directly on the IT infrastructure in the facility. Contractor shall be responsible for coordination with the owner's IT staff to ensure that the BAS will perform in the owner's environment without disruption to any of the other activities taking place on that LAN.

### 1.4 BAS SYSTEM ARCHITECTURE

- A. The BAS shall connect to the new Local Area Network (LAN) using BACnet/IP over Ethernet. This LAN is hereafter referred to as the "Site Management Level".
- B. The Site Management Level
  - 1. All servers, Operator Interface Workstations (OIW), Operating Systems (OS) and related applications shall reside on the management level.
  - 2. Routers shall reside on the management level.
  - 3. Communication Control Panels (CCPs) shall reside on the management level.
- C. The Automation Level
  - 1. The automation level shall comprise of Direct Digital Control Panels (DDCPs) and Unitary Controllers (UC). The controllers shall be in compliance to ASHRAE SSPC/135, BACnet standards latest revision.
  - 2. Supervisory controllers shall reside on the Automation level.
- D. The Field Level
  - 1. The field level shall include all instrumentation interfaced to the automation level controllers such as temperature, humidity, level, pressure and switches, etc.
  - 2. It shall also include the final control elements such as the control valves, damper actuators and control relays.
  - 3. All field level cables shall Plenum-type Teflon insulated (LSF - Low Smoke and Fire) rated.

### 1.5 SCOPE OF WORK

- A. Installation of Building Automation System (BAS)
  - 1. The BAS Contractor shall furnish and install a complete Building Automation System (BAS) for all mechanical systems and other facility systems as included in the project documents. The BAS will provide the functional features as defined in Part 1- General Requirements, Part 2- Products, and Part 3- Execution of these Specifications. The BAS Contractor shall provide a complete and operational system that will perform sequences of operations as verified by Owner Representative and Engineer.
  - 2. The components furnished shall be the most recent products offered by the BAS manufacturer that meet the specifications. If there are improved models of any components that become available before the on-site commencement of installation then these shall be offered by the BAS Contractor to the General Contractor at no additional cost to the Owner. The Owner shall have the option to accept or decline the offer. The components offered shall have been in successful operation in at least 2 similar applications for a minimum of 12 months.
  - 3. The BAS Contractor shall provide all software licenses necessary for the legal operation of the BAS. Coordinate with General Contractor.
  - 4. The BAS Contractor is responsible to coordinate all installation activities with General Contractor Site Facility personnel and the Engineer by submitting a written installation schedule outlining all proposed BAS installation activities. The schedule should include the anticipated time to install new controllers and network equipment, removal of existing equipment if applicable, installation of new monitoring devices and wiring, software programming, testing/commissioning, training and system acceptance.
  - 5. Provide a complete, neat and workmanlike installation. Use only manufacturer employees who are skilled, experienced, trained, and familiar with the specific equipment, software, standards and configurations to be provided for this Project.

6. Commissioning of Mechanical Systems: The BAS Contractor shall provide all labor as required to assist with the commissioning of all equipment and systems as scheduled and required by the project's Commissioning Agent.
7. In addition, the following apply:
  - a. The work under this Section shall include all materials and labor to perform all work required for the installation of the BAS as specified.
  - b. The drawings and Specifications are complementary to one another—meaning that what is called for on one is to be considered called for in both. Where conflicts exist between the Specifications and/or drawings, the more stringent requirement shall apply.
  - c. Where work specified under other Sections of this Specification connects to equipment or systems that are listed and described in this Section, the BAS Contractor shall provide proper connection(s) to such equipment, including trade coordination.
- B. Provide all miscellaneous low voltage field device mounting and interconnecting wiring for all Building mechanical systems.
- C. Provide all hydronic high performance control and isolation valve actuators, high performance linear control damper actuators. Coordinate with Construction Manager and Mechanical Contractor on scope of work.
- D. Provide control power transformers/power supplies for all new equipment.
- E. Provide and install proper earth ground on all BAS equipment to prevent the build-up of electromagnetic voltage potential. All BAS equipment shall be EMI immune.
- F. Interface/integrate with third-party equipment as defined and specified.
- G. Provide hardware interlocks for all systems requiring interlock as noted (Fire Alarm System, Mechanical, etc.).
- H. Provide system graphics for each HVAC, electrical, plumbing, and piping system and equipment. Provide scaled floor plans indicating equipment location, service, and system data as required by this specification. Graphics to incorporate integrated points communicated via multiple sources including direct protocol integration, gateways and third – party interfaces. Origin of information shall be transparent to the operator and shall be controlled, displayed, trended, etc. as if the points were hardwired to the BAS.
- I. Provide communication network amplification devices as required whenever device quantity and/or network wiring standard limitations length are exceeded.
- J. Provide the following support for all components furnished under this sub-contract:
  1. Warranty and service during the defects liability period.
  2. Submittals, samples and record documentation.
  3. Comprehensive commissioning and testing services.
  4. Detailed theoretical and practical training services for the BAS Supervisors and Operators.
  5. BAS equipment coordination with other site Specialists (Fire Alarm, etc.).
  6. Comprehensive and complete interoperability documentation and method statement for all third-party systems.
  7. Comprehensive PICS documentation regarding the BACnet object ID, component IP addresses, databases for all system database points.
  8. Where applicable, comprehensive LonWorks documentation to facilitate device integration. Documentation shall list all LonWorks network variables supported.
- K. All Power, Control and Overcurrent protection not indicated on the Electrical drawings shall be provided by Section 23 09 00, in accordance with Division 26 requirements. All wiring shall be in conduit.

## 1.6 COORDINATION WITH OTHER TRADES

- A. Contractors, Sub-contractors, Employees
  1. It will be the duty of this Contractor to work in cooperation with other contractors, and with other sub-contractors and employees, rendering assistance and arranging his or her work so that the entire project will be delivered in the best possible condition and in the shortest time. The BAS Contractor will coordinate with other Trade Contractors regarding the location and size of pipes, equipment, fixtures, conduit, ducts, openings, switches, outlets, structural, architectural features and so forth, in order to eliminate any delays in the progress of the job.

2. Any task related to the BAS turnkey installation that is not clearly identified in this document as being the responsibility of another trade shall be the responsibility of the BAS Contractor.

B. Coordination with Owner and Engineer

1. The BAS Contractor shall cooperate with Owner and the Engineer when performing work on this project as necessary to achieve a complete and neat installation. The Contractor shall also consult the drawings and specifications of existing on-site documentation, if applicable to further determine the nature and extent of BAS work.

## 1.7 QUALITY ASSURANCE

A. General

1. The Building Automation System Contractor shall be the primary manufacturer-owned branch office that is regularly engaged in the engineering, programming, installation and service of total integrated Building Automation Systems.
2. The BAS Contractor shall be a recognized national manufacturer, installer and service provider of BAS.
3. If a franchised dealer is to be considered via addendum, the dealer must provide a letter written by a minimum Vice President of Operations for the specific automatic temperature control manufacturer with the following verbiage: "should the Franchise Dealer fail to provide a complete and operational system (as judged by the owner/engineer), the Manufacturer will complete the project to the Engineer's satisfaction at no additional cost to the Owner". This letter must be provided to the engineer along with the other supporting documentation at the time of request for equivalence.
4. The Building Automation System architecture shall consist of the products of a manufacturer regularly engaged in the production of Building Automation Systems, and shall be the manufacturer's latest standard of design at the time of bid.
5. The BAS Contractor shall have a minimum of ten years' experience with the complete, turnkey installation of Building Automation Systems of similar size and technical complexity. The BAS Contractor shall provide a list of five comparable projects that have Building Automation Systems with the features as specified for this project. These projects must be on-line and functional.

B. Workspace Safety and Hazardous Materials

1. Provide a safety program in compliance with the Contract Documents
2. The BAS Contractor shall have a corporately certified comprehensive Safety Certification Manual and a designated Safety Supervisor for the Project.
3. The Contractor and its employees and sub trades comply with federal, state and local safety regulations.
4. The Contractor shall ensure that all subcontractors and employees have written safety programs in place that covers their scope of work, and that their employees receive the training required by OSHA have jurisdiction for at least each topic listed in the Safety Certification Manual.
5. Hazards created by the Contractor or its subcontractors shall be eliminated before any further work proceeds.
6. Hazards observed by not created by the Contractor or its subcontractors shall be reported to either the General Contractor or the Owner within the same day. The Contractor shall be required to avoid the hazard area until the hazard has been eliminated.
7. The Contractor shall sign and date a safety certification form prior to any work being performed, stating that the Contractors' company is in full compliance with the Project safety requirements.
8. The Contractor's safety program shall include written policy and arrangements for the handling, storage and management of all hazardous material to be used in the work in compliance with the requirements of the AHJ at the Project site.
9. The Contractor's employees and subcontractor's staff shall have received training as applicable in the use of hazardous materials and shall govern their actions accordingly.

C. Quality Management Program.

1. Designate a competent and experienced employee to provide BAS Project Management. The designated Project Manager shall be empowered to make technical, scheduling and related decisions on behalf of the BAS Contractor. At a minimum, the Project Manager shall:

- a. Manage the scheduling of the work to ensure that adequate materials, labor and other resources are available as needed.
- b. Manage the financial aspects of the BAS Contract.
- c. Coordinate as necessary with other trades.
- d. Be responsible for the work and actions of the BAS workforce on site.

## 1.8 CODES, PERMITS AND APPROVALS

- A. All work shall conform to the following Codes and Standards, as applicable:
  1. National Fire Protection Association (NFPA) Standards.
  2. National Electric Code (NEC) and applicable local Electric Code.
  3. Underwriters Laboratories (UL) listing and labels.
  4. NFPA 70 - National Electrical Code.
  5. NFPA 90A - Standard For The Installation Of Air Conditioning And Ventilations Systems.
  6. American National Standards Institute (ANSI).
  7. National Electric Manufacturer's Association (NEMA).
  8. American Society of Mechanical Engineers (ASME).
  9. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)
  10. ASHRAE 62 IAQ as applicable.
  11. Air Movement and Control Association (AMCA).
  12. Institute of Electrical and Electronic Engineers (IEEE).
  13. American Standard Code for Information Interchange (ASCII).
  14. Electronics Industries Association (EIA).
  15. Occupational Safety and Health Administration (OSHA).
  16. American Society for Testing and Materials (ASTM).
  17. Federal Communications Commission (FCC) including Part 15, Radio Frequency Devices.
  18. Americans Disability Act (ADA)
  19. ANSI/EIA 909.1-A-1999 (LonWorks)
  20. ANSI/ASHRAE Standard 195-2004 (BACnet)
- B. In the case of conflicts or discrepancies, the more stringent regulation shall apply.
- C. Obtain all required permits and inspection certificates. All permits and certificates shall be available to the Owner.
- D. The latest requirements of all national, county, municipal and other authorities having jurisdiction shall be met.
- E. Work shall be performed in compliance with the Owner's insurance underwriter and requirements.
- F. All electrical equipment, devices and components and their installation shall comply with the latest edition of the IEEE Wiring and all associated addenda.
- G. The BAS Contractor shall only offer equipment that meets UL 916 requirements and all electrical components shall be UL listed and shall carry the UL label.
- H. The BAS shall be listed and manufactured to ISO 9001 and ISO 9002 standards.
- I. All work shall conform to the requirements described in the electrical specifications. Where there is any conflict between the requirements of the different project trade sub-contract documents, statutes, codes, regulations, local ordinances and any requirement of an agency having jurisdiction over the project, the most stringent requirement shall apply unless determined otherwise by the Owner. Advise the Engineer of any discrepancy or conflicts between the various requirements for the project.
- J. Equipment, devices and materials shall be immune against Electro-Magnetic interferences and shall conform to all performance requirements of the specifications.

## 1.9 SUBMITTALS

- A. Shop Drawings, Product Data, and Samples
  1. Submittals shall be in defined packages. Each package shall be complete and shall only reference itself and previously submitted packages. The packages shall be as approved by the Architect and Engineer for Contract compliance.
  2. Allow 15 working days for the review of each package by the Architect and Engineer in the scheduling of the total BAS work.

3. Equipment and systems requiring approval of local authorities must comply with such regulations and be approved. Filing shall be at the expense of the BAS Contractor where filing is necessary. Provide a copy of all related correspondence and permits to the Owner.
4. Prepare an index of all submittals and shop drawings for the installation. Index shall include a shop drawing identification number, Contract Documents reference and item description.
5. The BAS Contractor shall correct any errors or omissions noted in the first review.
6. Graphics submittal shall be provided to owner and engineer for review 8 weeks after vendor award.
7. At a minimum, submit the following:
  - a. BAS Network architecture diagrams including all nodes and interconnections.
  - b. Systems schematics, sequences and flow diagrams.
  - c. Product data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated. Each control devices shall be labeled with setting or adjustable range of control.
  - d. Points schedule for each point in the BAS, including: Point Type, Object Name, Expanded ID, Display Units, Controller type, and Address.
  - e. Samples of Graphic Display screen types and associated menus.
  - f. Detailed Bill of Material list for each system or application, identifying quantities, part numbers, descriptions, and optional features.
  - g. Control Damper Schedule including a separate line for each damper provided under this section and a column for each of the damper attributes, including: Code Number, Fail Position, Damper Type, Damper Operator, Duct Size, Damper Size, Mounting, and Actuator Type.
  - h. Control Valve Schedules including a separate line for each valve provided under this section and a column for each of the valve attributes: Code Number, Configuration, Fail Position, Pipe Size, Valve Size, Body Configuration, Close off Pressure, Capacity, Valve CV, Design Pressure, and Actuator Type.
  - i. Room Schedule including a separate line for each VAV box and/or terminal unit indicating location and address.
  - j. Details of control panel faces, including controls, instruments and labeling.
  - k. Submit shop drawings of all control field panels for review before fabrication.
  - l. Trunk cable schematic showing all programmable control unit locations, all third party interface equipment locations, and trunk data conductors.
  - m. Provide a schedule showing locations and electrical characteristics for power connections.
  - n. Details of all BAS interfaces and connections to the work of other trades.
  - o. Product data sheets or marked catalog pages including part number, photo and description for all products including software, with corresponding specification section reference.
- B. Bidders will provide a Compliance Review of the Specifications and Addenda (if any). The Compliance Review shall be a paragraph-by-paragraph review of the Specifications with the following information, "C", "D" or "E" marked in the margin of the original Specifications and any subsequent Addenda.
  1. "C": Comply with no exceptions.
  2. "D": Comply with deviations. For each and every deviation, provide a numbered footnote with reasons for the proposed deviation and how the intent of the Specification can be satisfied.
  3. "E": Exception, do not comply. For each and every exception, provide a numbered footnote with reasons and possible alternatives.
- C. Unless a deviation or exception is specifically noted in the Compliance Review, it is assumed that the Bidder is in complete compliance with the plans and Specifications. Deviations or exceptions taken in cover letters, subsidiary documents, by omission or by contradiction do not release the Bidder from being in complete compliance, unless the exception or deviation has been specifically noted in the Compliance Review. The Bidder may submit the latest state-of-the-art components in lieu of specified items. All deviations from the Specifications must be approved by the Engineer.
- D. Proposal shall include the time and expenses for BAS vendor to participate in one (1) week of Commissioning testing. The BAS will be demonstrated during the aforementioned BAS system Cx testing. The aforementioned equipment Vendors will be responsible for providing the time and resources needed in order for the BAS to set up a temporary, mobile "head end" on a cart prior to the project team

arrival. This will include a graphical display and electronic recording of all specified status and alarms parameters.

- E. Software and Firmware Operational Documentation: Include the following:
  - 1. Software operating and upgrade manuals.
  - 2. Program Software Backup
  - 3. Device address list
  - 4. Printout of software application and graphic screens.
  - 5. Software license required by and installed for BAS workstations and control systems.
- F. Software Upgrade Kit: For owner to use in modifying software to suit future monitoring and control revisions.
- G. Qualification Data
  - 1. General: Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors. Revise Shop Drawings to reflect actual installation and operating sequences.
- H. Contract Closeout Submittals: All manuals shall be 100 percent custom written for this project. Closeout documents will include all as built software and hardware revision documentation, including a step-by-step, 'easy to read' decision tree diagram, which would lead facility operating personnel to specific manual sections for operating procedures, maintenance procedures, and diagnostic/trouble-shooting procedures. All manuals will be subject to the approval of Owner and Engineer prior to the warranty period, and shall provide as a minimum:
  - 1. Project Record Documents for:
    - a. Electronic As-Built Drawings in AutoCAD Format.
    - b. As-Built Riser Diagram.
    - c. Final software database (electronic). Includes PICS documentation regarding the BACnet object ID, component IP addresses, databases for all system database points.
    - d. Complete program listing with section and line by line comments.
    - e. Color coding, labeling, and other identification for point to point wiring.
  - 2. Operation and Maintenance Documentation for:
    - a. Operation and maintenance manuals for each system component.
    - b. List of recommended system spare parts.
  - 3. Test Data for:
    - a. All final system field test data to of temperature, humidity, water flow measurement, room differential pressure, etc. shall be provided in a standalone document to the Owner.
  - 4. Warranty Documentation for:
    - a. Materials, manufactured units, equipment and components.
    - b. Software.
    - c. Auxiliary system equipment.

#### 1.10 WARRANTY

- A. Standard Material and Labor Warranty:
  - 1. Provide a one-year labor and material warranty on the BAS.
  - 2. If within twelve (12) months from the date of acceptance of product, upon written notice from the owner, it is found to be defective in operation, workmanship or materials, it shall be replaced, repaired or adjusted at the option of the BAS Contractor at the cost of the BAS Contractor.
  - 3. Maintain an adequate supply of materials and local staff within 100 miles of the Project site such that replacement of key parts and labor support, including programming. Warranty work shall be done during BAS Contractor's normal business hours.
- B. Any material furnished by the BAS contractor which is defective or fails during normal operation of the system, shall be remedied (replaced or repaired) immediately by the BAS Contractor at no additional cost to the Owner, during the period prior to the issue of the certificate of completion, and during the warranty period.
- C. Repair work shall only be undertaken at times approved by the Owner.
- D. Respond and be on site within 4 hours of the Engineer and/or Owner placing a system trouble call for items of an immediate nature (e.g. failed component, non-functioning controller, etc.).

- E. Response to warranty calls made by the Engineer and/or Owner shall be within 24 hours for items not requiring immediate attention.
- F. Work to troubleshoot and identify the cause of the BAS system or component failure shall begin immediately and shall continue until repaired to the satisfaction of the Engineer and Owner.
- G. Any software upgrades and new software programs that become standard product offerings from the BAS Contractor and/or BAS equipment vendors during the Defects Liability Period shall be brought to the attention of the Owner together with the cost and, if the Owner wishes, he shall purchase the software. If at any time during the Defects Liability Period, software patches that correct software errors becomes available, the Owner shall be notified immediately and they shall be made available to the Owner at no additional cost.

#### 1.11 SCHEDULE

- A. Complete site requirements of the BAS sub-contract in accordance with the project program and prior to the scheduled Substantial Completion date for each phase.
- B. Attend project meetings as requested by the General Contractor.
- C. Provide to the General Contractor a schedule indicating the sequence of work, durations of individual tasks, delivery dates for all material, devices and equipment and detail any interface that must be coordinated with any other Specialists.
- D. Provide written status reports at required intervals in an electronic format acceptable to the Engineer. An updated schedule of work shall be included in each status report.
- E. Comply with the Project Construction Schedule. Provide additional staffing or work overtime as required to comply with the Project Schedule so as not to interfere with other on-site Specialists in their effort to comply with the Overall Project Schedule. Confirm, prior to tender submittal that all equipment, devices, material and services proposed are available and will be delivered accordingly to comply with the Overall Project Schedule.
- F. Provide written Request For Information (RFI) notices to the Engineer when specific information or clarification of the specifications is required. Request For Information notices shall be provided at least two (2) weeks prior to the need for the information to the Engineer.

#### 1.12 SPARE PARTS

- A. Submit spare parts lists for each different item of equipment furnished. Data to include a complete list of each supplier and product by part number, a list of parts and supplies that are either normally furnished at extra cost with the purchase of the equipment, or specified hereinafter as "Extra Materials" to be furnished as part of the sub-contract.
- B. Submit a list of additional items recommended by the manufacturer to assure efficient operation for a period of 360 days at the particular installation. The foregoing shall not relieve the BAS Contractor of any responsibilities during the BAS Warranty Period.

#### 1.13 EXTRA MATERIALS

- A. Provide special hardware and software tools required for maintenance or calibration of sensors or instruments.

### PART 2 - PRODUCTS

#### 2.1 GENERAL DESCRIPTION

- A. The Building Automation System (BAS) shall use an open architecture and fully support a multi-vendor environment. To accomplish this effectively, the BAS shall support open communication protocol standards and integrate a wide variety of third-party devices and applications. The system shall be designed for use on the Internet, or intranets using off the shelf, industry standard technology compatible with other owner provided networks.

- B. The system shall be modular in nature, and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, controllers and operator devices, while re-using existing controls equipment.
- C. System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution.
  - 1. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.
  - 2. The System shall maintain all settings and overrides through a system reboot.
- D. System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution.
- E. Acceptable Manufacturers
  - 1. Automated Logic
  - 2. Delta Controls
  - 3. Distech Controls
  - 4. Johnson Controls, Metasys
  - 5. KMC Controls
  - 6. Siemens, Apogee
  - 7. Trane

## 2.2 LABELING

- A. Provide engraved tag labeling for all DDC controllers, gateways, routers, hubs, field level components, panels and enclosures, etc., Labeling shall meet, at minimum, the following requirements:
  - 1. Engraved tags that shall be affixed to the panel or enclosure with rivets or permanent adhesive.
  - 2. Lettering 0.025 inch high that sharply contrasts the background color.
  - 3. Consistent throughout the project.
  - 4. Indicate all changes on the record (close-out) documents.
  - 5. Provide list of components inside each panel enclosure.
  - 6. Provide laminated wiring diagram of each panel or enclosure inside door.
- B. Provide labeling of all cabling. Labeling shall meet, at minimum, the following requirements:
  - 1. Identified with permanent tag or self-adhesive label within the panel.
  - 2. Cross referenced on the associated record (close-out) documentation and laminated record drawing within the panel enclosure showing wiring and all components contained within enclosure.
  - 3. The BAS Contractor shall provide labeling for all cable furnished and installed by the BAS Contractor.

## 2.3 PANEL AND ENCLOSURES

- A. Install equipment (servers, printers, routers, etc.) in a secure, lockable enclosure, suitable for mounting peripheral equipment and data network equipment. Enclosure will be free-standing, with a minimum height of 4 ½ feet from finish floor.
- B. Provide panels and enclosures for all components of the BAS except where it is specifically identified within these contract documents that the enclosure shall be furnished by another trade. Panels and enclosures shall meet, at minimum, the following requirements:
  - 1. Painted steel panels with locking door. All panels shall be lockable with the same key.
  - 2. Ventilated to prevent excessive heat buildup, where required.
  - 3. Field cabling shall be terminated on a terminal strip. Provide cable support.
  - 4. Internal components shall be installed to allow easy access for diagnostics, maintenance, removal or replacement.
  - 5. Panel or enclosure shall be suitable rated for the environment for which it is to be installed, Interior enclosures shall be, at minimum, NEMA I and exterior enclosures shall be weatherproof NEMA IV unless specifically noted otherwise within these documents.
- C. Panels and enclosures shall only be located as indicated on the control submittal drawings approved by Engineer.



- D. The BAS Contractor shall coordinate with the trade furnishing the motor starters and variable frequency drives to provide an interface terminal strip (for BAS Contractor use) in a dedicated external enclosure or a compartment within the motor starter enclosure. Refer to the sub-contract documents for the trade furnishing the motor starter and the variable frequency drive controllers for the details of the enclosure. DDC controllers shall not be located in the MCC panels.

#### 2.4 CONDUIT AND FITTINGS

- A. The BAS Contractor shall provide conduit and fittings as necessary for a fully functioning system as detailed in these specifications.
- B. Flexible metallic rustproof conduit shall be provided for the final one (1) meter before connection from a non-vibrating location to equipment subject to vibration or movement. Flexible metallic conduit shall be provided for between the last 300 mm (12 inches) and the last 1000 mm (39 inches) of connection to field instrumentation, relays and final control elements as necessary to facilitate the removal of devices without the disconnection or the bending of the non-flexible conduit. Watertight conduit shall be provided where appropriate. Flexible conduit shall not exceed 1000 mm (39 inches).
- C. Conduit shall run parallel or perpendicular to the building lines and shall be installed in a workmanlike manner. Avoid obstructions and crossovers where possible.
- D. Conduit shall be installed such that any condensation in the conduit cannot run into BAS equipment. Where necessary conduit shall enter enclosures from the bottom or shall be sloped up to the enclosure. All conduit entrances into a NEMA 3R or higher enclosure shall penetrate into the bottom or the back.
- E. Junction and pull boxes shall be securely fastened to the conduit and be accessible where required by code or where necessary to facilitate the pulling of cables.
- F. Coordinate installation of conduit with building structure and other trades.
- G. Containment shall be provided, for all BAS cable except where specifically noted otherwise.
- H. Signal wiring and cables shall be installed in minimum sized raceways and/or electric metallic tubing (EMT) where required by local code authorities.
- I. Following shall be minimum approved raceways for their specific application:
  - 1. EMT: Machine rooms, electrical closets, building exterior and in all locations where cables are subject to mechanical damage.
  - 2. Plenum Rated Cable (Without Conduit): From field equipment/sensors above accessible ceilings. Locations where cable is protected by building construction.

#### 2.5 CABLE - COPPER

- A. Provide all cables for the BAS Automation and Field levels, including all cables to interconnect the BAS Management level devices and the BAS Management level Network as detailed in these specifications. Cables shall meet, at minimum, the following requirements:
  - 1. Minimum 98% conductivity copper.
  - 2. Stranded conductors.
  - 3. Proper impedance for the application as recommended by the BAS component manufacturer.
- B. All field level cables shall Plenum-type Teflon insulated (LSF - Low Smoke and Fire) rated. This includes cables which are enclosed in conduit.
- C. Terminations shall be mechanically and electrically secure. Twist type wire nuts shall not be acceptable. Insulated tinned copper lugs shall be provided.
- D. Cable within panels or enclosures shall be installed in wiring guides.
- E. LSF cables not required to be in conduit (refer to requirements for conduit above) shall be routed parallel and perpendicular with the building column lines or parallel to ductwork, mounted directly above the duct in rings. Cables in ceilings shall be run as close to the structure as possible. Provide metal cable rings and supports to support the cabling. Supports shall be positioned in accordance with NEC. Cables directly attached to existing objects such as ceiling wire, duct strap or all thread will not be accepted.
- F. All wiring terminations within field panels shall be terminated at terminal stripes and shall be marked by identification tags on each end of the cable at each terminal strip. The identification tag shall clearly state the destination and function of the wire (example: CH-1 CHWST). All termination strips shall be labeled.
- G. All LSF wiring installation above accessible ceilings shall be such that there will be no interference with the installation of lighting fixtures, fire protection devices, air distribution devices or any other devices.

## 2.6 CABLE - FIBER OPTIC

- A. Fiber optic cable may be used for data communication.
- B. Fiber optic cable (data transmission) shall meet, at minimum, the following requirements:
  - 1. 50 micron core (multi-mode or single mode fiber).
  - 2. 850 nm or 1300 nm LED compatible operation, as required.
- C. Fiber optic cable shall comply with ANSI/TIA/EIA-862 (Building Automation Systems Cabling Standard for Commercial Buildings) and all other applicable codes.

## 2.7 NETWORK SWITCHES

- A. General
  - 1. The Switch will be DIN rail mountable out of the box, without the requirement to add or assemble any adaptor or similar mounting plate.
  - 2. DIN rail mounted switches shall be capable of being installed side by side, with no gap or air space required for heat dissipation, with no loss of accuracy.
  - 3. DIN rail mounted switches will be installed in BAS panels or server racks (where approved by the Owner) that provide appropriate protection from environmental influences. All network switches shall be installed indoors. Connections to outdoor equipment shall be protected from lightning surges.
  - 4. Switches serving multiple pieces of equipment shall only be installed in panels provided with dual fed power and an ATS. These shall operate on the self-healing loop.
  - 5. All switch connectors will be clearly labeled to provide easy reference.
  - 6. Performance Criteria:
    - a. Operating temperature range: -20°C to +60°C (-4°F to +140°F)
    - b. ESD Protection: 4KV to 6KV
    - c. RF Rejection: 3 Volts/Meter
    - d. Vibration: 5G
  - 7. The switch will withstand a maximum continuous operating humidity of 95% without condensation.
  - 8. Units should be of fan-less design to increase reliability.
- B. Switching Capabilities:
  - 1. Auto-Negotiation
    - a. All Copper TX ports will support auto negotiation.
    - b. Each TX port will be able to interface to 10/100/1000 Mbps or full/half duplex devices.
    - c. Fiber optic ports will only support continuous 1000 Mbps full duplex communications.
  - 2. Auto Cross
  - 3. All TX ports will support MDIX providing cable autocross capability.
  - 4. Accuracy and Capacity of switching table.
    - a. The switch will only forward valid Ethernet frames using the store and forward or equivalent method.
    - b. The MAC address table will have a storage capacity of 1000 addresses.
    - c. Diagnostics.
  - 5. Port Status LED's
  - 6. Link: Each port will have an LED indication that there is a proper electrical connection to the attached device as well as providing indication that there is port activity
  - 7. Communication: Each port will have an LED indication for detection of packet collisions, and showing communication duplex mode
  - 8. To simplify the process of troubleshooting, the status indication of heavy communications traffic vs. the status of an active link with no communications traffic will be unambiguous.
    - a. Alarm Contact
  - 9. Switch to be equipped with an alarm contact to enable automatic audible or visual alarm in the event of loss of port communication, or either (or both) power supply inputs. BAS shall monitor the alarm contact.
  - 10. Switch to be equipped with an LED to indicate the status of the alarm contact.
    - a. Power Supply LED

11. Switch will have a separate power indication LED for each power supply connection.
  - a. BACnet MS/TP: 76,800 kbps
  - b. Modbus RS-485: 38,400 kbps

## 2.8 OPERATOR INTERFACE WORKSTATION (OIW)

- A. Where indicated on plans the BAS Contractor shall provide and install a personal computer for command entry, information management, network alarm management, and database management functions. All real-time control functions, including scheduling, history collection and alarming, shall be resident in the BAS Network Automation Engines to facilitate greater fault tolerance and reliability.
- B. The architecture of the computer shall be implemented to conform to industry standards, so that it can accommodate applications provided by the BAS Contractor and by other third party applications suppliers, including but not limited to Microsoft Office Applications.
- C. The BAS Workstation shall have Microsoft Windows 7 or Server 2008 operating system or the latest version of this software at time of implementation.
- D. PC Hardware– The personal computer(s) shall be configured as follows:
  1. Memory – 12 GB
  2. CPU– Intel Core I7 processor with quad cores. Minimum processor speed of 3.2 GHz.
  3. Hard Drive – Two (2) 1.5 TB hard disks in a RAID 1 configuration
  4. Hard drive backup system – CD/RW, DVD/RW or network backup software provided by IT department
  5. 16X speed R/RW DVD drive
  6. Ports – two (2) Serial and one (1) parallel, two (2) USB ports
  7. Keyboard – 101 Keyboard and 2 Button Mouse
  8. Dual 100/1000 Mbps Ethernet adaptors
  9. Real time software or hardware clock
  10. Dual integral power supplies which shall be suitably rated for the service. Server shall be provided with two (2) dedicated UPS circuits.
- E. Provide an alarm to uniquely identify a communication failure.
- F. Following a power failure, all PC's shall return to a fully operational status without operator intervention within two (2) minutes of the return of mains power. Software changes, including modifications to database(s), shall not be lost in a power failure.
- G. All PCs shall be the latest model at the time of purchase and shall be from a recognized manufacturer of PCs. Purchase of the PC shall be delayed until the latest time possible without causing a delay in the BAS installation schedule in order to ensure that it is state-of-the-art and is based on the latest proven technology prior to purchasing. All PCs shall be suitable for rugged and continuous operation.
- H. The OIW shall have one (1) report printer. Where there are multiple OIW at one location, report printers shall be networked such that they are available to each OIW.

## 2.9 PERIPHERAL OPERATOR I/O DEVICES

- A. Printers: General
  1. The operator shall be able to direct the hardcopy output to any printer. The BAS Contractor shall set up the system such that all BAS generated messages such as alarms, returns to normal, etc. are directed to the appropriate alarm printers and all BAS automatically generated and operator requested reports are output to the appropriate report printer.
  2. The printers at one location shall be accessible from any OIW such that an operator at one location can generator a hardcopy message at any other location.
- B. Report Printers:
  1. The report printer shall meet, at minimum, the following specifications:
    - a. Minimum print speed of twelve pages per minute black and three pages per minute color. Slower speed printers shall not be acceptable when printing in normal quality.
    - b. Scalable fonts.
    - c. Single or double bin paper trays, capable of printing A3 size and A4 size.
    - d. Page feed and page discharge controls.
    - e. Color and black and white printing capacity without changing ink or toner cartridges.

- f. 1200 dpi black and white and 600 x 300 dpi color.
  - g. Laser technology.
- C. Keyboard:
- 1. Provide a keyboard for operator access at each OIW and data server location. This shall be in addition to any other operator input device such as a mouse.
  - 2. The keyboard shall be in a standard typewriter (QWERTY) configuration with a full alphanumeric standard ASCII character set and with additional dedicated keys for other functions associated with the BAS print screen. Keyboard shall be wired or rechargeable wireless.
- D. Mouse:
- 1. Provide a mouse at each OIW and data server and configure the system such that cursor control can be undertaken from both the keyboard and mouse as selected by the operator.
  - 2. Mouse shall not have a rolling ball. Mouse shall have at least two buttons and a clickable, side tilting scroll wheel.
  - 3. Mouse shall be wired or rechargeable wireless.
- E. Video Display Unit (VDU)
- 1. Provide two (2) high-resolution LCD displays at OIW location, the monitor shall be a flat panel LCD type, 16:9 aspect ratio.
  - 2. The VDU shall be used for the display of operator entered and requested data and the output of BAS generated alarm and other information.
  - 3. The VDU shall have a minimum screen diagonal measurement of 21 inches.
  - 4. The VDU shall have a minimum resolution of 1600 x 900 pixels with 120 Hz minimum refresh rate.
  - 5. The unit shall be capable of displaying both schematic and alphanumeric data at the same time.
  - 6. A minimum of 16.7 million discrete colors shall be available for display selection.

## 2.10 BAS SYSTEM SOFTWARE

- A. General
- 1. All necessary software to form a complete operating system as described in this specification shall be provided.
  - 2. The software programs specified in this Section shall be provided as an integral part of the DDC controller and shall not be dependent upon any higher level computer for execution.
- B. Control Software Description:
- 1. Pre-Tested Control Algorithms: The DDC controllers shall have the ability to perform the following pre-tested control algorithms:
    - a. Two Position Control
    - b. Proportional Control
    - c. Proportional plus Integral Control
    - d. Proportional, Integral, plus Derivative Control
    - e. Automatic Control Loop Tuning
  - 2. All programs shall be executed automatically without the need for operator intervention and shall be flexible enough to allow operator customization. Programs shall be applied to building equipment as described in the Execution portion of this specification.
  - 3. Custom Process Programming Capability: DDC controllers shall be able to execute custom, job-specific processes defined by the operator, to automatically perform calculations and specific control routines.
    - a. Process Inputs and Variables: It shall be possible to use any of the following in a custom process:
      - 1) Any system-measured point data or status
      - 2) Any calculated data
      - 3) Any results from other processes.
      - 4) User-Defined constraints
      - 5) Arithmetic functions
      - 6) Boolean logic operators
      - 7) On-delay/Off-delay/One-shot timers

- b. Process Triggers: Custom processes may be triggered based on any combination of the following:
  - 1) Time interval
  - 2) Time of day
  - 3) Date
  - 4) Other processes
  - 5) Time programming
  - 6) Events
  - 7) Restart of equipment following the return to normal condition after equipment shutdown by the Fire Alarm Systems (FAS)
4. Dynamic Data Access: A single process shall be able to incorporate measured or calculated data from any and all other DDC controllers on the local area network. In addition, a single process shall be able to issue commands to points in any and all other DDC panels on the local area network.
5. Advisory/Message Generation: Processes shall be able to generate operator message and advisories to operator I/O devices. A process shall be able to directly send a message to a specified device, buffer the information in a follow-up file, or cause the execution of a dial-up connection to a remote device such as a printer.
6. Custom Process Documentation: The custom control programming feature shall be self-documenting. All interrelationships defined by this feature shall be documented via graphical flowcharts and English language descriptors.
7. Alarm Management: Alarm management shall be provided to monitor, buffer, and direct alarm reports to operator devices and memory files. Each DDC controller shall perform distributed independent alarm analysis and filtering to minimize operator interruptions due to non-critical alarms, minimize network traffic, and prevent alarms from being lost. At no time shall the DDC's ability to report alarms be affected by either operator activity at a PC Workstation or local I/O device, or communications with other panels on the network. Each analog input shall have associated alarm and pre-alarm (warning) levels that are software adjustable. Provide a minimum of one high alarm, one high warning alarm, one low alarm and one low warning alarm level per analog input.
  - a. Point Change Report Description: All alarm or point change reports shall include the points English language description and the time and date of occurrence.
  - b. Prioritization: The user shall be able to define the specific system reaction for reach point. Alarms shall be prioritized to minimize nuisance reporting and to speed operator response to critical alarms. A minimum of three priority levels shall be provided. Each DDC shall automatically inhibit the reporting of selected alarms during system shutdown and start-up. Users shall have the ability to manually inhibit alarm reporting for each point as well as be able to define under which conditions point changes need to be acknowledged by an operator, and/or sent to follow-up files for retrieval and analysis at a later date.
  - c. Report Routing: Alarm reports, messages, and files will be directed to a user-defined list of operator devices or PC disk files used for archiving alarm information. Alarms shall also be automatically directed to a default device in the event a primary device is found to be off-line.
  - d. Alarm Messages: In addition to the point's descriptor and the time and date, the user shall be able to print, display or store a minimum of 65 character alarm message to more fully describe the alarm condition or direct operator response. Each standalone DDC shall be capable of storing a library of at least 250 Alarm Messages which are assignable to any number of points in the panel.
  - e. Auto-Dial Alarm Management: In Dial-up applications, only critical alarms shall initiate a call to a remote operator device. In all other cases, call activity shall be minimized by time-stamping and saving reports until an operator scheduled time, a manual request, or until the buffer space is full. The alarm buffer must store a minimum of 50 alarms.
  - f. Transaction Logging: Operator commands and system events shall be automatically logged to disk in Personal Computer industry standard database forma. Operator commands initiated from Direct-connected workstations, dial-up workstations, and local DDC panel Network Terminal devices shall be logged to this transaction file. This data shall be

available at the OIW. Facility shall be provided to allow the user to search the transaction file using standard database query techniques, including searching by dates, operator name, data point name, etc. In addition, this transaction file shall be accessible with standard third party database and spreadsheet packages.

8. Historical Data and Trend Analysis: A variety of historical data collection utilities shall be provided to automatically sample, store, and display system data in all of the following ways:
  - a. Continuous Point Histories: Standalone DDC's shall store Point History Files for all analog and binary inputs and outputs. The Point History routine shall continuously and automatically sample the value of all analog inputs at half hour intervals. Samples for all points shall be stored for the past 24 hours to allow the user to immediately analyze equipment performance and all problem related events for the past day. Point History Files for binary input or output points and analog output points shall include a continuous record of the last ten status changes or commands for each point.
  - b. Control Loop Performance Trends: Standalone DDC's shall also provide high resolution sampling capability in one-second increments for verification of control loop performance.
  - c. Extended Sample Period Trends: Measured and calculated analog and binary data shall be assignable to user-definable trends for the purpose of collecting operator-specified performance data over extended periods of time. Sample intervals of 1 minute to 2 hours shall be provided. Each standalone DDC shall have a dedicated buffer for trend data, and shall be capable of storing a minimum of 500 data samples.
  - d. Data Storage and Archiving: Trend data shall be stored at the Standalone DDC's and uploaded to hard disk storage when archival is desired. Uploads shall occur based upon either user-defined interval, manual command, or when the trend buffers become full. All trend data shall be available in a format compatible with Third Party personal computer applications such as Microsoft Excel.
  - e. Trends shall be available and enabled on all input and output points, all PID outputs, and all set points at minimum. Initial trend time increment shall be 1 minute.
  - f. Controls contractor shall include pricing for programming a minimum of 5 control points as coordinated with the owner. Refer to Section 23 09 93 for available points.
- C. Operator Interface Workstation (OIW) Software
  1. Operator Interface Software - General
    - a. An integrated browser based client application shall be used as the user operator interface program.
    - b. All Inputs, Outputs, Set points, and all other parameters as defined within Part 3, shown on the design drawings, or required as part of the system software, shall be displayed for operator viewing and modification from the operator interface software.
    - c. The user interface software shall provide help menus and instructions for each operation and/or application.
    - d. The system shall support user preferences in the following screen presentations:
      - 1) Alarm
      - 2) Trend
      - 3) Display
      - 4) Applications
    - e. All controller software operating parameters shall be displayed for the operator to view/modify from the user interface. These include: set points, alarm limits, time delays, PID tuning constants, run-times, point statistics, schedules, and so forth.
    - f. The operation of the control system shall be independent of the user interface, which shall be used for operator communications only. Systems that rely on an operator workstation to provide supervisory control over controller execution of the sequences of operations or system communications shall not be acceptable.
  2. Alarms
    - a. Each workstation shall receive and process alarms sent to it by the control system. The alarm management portion of the operator workstation software shall, at a minimum, provide the following functions:
      - 1) Log date and time of alarm occurrence.

- 2) Generate a "Pop-Up" window, with audible alarm, informing a user that an alarm has been received.
  - 3) Allow a user, with the appropriate security level, to acknowledge, temporarily silence, or discard an alarm.
  - 4) Provide an audit trail on hard drive for alarms by recording user acknowledgment, deletion, or disabling of an alarm. The audit trail shall include the name of the user, the alarm, the action taken on the alarm, and a time/date stamp.
  - 5) Record all alarms received at that operator's workstation on to the hard drive.
  - 6) Provide the ability to direct alarms to an e-mail address or alphanumeric pager. This must be provided in addition to the pop up window described above. Systems that use e-mail and pagers as the exclusive means of annunciating alarms are not acceptable.
  - 7) Any attribute of any object in the system may be designated to report an alarm.
  - b. The BAS shall annunciate diagnostic alarms indicating system failures and non-normal operating conditions.
  - c. The BAS shall annunciate application alarms at minimum, as required by Part 3.
  - d. Alarms shall be generated by the operator workstation for any controller that is "OFF-LINE" and is not communicating, or does not have an active control program loaded.
  - e. Changes to alarms at the operator workstation shall directly modify the controller alarm management database.
3. Reports and Summaries
- a. Reports and Summaries shall be generated and directed to the user interface displays, with subsequent assignment to printers, or disk. As a minimum, the system shall provide the following reports:
    - 1) All points in the BAS
    - 2) All points in each BAS application
    - 3) All points in a specific controller
    - 4) All points in a user-defined group of points, including, but not limited to:
      - a) Values
      - b) Set points
      - c) Alarm Limits
      - d) Statistics
      - e) Run Times
    - 5) All points currently in alarm
    - 6) All points in hardware override
    - 7) All points locked out
    - 8) All BAS schedules
    - 9) All disabled alarms
    - 10) All active, un-acknowledged alarms
    - 11) All active, acknowledged alarms
    - 12) All user defined and adjustable variables, schedules, interlocks and the like.
  - b. Summaries and Reports shall be accessible via standard UI functions and not dependent upon custom programming or user defined HTML pages.
  - c. System shall allow for creation for custom report point groups as defined by the operator that shall be capable of pulling points from multiple controllers.
  - d. Selection of a single menu item, tool bar item, or tool bar button shall print any displayed report or summary on the system printer for use as a Building Automation and diagnostics tool.
  - e. Provide the capability to view, command and modify large quantities of similar data in tailored summaries created online without the use of a secondary application like a spreadsheet. Summary definition shall allow up to seven user defined columns describing attributes to be displayed including custom column labels. Summary viewing shall be available over the network using a standard Web browser.
  - f. Reports shall be selectable by date, time, area and device. Each report shall include a color visual summary of essential energy information.
4. Schedules

- a. A graphical display for time-of-day scheduling and override scheduling of building operations shall be provided. At a minimum, the following functions shall be provided:
    - 1) Weekly schedules
    - 2) Exception Schedules
    - 3) Monthly calendars
  - b. Weekly schedules shall be provided for each group of equipment with a specific time use schedule.
  - c. It shall be possible to define one or more exception schedules for each schedule including references to calendars.
  - d. Monthly calendars shall be provided that allow for simplified scheduling of holidays and special days for a minimum of five years in advance. Holidays and special days shall be user-selected with the pointing device or keyboard, and shall automatically reschedule equipment operation as previously defined on the exception schedules.
  - e. Changes to schedules made from the User Interface shall directly modify the schedule database.
  - f. Schedules and Calendars shall comply with ASHRAE SP135/2003 BACnet Standard.
  - g. Selection of a single menu item or tool bar button shall print any displayed schedule on the system printer for use as a Building Automation and diagnostics tool.
  - h. Software shall be provided to configure and implement optimal start and stop programming based on existing indoor and outdoor environmental conditions as well as equipment operating history.
5. Password
- a. Multiple-level password access protection shall be provided to allow the user/manager to user interface control, display, and database manipulation capabilities deemed appropriate for each user, based on an assigned password.
  - b. Each user shall have the following: a username and password (accept 8 characters minimum), and access levels.
  - c. The system shall prevent the use of simple or common passwords.
  - d. The system shall allow each user to change his or her password at will.
  - e. When entering or editing passwords, the system shall not echo the actual characters for display on the monitor.
  - f. A minimum of five levels of access shall be supported individually or in any combination as follows:
    - 1) Level 1 = View Data
    - 2) Level 2 = Command
    - 3) Level 3 = Operator Overrides
    - 4) Level 4 = Database Modification
    - 5) Level 5 = Database Configuration
    - 6) Level 6 = All privileges, including Password Add/Modify
  - g. Operators shall be able to perform only those commands available for their respective passwords. Display of menu selections shall be limited to only those items defined for the access level of the password used to log-on.
  - h. The system shall automatically generate a report of log-on/log-off and system activity for each user. Any action that results in a change in the operation or configuration of the control system shall be recorded, including: modification of point values, schedules or history collection parameters, and all changes to the alarm management system, including the acknowledgment and deletion of alarms.
6. Screen Manager – The OIW shall be provided with a screen management application that allows the user to activate, close, and simultaneously manipulate a minimum of 16 windows across a minimum of 4 physical screens.
7. Graphical User Interface (GUI)
- a. Operating System: The GUI shall run on Microsoft Windows 7 or later.
  - b. The GUI shall employ browser-like functionality for ease of navigation. It shall include a tree view (similar to Windows Explorer) for quick viewing of, and access to, the hierarchical structure of the database. In addition, menu-pull downs, and toolbars shall employ buttons, commands and navigation to permit the operator to perform tasks with a



- minimum knowledge of the HVAC Control System and basic computing skills. These shall include, but are not limited to, forward/backward buttons, home button, and a context sensitive locator line (similar to a URL line), that displays the location and the selected object identification.
- c. Real-Time Displays. The GUI, shall at a minimum, support the following graphical features and functions:
    - 1) Graphic screens shall be developed using any drawing package capable of generating a GIF, BMP, or JPG file format. Use of proprietary graphic file formats shall not be acceptable. In addition to, or in lieu of a graphic background, the GUI shall support the use of scanned pictures.
    - 2) Graphic screens shall have the capability to contain objects for text, real-time values, animation, color spectrum objects, logs, graphs, HTML or XML document links, schedule objects, hyperlinks to other URL's, and links to other graphic screens.
    - 3) Graphics shall support layering and each graphic object shall be configurable for assignment to a layer. A minimum of six layers shall be supported.
    - 4) Modifying common application objects, such as schedules, calendars, and set points shall be accomplished in a graphical manner.
    - 5) Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
    - 6) Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.
    - 7) Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.
    - 8) Adjustments to analog objects, such as set points, shall be done by right-clicking the selected object and using a graphical slider to adjust the value. No entry of text shall be required.
  - d. System Configuration. At a minimum, the GUI shall permit the operator to perform the following tasks, with proper password access:
    - 1) Create, delete or modify control strategies.
    - 2) Add/delete objects from the system
    - 3) Tune control loops through the adjustment of control loop parameters.
    - 4) Enable or disable control strategies.
    - 5) Manual Override of any piece of equipment operation start/stop
    - 6) Generate hard copy records or control strategies on a printer.
    - 7) Select points to be alarmable and define the alarm state.
    - 8) Select points to be trended over a period of time and initiate the recording of values automatically.
  - e. Symbol library – The BAS system shall be provided with a very complete symbol library containing all of the basic symbols used to represent HVAC, Electrical, Fire, and Security components of a typical BAS system.
  - f. Symbols shall be able to be added to any graphic display being constructed by simply dragging the symbol from the library to the graphic under construction.
  - g. Creating symbols – The user shall be able to add any number of new symbols to the symbol library. Symbol generation shall include all of the abilities described for the graphic editor.
8. Web Based Operator Interface (WBI) Software
- a. A graphical interface shall be provided that allows customers to access their BAS data via the Internet or Intranet. This interface shall use HTML-based pages to send and receive data from a BAS system to a web browser. The interface shall mimic the graphics on the server.
  - b. The software shall run on the latest version of Microsoft Internet Explorer, Mozilla Firefox, Apple Safari, and Google Chrome.
  - c. Users shall log in with the same credentials used to log in at the BAS server or OIW and users shall have the same privileges as they would have at the BAS server.

- d. The interface shall provide a user account utility, complete with a user profile database that includes user ID, encrypted password, access level, and language preference. Operators with the appropriate access level shall be able to add, modify, and delete users within the user profile database, as well as change users' access levels.
  - e. The interface shall provide a means by which the user can collect items (BAS data points) into "summary" groups. This functionality shall allow authorized users to perform actions ranging from viewing summary groups, to adding items to or deleting items from groups, to creating new summary groups.
  - f. The web-based interface shall provide the following four screens (or views) and the indicated functionality for each:
    - 1) Logon screen – allows the user to enter his or her user name and password for logging into the system.
    - 2) System view – provides the following three panels:
      - a) Browser – the user can browse the available servers and view the branches of information (BAS data points) registered within each.
      - b) Items – the panel displays the items (BAS data points) associated with the server selected in the Browser panel.
      - c) Operation – displays the operation and its value associated with the item selected in the Items panel, and allows authorized users to modify the item or to add the item to a summary.
    - 3) Summary view – allows the user to view items that have been grouped together into summaries, and allows authorized users to modify or delete groups or items within a group.
    - 4) User Account view – displays a list of the currently defined users and the corresponding user information. Users with level 2 access can change their passwords. Users with level 1 access can also modify and delete other users' information.
  - g. The interface shall provide navigation tools for moving between the System, Summary, and User Account views. In addition, it shall provide tools for gaining access to help and for logging out of the system.
9. Historical trending and data collection
- a. Each Network Controller shall store trend and point history data for all analog and digital inputs and outputs, as follows:
    - 1) Any point, physical or calculated, may be designated for trending. Three methods of collection shall be allowed: Defined time interval, upon a change of value and wherever a value is out of range.
    - 2) Each Network Controller shall have the capability to store multiple samples for each physical point and software variable based upon available memory, including an individual sample time/date stamp. Points may be assigned to multiple history trends with different collection parameters.
  - b. Trend and change of value data shall be stored within the controller and then uploaded to the trend database(s). Uploads shall occur based upon one of the following: user-defined interval, manual command, or when the trend buffers are full.
  - c. The system shall provide a configurable data storage subsystem for the collection of historical data. Data shall be stored in a database provided by the BAS vendor. Acceptable databases are Microsoft SQL Express, Microsoft SQL, PostGRE SQL, MySQL, Oracle or approved equal.
  - d. To enable users to easily access stored data, the system shall provide the capability to store historical data in more than one file system.
  - e. Provide the capability to perform statistical functions on the historical database without having to design special queries. On a specified data interval, provide functions for calculating:
    - 1) Average
    - 2) Arithmetic Mean
    - 3) Maximum/Minimum Values
    - 4) Range

- 5) Standard Deviation
  - 6) Sum of all Values
  - 7) Variance
10. Trend data viewing and analysis
- a. Provide a trend viewing utility that shall have access to all database points.
  - b. It shall be possible to retrieve any historical database point for use in displays and reports by specifying the point name and associated trend name.
  - c. The trend viewing utility shall have the capability to define trend study displays to include multiple trends.
  - d. Displays shall be able to be single or stacked graphs with on-line selectable display characteristics, such as ranging, color, and plot style.
  - e. Display magnitude and units shall both be selectable by the operator at any time without reconfiguring the processing or collection of data. This is a zoom capability.
  - f. Display magnitude shall automatically be scaled to show full graphic resolution of the data being displayed.
  - g. Trend studies shall be capable of calculating and displaying calculated variables including highest value, lowest value and time based accumulation.
  - h. The Display shall support the user's ability to change colors, sample sizes, and types of markers.

## 2.11 BAS CONTROLLERS - GENERAL

- A. There shall be 3 types of BAS control panels:
  1. Communications Control Panel (CCP)
  2. Direct Digital Control Panels (DDCP)
  3. Unitary Controllers (UC)
- B. All BACnet controllers shall be based on native BACnet and shall support all applicable BIBBs from the data sharing, alarm event, schedule, trend and device manager groups. Standard BACnet object types supported by the controllers shall include:
  1. Binary input and output and value.
  2. Analog input, output and value.
  3. Multi-state input and output.
  4. Loop calendar, notification class, command, file, program, schedule, group, event enrollment and device.
  5. Proprietary object types shall not be used unless specifically approved by the Engineer.
- C. All Controllers shall have a minimum of 10-bit Input /Output resolution.
- D. Following a loss of power the PC, CCP, DDCP and UC shall reboot in an orderly fashion and attain a normal operating status within 2 minutes of the return of power. That shall be accomplished without operator intervention.

## 2.12 COMMUNICATION CONTROL PANELS (CCP)

- A. The Communication Control Panels shall be programmable controllers on the BAS primary LAN and shall undertake two roles:
  1. Gateway interface to third-party controllers, if the data communicated from the third party system cannot be provided in the form of BACnet Objects.
- B. The CCP shall incorporate software as necessary to provide communications on the network including Network interface Cards if necessary. Additionally, if the CCP acts as a gateway, then the CCP shall incorporate all software as necessary to perform this function including any change of protocol between the networks. The BAS Contractor shall provide all third-party controller gateways and complete software/hardware documentation.
- C. Communication Control Panels shall also meet the following requirements:
  1. Provide integral network communication connections.
  2. CCP shall be totally independent of any other LAN/BAS Management Level Network nodes for their operating functions.

3. CCP failure shall not place any BAS component or any component controlled by the BAS in a situation that may cause damage to equipment or harm or discomfort to building occupants and operations staff. The failure of a CCP shall not affect the operation of any other network node.
  4. The failure of any CCP shall be annunciated as a critical alarm at the OIW.
  5. Cabling shall be terminated on rugged and easily accessible terminal strips. Each termination shall be clearly marked and shall be as detailed in the shop and record drawings.
  6. Each CCP shall have, at minimum, an 16 bit microprocessor.
  7. All CCP memory shall be battery-backed RAM. Battery shall be rechargeable with a minimum life of 7 years and shall be capable of providing data retention for a minimum of 60 days.
  8. Provide a real-time clock at each CCP. The real-time clock at the CCP shall be synchronized at least once every 24 hours.
  9. Provide a hardware or software watchdog timer.
  10. Provide interoperability documentation for the CCP. All the data related to the CCP shall be presented along with their respective BACnet object ID created in the system, along with their PICS, BIBBS, addresses and method statements to read and write data via integration of the CCP with another system in the future. This may be part of the overall interoperability documentation.
- D. The CCP shall be housed in the enclosure panels as detailed in the "Panels and Enclosures" Paragraph.
- E. Diagnostics – Controller shall continuously perform self-diagnostics, communication diagnosis, and diagnosis of all panel components. The network controller shall provide both local and remote annunciation of any detected component failures, low battery conditions, or repeated failures to establish communication.
- F. Certification – All controllers shall be listed by Underwriters Laboratories (UL).

## 2.13 DIRECT DIGITAL CONTROLLER PANELS (DDCP)

- A. The DDCPs shall be standalone, shall reside on the Automation Level and shall meet the following requirements:
1. DDCP controllers shall be freely programmable and shall have an I/O capability to handle major items of equipment such as air handling units.
  2. DDCP shall interface via Point Interface Modules (PIM) to the field instrumentation and final control elements.
  3. DDCP may be used for any equipment monitored and controlled by the BAS. A dedicated DDCP shall be provided at minimum to monitor and control the following:
    - a. Each Chiller and associated Pump
    - b. Each Air Handling Unit
    - c. Other major equipment
  4. The DDCP shall control its own communications so that the failure of any one node, including any PC shall not inhibit communications on the network between the remaining nodes. Provide integral network communications connections.
  5. DDCP shall be totally independent of any other primary and secondary LAN nodes for their monitoring and control functions. DDCP shall monitor and control entire systems, multiple DDCP for a single system shall not be allowed.
  6. Where a DDCP receives data from other nodes, such as an outdoor air temperature, which is used for a global system program strategy executed at that DDCP, then alternative control strategies shall be automatically initiated, based on operator definable default values, if there is a loss of communication of the required data.
  7. DDCP failure shall not place any BAS component or any BAS controlled component in a situation that may cause damage to equipment or harm or discomfort to building occupants and operations staff. The failure of a DDCP shall not affect the operation of any other network node.
  8. The failure of any DDCP shall be annunciated as a critical alarm at the OIW.
  9. Cabling shall be terminated on rugged and easily accessible terminal strips. Each termination shall be clearly marked and shall be as detailed in the shop and record drawings.
  10. Each DDCP shall have, at minimum, an 16 bit microprocessor.
  11. All operating sequences, schedules and trend data for equipment controlled by the DDCP shall reside at the DDCP.

12. Provide each DDCP with a battery back-up for the protection of volatile memory for a minimum of 72 hours. Provide a 10-hour minimum full function, battery support capability.
13. Provide a real-time clock, at each DDCP. The real-time clock at the DDCP shall be synchronized at least once every 24 hours.
14. DDCP shall be housed in enclosures that shall meet the requirements detailed in Section titled "Panels and Enclosures" of these specifications. The DDCP shall be placed at the same location as the equipment they control. The BAS Contractor shall provide a suitably rated enclosure for all associated BAS components, including the controllers, relays, wiring guides, terminal strips, etc. The installation of the control enclosure and the installation of all cable and containment between the field instrumentation, including any current sensing relays in the MCC panels, and the DDCP shall be by the BAS Contractor.
15. Interfaces to field instrumentation and final control elements shall have Point Interface Modules (PIM) that shall:
  - a. Enable the DDCP to receive signals from the digital and analog instrumentation.
  - b. Enable the DDCP to output control signals to the final control elements.
16. PIM shall be incorporated into the DDCP by one or the following methods:
  - a. Plug-in type modules with specific or universal input/output capabilities.
  - b. Integral to the DDCP controller board.
17. PIM shall accommodate the following point types:
  - a. Analog and digital inputs.
  - b. Analog and digital outputs.
  - c. Pulse inputs.
18. Analog input PIM shall have a minimum 10-bit analog-to-digital conversion and shall interface to all of the signal types required by the sequence of operations.
19. Analog output PIM shall have a minimum 10-bit digital-to-analog conversion and shall meet all of the output signal required by the sequence of operations.
20. Digital input and output PIM shall have electrical isolation and all relay contacts shall be suitably rated for the application.
21. All PIM shall be easily exchanged and the failure of one PIM shall not affect any other PIM. Field terminations shall be such that the removal of a failed PIM shall not require the removal and reconnecting of field device cable terminations.
22. All PIM shall be such that all output points can be manually positioned via an on board on-off-auto or potentiometer dial as applicable to the individual point.
23. Control shall be based on either three term algorithms, i.e. proportional plus integral plus derivative, or two term algorithms, i.e. proportional plus integral, unless specified otherwise.
24. DDCP mounted on vibrating equipment, such as an air handling units, shall have vibration isolation protection that ensures their satisfactory operation.
25. DDCP shall have optic-isolation or equivalent.
26. DDCP shall be BACnet compliant and shall comply with all of the requirements of ASHRAE SSPC/135.
27. The BAS Contractor shall provide interoperability documentation for the DDCP. All the data related to the DDCP shall be presented along with their respective BACnet object ID created in the system, along with their PICS, BIBBS, addresses and method statements to read and write data via integration of the DDCP with another system in the future. This may be part of the overall interoperability documentation.

#### 2.14 UNITARY CONTROLLERS (UC)

- A. Unitary Controllers (UC) shall be "freely programmable" controllers with pre-packaged operating sequences maintained in EEPROM or flash EPROM.
- B. Unitary controllers shall reside at the BAS Automation Level.
- C. Customization of "freely programmable" controllers shall be possible to the extent that variable operating parameters, such as sequences of operation, set points, control loop parameters, control constants, and schedules shall be changeable on-line by the OIW operator.
- D. Communicate using EIA/CEA 709.1 datalink/physical layer protocol using LonTalk protocol.
- E. UC shall reside on a BACnet (or LonWorks) BAS LAN.

- F. UC shall provide an interface via PIM to the field instrumentation and final control elements of the following types of equipment:
  - 1. Fan Powered VAV terminal unit with or without Electric Reheat.
  - 2. Fan Coil Unit
  - 3. Self-contained A/C unit
  - 4. Miscellaneous equipment input monitoring.
- G. Panels meeting the requirements of DDCP shall control all other types of equipment and systems.
- H. The UC shall be a node on the primary BAS LAN. The UC shall control its own communications so that the failure of any one node shall not inhibit communications on the network between the remaining nodes and the BAS Management Level Network.
- I. UC shall be totally independent of other Management and BAS Automation Level components for their monitoring and control functions.
- J. UC failure shall not place any BAS component or any BAS controlled component in a situation that may cause damage to equipment or harm or discomfort to building occupants and operations staff. The failure of a UC shall not affect the operation of any other network node.
- K. The failure of any UC shall be annunciated as a critical alarm at the OIW.
- L. Cabling shall be terminated on rugged and easily accessible terminal strips. Each termination shall be clearly marked and shall be as detailed in the shop and record drawings.
- M. UC shall be powered from the electrical service that serves the equipment monitored and controlled by the UC. The BAS Contractor shall furnish transformers suitably rated for the application. The UC shall be housed in an enclosure that provides adequate physical and electrical protection.
- N. Each UC shall have, at minimum, a 16 bit microprocessor.
- O. Provide each UC with a battery back-up for the protection of volatile memory for a minimum of 72 hours. Batteries shall be rated for a 7 year life. The UC serving VAV terminal units and FCU shall not be placed on UPS power.
- P. Provide a real time clock at each UC. The real-time clock at the UC shall be synchronized from the real-time clock at the BAS Network Data Servers (NDS) at least once every 24 hours.
- Q. UC shall be housed in enclosures that shall meet the requirements detailed in Section titled "Panels and Enclosures" of these specifications. The UC shall be placed at the same location as the equipment they control. The BAS Contractor shall provide a suitably rated enclosure for all associated BAS components, including the controllers, relays, wiring guides, terminal strips, etc. The installation of the control enclosure and the installation of all cable and containment between the field instrumentation and the UC shall be by the BAS Contractor.
- R. Interfaces to field instrumentation and final control elements shall have Point Interface Modules (PIM) that shall:
  - 1. Enable the UC to receive signals from the digital and analog instrumentation.
  - 2. Enable the UC to output control signals to the final control elements.
- S. PIM shall accommodate the following point types:
  - 1. Analog and digital inputs.
  - 2. Analog and digital outputs.
  - 3. Pulse inputs.
- T. Analog input PIM shall have a minimum 8-bit analog-to-digital conversion and shall interface to all of the signal types required by the sequence of operations.
- U. Analog output PIM shall have a minimum 8-bit digital-to-analog conversion and shall meet all of the output signal required by the sequence of operations.
- V. Digital input and output PIM shall have electrical isolation and all relay contacts shall be suitably rated for the application.
- W. UC shall control and monitor all points associated with a system. Multiple UC shall not be used to control and monitor a single system.
- X. All application programs shall reside at the UC.
- Y. Operating sequences for UC shall be resident at the UC. Database changes shall be undertaken from the OIW and POT. Schedules and trend data shall reside at the UC.
- Z. Control shall be based on either three term algorithms, i.e. proportional plus integral plus derivative, or two term algorithms, i.e. proportional plus integral, unless specified otherwise.
- AA. UC mounted on vibrating equipment, such as on FCUs, shall have vibration isolation protection that ensures their satisfactory operation.

- BB. UC shall be BACnet compliant and shall comply with all of the requirements of ASHRAE SSPC/135.
- CC. The BAS Contractor shall provide interoperability documentation for the UC. All the data related to the UC shall be presented along with their respective BACnet object ID created in the system, along with their PICS, BIBBS, addresses and method statements to read and write data via integration of the UC with another system in the future. This may be part of the overall interoperability documentation.

## 2.15 BACNET ROUTERS

- A. Provide all BACnet routers as necessary to meet the requirements of these specifications.
- B. BACnet routers shall be native BACnet only. Proprietary and other standard protocols shall not be provided. Routers shall be provided as necessary to connect one medium to another, e.g. BACnet/IP to BACnet MS/TP, etc.
- C. The BACnet routers shall, at minimum, support BIBBs for data sharing, alarm and event management.

## 2.16 FIELD DEVICES

- A. Input/Output Module
  - 1. The Input/Output Module (IOM) provides additional inputs and outputs for use in the DDC Controllers.
  - 2. The IOM shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9 on the controller network.
    - a. The IOM shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
    - b. The IOM shall be tested and certified as a BACnet Application Specific Controller (B-ASC).
    - c. A BACnet Protocol Implementation Conformance Statement shall be provided for the FEC.
    - d. The Conformance Statement shall be submitted 10 days prior to bidding.
  - 3. The IOM shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.
  - 4. The IOM shall support the following types of inputs and outputs:
    - a. Universal Inputs - shall be configured to monitor any of the following:
      - 1) Analog Input, Voltage Mode
      - 2) Analog Input, Current Mode
      - 3) Analog Input, Resistive Mode
      - 4) Binary Input, Dry Contact Maintained Mode
      - 5) Binary Input, Pulse Counter Mode
    - b. Binary Inputs - shall be configured to monitor either of the following:
      - 1) Dry Contact Maintained Mode
      - 2) Pulse Counter Mode
    - c. Analog Outputs - shall be configured to output either of the following:
      - 1) Analog Output, Voltage Mode
      - 2) Analog Output, current Mode
    - d. Binary Outputs - shall output the following:
      - 1) 24 VAC Triac
    - e. Configurable Outputs - shall be capable of the following:
      - 1) Analog Output, Voltage Mode
      - 2) Binary Output Mode
  - 5. The IOM shall include troubleshooting LED indicators to identify the following conditions:
    - a. Power On
    - b. Power Off
    - c. Download or Startup in progress, not ready for normal operation.
    - d. No Faults
    - e. Device Fault
    - f. Normal Data Transmission
    - g. No Data Transmission
    - h. No Communication

## B. Networked Thermostat

1. The networked thermostat shall be capable of controlling two- or four-pipe fan coils, cabinet unit heaters or other similar equipment.
2. The TEC shall communicate over the Field Controller Bus using BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9.
3. The TEC shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
  - a. The TEC shall be tested and certified as a BACnet Application Specific Controller (B-ASC).
  - b. A BACnet Protocol Implementation Conformance Statement shall be provided for the TEC.
  - c. The Conformance Statement shall be submitted 10 days prior to bidding.
4. The Networked Thermostat shall support remote read/write and parameter adjustment from the web based User Interface through a Network Automation Engine.
5. The Networked Thermostat shall include an intuitive User Interface providing plain text messages.
  - a. Two line, 8 character backlit display
  - b. LED indicators for Fan, Heat, and Cool status
  - c. Five (5) User Interface Keys
    - 1) Mode
    - 2) Fan
    - 3) Override
    - 4) Degrees C/F
    - 5) Up/Down
  - d. The display shall continuously scroll through the following parameters:
    - 1) Room Temperature
    - 2) System Mode
    - 3) Schedule Status – Occupied/Unoccupied/Override
    - 4) Applicable Alarms
6. The Networked Thermostat shall provide the flexibility to support any one of the following inputs:
  - a. Integral Indoor Air Temperature Sensor
  - b. Duct Mount Air Temperature Sensor
  - c. Remote Indoor Air Temperature Sensor with Occupancy Override and LED Indicator
  - d. Two configurable binary inputs
7. The Networked Thermostat shall provide the flexibility to support any one of the following outputs:
  - a. Three Speed Fan Control
  - b. Two On/Off
  - c. Two Floating
  - d. Two Proportional (0 to 10V)
8. The Networked Thermostat shall provide a minimum of six (6) levels of keypad lockout.
9. The Networked Thermostat shall provide the flexibility to adjust the following parameters:
  - a. Adjustable Temporary Occupancy from 0 to 24 hours
  - b. Adjustable heating/cooling deadband from 2°F to 5°F
  - c. Adjustable heating/cooling cycles per hour from 4 to 8
10. Where required by application and indicated on plans or room schedules provide the Networked Thermostat with an integral Passive Infra-Red (PIR) occupancy sensor.
11. The Networked Thermostat shall employ nonvolatile electrically erasable programmable read-only memory (EEPROM) for all adjustable parameters.

## C. Networked Thermostat

1. The Networked Thermostat shall be capable of controlling a pressure dependent Variable Air Volume System or other similar zoning type systems employing reheat including local hydronic reheat valves.
2. The Networked Thermostat shall communicate using BACnet Standard protocol SSPC-135, Clause 9.
3. The network thermostat shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
  - a. The network thermostat shall be tested and certified as a BACnet Application Specific Controller (B-ASC).



- b. A BACnet Protocol Implementation Conformance Statement shall be provided for the network thermostat.
  - c. The Conformance Statement shall be submitted 10 days prior to bidding.
  4. The Networked Thermostat shall be capable of remote read/write and parameter adjustment from the web based User Interface (UI).
  5. The Networked Thermostat shall include an intuitive UI providing plain text messages.
    - a. Two line, 8 character backlit display
    - b. LED indicators for Heating, and cooling status
    - c. Three (3) User Interface Keys
      - 1) Override
      - 2) Up
      - 3) Down
    - d. The display shall continuously scroll through the following parameters:
      - 1) Room Temperature
      - 2) System Mode
      - 3) Schedule Status – Occupied/Unoccupied/Override
      - 4) Applicable Alarms
  6. The Networked Thermostat shall provide the flexibility to support any one of the following inputs:
    - a. Integral Indoor Air Temperature Sensor
    - b. Duct Mount Air Temperature Sensor
    - c. Remote Indoor Air Temperature Sensor with Occupancy Override and LED Indicator
    - d. Two configurable binary inputs
  7. The Networked Thermostat shall provide the flexibility to support either of the following outputs:
    - a. Two On/Off or Floating
    - b. Two Proportional (0 to 10V)
  8. The Networked Thermostat shall provide a minimum of six (6) levels of keypad lockout.
  9. The Networked Thermostat shall provide the flexibility to adjust the following parameters:
    - a. Adjustable Temporary Occupancy from 0 to 24 hours
    - b. Adjustable heating/cooling deadband from 2° F to 5° F
    - c. Adjustable heating/cooling cycles per hour from 4 to 8
  10. The Networked Thermostat shall employ nonvolatile electrically erasable programmable read-only memory (EEPROM) for all adjustable parameters.
- D. VAV Modular Assembly (VMA)
1. The VAV Modular Assembly shall provide both standalone and networked direct digital control of pressure-independent, variable air volume terminal units. It shall address both single and dual duct applications.
  2. The VMA shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
    - a. The VMA shall be tested and certified as a BACnet Application Specific Controller (B-ASC).
    - b. A BACnet Protocol Implementation Conformance Statement shall be provided for the VMA.
    - c. The Conformance Statement shall be submitted 10 days prior to bidding.
  3. The VAV Modular Assembly shall communicate using BACnet Standard protocol SSPC-135, Clause 9.
  4. The VAV Modular Assembly shall have internal electrical isolation for AC power, DC inputs, and MS/TP communications. An externally mounted isolation transformer shall not be acceptable.
  5. The VAV Modular Assembly shall be a configurable digital controller with integral differential pressure transducer and damper actuator. All components shall be connected and mounted as a single assembly that can be removed as one piece.
  6. The VAV Modular Assembly shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.
  7. The integral damper actuator shall be a fast response stepper motor capable of stroking 90 degrees in 30 seconds for quick damper positioning to speed commissioning and troubleshooting tasks.
  8. The controller shall determine airflow by dynamic pressure measurement using an integral dead-ended differential pressure transducer. The transducer shall be maintenance-free and shall not require air filters.

9. Each controller shall have the ability to automatically calibrate the flow sensor to eliminate pressure transducer offset error due to ambient temperature / humidity effects.
10. The controller shall utilize a proportional plus integration (PI) algorithm for the space temperature control loops.
11. Each controller shall continuously, adaptively tune the control algorithms to improve control and controller reliability through reduced actuator duty cycle. In addition, this tuning reduces commissioning costs, and eliminates the maintenance costs of manually re-tuning loops to compensate for seasonal or other load changes.
12. The controller shall provide the ability to download and upload VMA configuration files, both locally and via the communications network. Controllers shall be able to be loaded individually or as a group using a zone schedule generated spreadsheet of controller parameters.
13. Control set point changes initiated over the network shall be written to VMA non-volatile memory to prevent loss of set point changes and to provide consistent operation in the event of communication failure.
14. The controller firmware shall be flash-upgradeable remotely via the communications bus to minimize costs of feature enhancements.
15. The controller shall provide fail-safe operation if the airflow signal becomes unreliable, by automatically reverting to a pressure-dependent control mode.
16. The controller shall interface with balancer tools that allow automatic recalculation of box flow pickup gain ("K" factor), and the ability to directly command the airflow control loop to the box minimum and maximum airflow set points.
17. Controller performance shall be self-documenting via on-board diagnostics. These diagnostics shall consist of control loop performance measurements executing at each control loop's sample interval, which may be used to continuously monitor and document system performance. The VMA shall calculate exponentially weighted moving averages (EWMA) for each of the following. These metrics shall be available to the end user for efficient management of the VAV terminals.
  - a. Absolute temperature loop error.
  - b. Signed temperature loop error.
  - c. Absolute airflow loop error.
  - d. Signed airflow loop error.
  - e. Average damper actuator duty cycle
18. The controller shall detect system error conditions to assist in managing the VAV zones. The error conditions shall consist of:
  - a. Unreliable space temperature sensor
  - b. Unreliable differential pressure sensor
  - c. Starved box
  - d. Actuator stall
  - e. Insufficient cooling
  - f. Insufficient heating
19. The controller shall provide a flow test function to view damper position vs. flow in a graphical format. The information would alert the user to check damper position. The VMA would also provide a method to calculate actuator duty cycle as an indicator of the damper actuator runtime.
20. The controller shall provide a compliant interface for ASHRAE Standard 62-1989 (indoor air quality), and shall be capable of resetting the box minimum airflow Based on the percent of outdoor air in the primary air stream.
21. The controller shall comply with ASHRAE Standard 90.1 (energy efficiency) by preventing simultaneous heating and cooling, and where the control strategy requires reset of airflow while in reheat, by modulating the box reheat device fully open prior to increasing the airflow in the heating sequence.
22. Inputs:
  - a. Analog inputs with user defined ranges shall monitor the following analog signals, without the addition of equipment outside the terminal controller cabinet:
    - 1) 0-10 VDC Sensors
    - 2) 1000ohm RTDs
    - 3) NTC Thermistors

- b. Binary inputs shall monitor dry contact closures. Input shall provide filtering to eliminate false signals resulting from input “bouncing.”
  - c. For noise immunity, the inputs shall be internally isolated from power, communications, and output circuits.
  - d. Provide side loop application for humidity control.
23. Outputs
- a. Analog outputs shall provide the following control outputs:
    - 1) 0-10 VDC
  - b. Binary outputs shall provide a SPST Triac output rated for 500mA at 24 VAC.
  - c. For noise immunity, the outputs shall be internally isolated from power, communications, and other output circuits.
24. Application Configuration
- a. The VAV Modular Assembly shall be configured with a software tool that provides a simple Question/Answer format for developing applications and downloading.
25. Sensor Support
- a. The VMA shall support an LCD display room sensor.
  - b. The VMA shall also support standard room sensors as defined by analog input requirements.
  - c. The VMA shall support humidity sensors defined by the AI side loop.

## 2.17 SYSTEM TOOLS

### A. System Configuration Tool (SCT)

- 1. The Configuration Tool shall be a software package enabling a computer platform to be used as a stand-alone engineering configuration tool.
- 2. The configuration tool shall provide an archive database for the configuration and application data.
- 3. The configuration tool shall have the same look-and-feel at the User Interface (UI) regardless of whether the configuration is being done online or offline.
- 4. The configuration tool shall include the following features:
  - a. Basic system navigation tree for connected networks
  - b. Integration of LonWorks, and BACnet enabled devices
  - c. Customized user navigation trees
  - d. Point naming operating parameter setting
  - e. Graphic diagram configuration
  - f. Alarm and event message routing
  - g. Graphical logic connector tool for custom programming
  - h. Downloading, uploading, and archiving databases
- 5. The configuration tool shall have the capability to automatically discover field devices on connected buses and networks. Automatic discovery shall be available for the following field devices:
  - a. BACnet Devices
  - b. LonWorks devices
- 6. The configuration tool shall be capable of programming the DDC Controllers.
  - a. The configuration tool shall provide the capability to configure, simulate, and commission the DDC Controllers.
  - b. The configuration tool shall allow the FECs to be run in Simulation Mode to verify the applications.
  - c. The configuration tool shall contain a library of standard applications to be used for configuration.
- 7. The configuration tool shall be capable of programming the field devices.
  - a. The configuration tool shall provide the capability to configure, simulate, and commission the field devices.
  - b. The configuration tool shall allow the field devices to be run in Simulation Mode to verify the applications.
  - c. The configuration tool shall contain a library of standard applications to be used for configuration.

- 8. A wireless access point shall allow a wireless enabled portable PC to make a temporary Ethernet connection to the automation network.
  - a. The wireless connection shall allow the PC to access configuration tool through the web browser using the User Interface (UI).
  - b. The wireless use of configuration tool shall be the same as a wired connection in every respect.
  - c. The wireless connection shall use the Bluetooth Wireless Technology.
- B. Handheld VAV Balancing Sensor
  - 1. The sensor shall be a light weight portable device of dimensions not more than 3.2 x 3.2 x 1.0 inches.
  - 2. The sensor shall be capable of displaying data and setting balancing parameters for VAV control applications.
  - 3. The sensor shall be powered through a connection to either the Sensor-Actuator (SA) or the DDC Controller Bus.
  - 4. The sensor shall be a menu driven device that shall modify itself automatically depending upon what type of application resides in the controller.
  - 5. The sensor shall contain a dial and two buttons to navigate through the menu and to set balancing parameters.
  - 6. The sensor shall provide an adjustable time-out parameter that will return the controller to normal operation if the balancing operation is aborted or abandoned.
  - 7. The sensor shall include the following
    - a. 5 foot retractable cable
    - b. Laminated user guide
    - c. Nylon carrying case
  - 8. The sensor shall be Underwriters Laboratory UL 916 listed and CSA certified C22.2 N. 205, CFR47.

2.18 INPUT DEVICES

- A. General Requirements
  - 1. Installation, testing, and calibration of all sensors, transmitters, and other input devices shall be provided to meet the system requirements.
- B. Temperature Sensors
  - 1. General Requirements:
    - a. Sensors and transmitters shall be provided, as outlined in the input/output summary and sequence of operations.
    - b. The temperature sensor shall be of the resistance type, and shall be either two-wire 1000 ohm nickel RTD, or two-wire 1000 ohm platinum RTD.
    - c. The following point types (and the accuracy of each) are required, and their associated accuracy values include errors associated with the sensor, lead wire, and A to D conversion:

Point Type	Accuracy
Chilled Water	± .5°F.
Room Temp	± .5°F.
Duct Temperature	± .5°F.
All Others	± .5°F.

- 2. Room Temperature Sensors with Integral Display
  - a. Room sensors shall be constructed for either surface or wall box mounting.
  - b. Room sensors shall have an integral LCD display and four button keypad with the following capabilities:
    - 1) Display room and outside air temperatures.
    - 2) Display and adjust room comfort set point.
    - 3) Display and adjust fan operation status.
    - 4) Timed override request push button with LED status for activation of after-hours operation.

- 5) Display controller mode.
  - 6) Password selectable adjustment of set point and override modes.
3. Thermowells
    - a. When thermowells are required, the sensor and well shall be supplied as a complete assembly, including wellhead and Greenfield fitting.
    - b. Thermowells shall be pressure rated and constructed in accordance with the system working pressure.
    - c. Thermowells and sensors shall be mounted in a thread-o-let or ½ inch NPT saddle and allow easy access to the sensor for repair or replacement.
    - d. Thermowells shall be constructed of 316 stainless steel.
  4. Outside Air Sensors
    - a. Outside air sensors shall be designed to withstand the environmental conditions to which they will be exposed. They shall also be provided with a solar shield.
    - b. Sensors exposed to wind velocity pressures shall be shielded by a perforated plate that surrounds the sensor element.
    - c. Temperature transmitters shall be of NEMA 3R construction and rated for ambient temperatures.
  5. Temperature Transmitter
    - a. Temperature transmitters shall be an integral two or three-wire 4-20ma device with 100-OHM platinum RTD sensor. All transmitters shall be factory calibrated. NIST traceable certificates of calibration shall be provided with each device. The transmitter shall be provided with non-interacting zero and span adjustments. The transmitter shall be protected against damage from reverse polarity and line transients.
    - b. Thermistors, IC type or non-transmitting devices will not be acceptable.
    - c. The device shall meet or exceed the following specifications.
      - 1) Calibrated Accuracy            +/- 0.4% of span
      - 2) Stability                            +/- 0.1% of span
      - 3) Response Time                    100 ms
      - 4) Temperature                      -58 to 160 deg. F
      - 5) Output Signal                    4 to 20mA
      - 6) Input Power                        Loop Powered
    - d. For outdoor air duct applications, a weatherproof mounting box with weatherproof cover and gasket shall be used.
  6. Averaging Sensors
    - a. For ductwork greater in any dimension than 48 inches and/or where air temperature stratification exists, an averaging sensor with multiple sensing points shall be used.
    - b. For plenum applications, such as mixed air temperature measurements, a string of sensors mounted across the plenum shall be used to account for stratification and/or air turbulence. The averaging string shall have a minimum of 4 sensing points per 12-foot long segment.
    - c. Capillary supports at the sides of the duct shall be provided to support the sensing string.
- C. Differential Pressure Transmitters
1. General Air and Water Pressure Transmitter Requirements:
    - a. Pressure transmitters shall be constructed to withstand 100% pressure over-range without damage, and to hold calibrated accuracy when subject to a momentary 40% over-range input.
    - b. Pressure transmitters shall transmit a 0 to 5 VDC, 0 to 10 VDC, or 4 to 20 mA output signal.
    - c. Differential pressure transmitters used for flow measurement shall be sized to the flow sensing device, and shall be supplied with Tee fittings and shut-off valves in the high and low sensing pick-up lines to allow the balancing Contractor and Owner permanent, easy-to-use connection.
    - d. A minimum of a NEMA 1 housing shall be provided for the transmitter. Transmitters shall be located in accessible local control panels wherever possible.
      - 1)
  2. High Differential Water Pressure Applications (Over 21 inches w.c.)

- a. The differential pressure transmitter shall meet the low pressure transmitter specifications with the following exceptions:
    - 1) Differential pressure range 10 inches w.c. to 300 PSI.
    - 2) Reference Accuracy: +1% of full span (includes non-linearity, hysteresis, and repeatability).
  - b. Standalone pressure transmitters shall be mounted in a bypass valve assembly panel. The panel shall be constructed to NEMA 1 standards. The transmitter shall be installed in the panel with high and low connections piped and valved. Air bleed units, bypass valves, and compression fittings shall be provided.
3. Building Differential Air Pressure Applications (-1 inch to +1 inch w.c.)
    - a. The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of differential pressure or air pressure sensing points.
    - b. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:
      - 1) -1.00 to +1.00 w.c. input differential pressure ranges. (Select range appropriate for system application)
      - 2) 4-20 mA output.
      - 3) Maintain accuracy up to 20 to 1 ratio turndown.
      - 4) Reference Accuracy: +0.2% of full span.
  4. Low Differential Air Pressure Applications (0 inch to 5 inches w.c.)
    - a. The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of differential pressure or air pressure sensing points.
    - b. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:
      - 1) (0.00 - 1.00 inch to 5.00 inches) w.c. input differential pressure ranges. (Select range appropriate for system application.)
      - 2) 4-20 mA output.
      - 3) Maintain accuracy up to 20 to 1 ratio turndown.
      - 4) Reference Accuracy: +0.5 % of full span.
- D. Air Flow Monitoring
1. Fan Inlet Air Flow Measuring Stations
    - a. At the inlet of each fan and near the exit of the inlet sound trap, airflow traverse probes shall be provided that shall continuously monitor the fan air volumes and system velocity pressure.
    - b. Each traverse probe shall be of a dual manifolded, cylindrical, type 3003 extruded aluminum configuration, having an anodized finish to eliminate surface pitting and unnecessary air friction. The multiple total pressure manifold shall have sensors located along the stagnation plane of the approaching airflow. The manifold should not have forward projecting sensors in the air stream. The static pressure manifold shall incorporate dual offset static tops on the opposing sides of the averaging manifold so as to be insensitive to flow-angle variations of as much as +20° in the approaching air stream.
    - c. The airflow traverse probe shall not induce a measurable pressure drop, nor shall the sound level within the duct be amplified by its singular or multiple presence in the air stream. Each airflow-measuring probe shall contain multiple total and static pressure sensors placed at equal distances along the probe length. The number of sensors on each probe and the quantity of probes utilized at each installation shall comply with the ASHRAE Standards for duct traversing.
    - d. Airflow measuring stations shall be manufactured by Air Monitor Corp., Tek-Air Systems, Inc., Ebtron, or Dietrich Standard.
  2. Single Probe Air Flow Measuring Sensor
    - a. The single probe airflow-measuring sensor shall be duct mounted with an adjustable sensor insertion length of up to eight inches. The transmitter shall produce a 4-20 mA or 0-10 VDC signal linear to air velocity. The sensor shall be a hot wire anemometer and utilize two temperature sensors and a heater element temperature. The other sensor shall measure

the downstream air temperature. The temperature differential shall be directly related to airflow velocity.

- b. Duct Air Flow Measuring Stations
  - c. Each device shall be designed and built to comply with, and provide results in accordance with, accepted practice as defined for system testing in the ASHRAE Handbook of fundamentals, as well as in the Industrial Ventilation Handbook.
  - d. Airflow measuring stations shall be fabricated of 14-gauge galvanized steel welded casing with 90 Deg. connecting flanges in configuration and size equal to that of the duct into which it is mounted. Each station shall be complete with an air directionalizer and parallel cell profile suppressor (3/4 inch maximum cell) across the entering air stream and mechanically fastened to the casing in such a way to withstand velocities up to 6000 feet per minute. This air directionalizer and parallel cell honeycomb suppressor shall provide 98% free area, equalize the velocity profile, and eliminate turbulent and rotational flow from the air stream prior to the measuring point.
  - e. The total pressure measurement side (high side) will be designed and spaced to the Industrial Ventilation Manual 16th Edition, Page 9-5. The self-averaging manifolding will be manufactured of brass and copper components.
  - f. The static pressure sensing probes (low side) shall be bullet-nosed shaped, per detailed radius as illustrated in Industrial Ventilation Manual 16th Edition, Page 9-5.
  - g. The main take-off point from both the total pressure and the static pressure manifolds must be symmetrical.
  - h. Total and static pressure manifolds shall terminate with external ports for connection to control tubing. An identification label shall be placed on each unit casing, listing model number, size, area, and specified airflow capacity.
  - i. Installation Considerations
    - 1) The maximum allowable pressure loss through the Flow and Static Pressure elements shall not exceed .065 inch w.c. at 1000 feet per minute, or 23 inches w.c. at 2000 feet per minute. Each unit shall measure the airflow rate within an accuracy of plus 2% as determined by U.S. - GSA certification tests, and shall contain a minimum of one total pressure sensor per 36 square inches of unit measuring area.
    - 2) The units shall have a self-generated sound rating of less than NC40, and the sound level within the duct shall not be amplified nor shall additional sound be generated.
    - 3) Where the stations are installed in insulated ducts, the airflow passage of the station shall be the same size as the inside airflow dimension of the cut. Station flanges shall be two inch to three inch to facilitate matching connecting ductwork.
    - 4) Where control dampers are shown as part of the airflow measuring station, opposed blade precision controlled volume dampers integral to the station and complete with actuator, pilot positioner, and linkage shall be provided.
    - 5) Stations shall be installed in strict accordance with the manufacturer's published requirements, and in accordance with ASME Guidelines affecting non-standard approach conditions.
  - j. Static Pressure Traverse Probe
    - 1) Duct static traverse probes shall be provided where required to monitor duct static pressure. The probe shall contain multiple static pressure sensors located along exterior surface of the cylindrical probe.
  - k. Shielded Static Air Probe
    - 1) A shielded static pressure probe shall be provided at each end of the building. The probe shall have multiple sensing ports, an impulse suppression chamber, and airflow shielding. A suitable probe for indoor and outdoor locations shall be provided.
- E. Smoke Detectors
- 1. Ionization type air duct detectors shall be furnished as specified elsewhere in Division 26 for installation under Division 23. All wiring for air duct detectors shall be provided under Division 26, Fire Alarm System.
- F. Status and Safety Switches
- 1. General Requirements

- a. Switches shall be provided to monitor equipment status, safety conditions, and generate alarms at the BAS when a failure or abnormal condition occurs. Safety switches shall be provided with two sets of contacts and shall be interlock wired to shut down respective equipment.
2. Current Sensing Switches
  - a. Current switches shall be acceptable for monitoring status of any motor less than 1HP and for monitoring status of any electric heat coil.
  - b. The current sensing switch shall be self-powered with solid-state circuitry and a dry contact output. It shall consist of a current transformer, a solid state current sensing circuit, adjustable trip point, solid state switch, SPDT relay, and an LED indicating the on or off status. A conductor of the load shall be passed through the window of the device. It shall accept over-current up to twice its trip point range.
  - c. Current sensing switches shall be used for run status for fans, pumps, and other miscellaneous motor loads.
  - d. Current sensing switches shall be calibrated to show a positive run status only when the motor is operating under load. A motor running with a broken belt or coupling shall indicate a negative run status.
3. Current Transducers
  - a. Current transducers shall be used to monitor amps for fans, pumps, compressors and other miscellaneous motor loads greater than or equal to 1 HP.
  - b. Current transducers shall have a loop powered output of 4-20mA. A signal of 4 mA or 20 mA shall be treated as a sensor failure and an alarm shall be generated.
  - c. A conductor of the load shall be passed through the window of the device. It shall accept over-current up to twice the motor's FLA without damage to the sensor.
  - d. Current transducers shall be programmed in software to show a positive run status only when the motor is operating under load. A motor running with a broken belt or coupling shall indicate a negative run status.
  - e. Current transducers shall be split core style. Removal and replacement of the transducer shall not require removal of power wiring.
  - f. Current transducers shall have a removable mounting bracket. Whenever installation conditions allow, the bracket shall be installed.
4. Air Filter Status Switches
  - a. Differential pressure switches used to monitor air filter status shall be of the automatic reset type with SPDT contacts rated for 2 amps at 120VAC.
  - b. A complete installation kit shall be provided, including: static pressure tops, tubing, fittings, and air filters.
  - c. Provide appropriate scale range and differential adjustment for intended service.
5. Water Flow Switches
  - a. Calorimetric type or other device equally resistant to fouling and corrosion.
  - b. Shall not require more than one pipe diameter (or 12 inches, whichever is larger) of straight piping for proper operation
  - c. Device set point shall be configurable to at least 10% below manufacturer's listed minimum chiller flow rate.
6. Air Flow Switches
  - a. Differential pressure flow switches shall be bellows actuated mercury switches or snap acting micro-switches with appropriate scale range and differential adjustment for intended service.
7. Low Temperature Limit Switches
  - a. The low temperature limit switch shall be of the manual reset type with Double Pole/Single Throw snap acting contacts rated for 16 amps at 120VAC.
  - b. The sensing element shall be a minimum of 15 feet in length and shall react to the coldest 18-inch section. Element shall be mounted horizontally across duct in accordance with manufacturers recommended installation procedures.
  - c. For large duct areas where the sensing element does not provide full coverage of the air stream, additional switches shall be provided as required to provide full protection of the air stream.



## 2.19 OUTPUT DEVICES

## A. Actuators

1. General Requirements
  - a. Damper and valve actuators shall be electric/electronic. Provide local position indicator dial on all actuators, with manual override position capability.
  - b. Provide a separate actuator for each damper bank. Linkages are not allowed.
  - c. Warranty: Valve and damper actuators shall carry a manufacturer's 5-year warranty.
2. Electric Actuators
  - a. Entire actuator shall be UL or CSA approved by a National Recognized Testing Laboratory.
  - b. Enclosure shall meet NEMA 4X weatherproof requirements for outdoor applications.
  - c. Dampers. The actuator shall be direct coupled over the shaft, enabling it to be mounted directly to the damper shaft without the need for connecting linkage. The clamp shall be steel of a V-bolt design with associated V-shaped, toothed cradle attaching to the shaft for maximum strength and eliminating slippage via cold weld attachment. Single bolt or set screw type fasteners are not acceptable. Aluminum clamps are unacceptable.
  - d. Valves. Actuators shall be specifically designed for integral mounting to valves without external couplings.
  - e. Actuator shall have microprocessor based motor controller providing electronic cut off at full open so that no noise can be generated while holding open. Holding noise level shall be inaudible.
  - f. Noise from actuator while it is moving shall be inaudible through a tee-bar ceiling.
  - g. Actuators shall provide protection against actuator burnout using an internal current limiting circuit or digital motor rotation sensing circuit. Circuit shall insure that actuators cannot burn out due to stalled damper or mechanical and electrical paralleling. End switches to deactivate the actuator at the end of rotation or use of magnetic clutches are not acceptable.
  - h. Modulating Actuators:
    - 1) General: Actuators shall accept a 0 to 10 VDC or 0 to 20 mA control signal and provide a 2 to 10 VDC or 4 to 20 mA operating range. Actuators shall have positive positioning circuit so that controlled device is at same position for a given signal regardless of operating differential pressure. Actuators that internally use a floating actuator with an analog signal convertor are not acceptable.
  - i. Where indicated on Drawings or Points List, actuators shall include:
    - 1) 2 to 10 VDC position feedback signal
    - 2) Limit (end) position switches
  - j. All 24 VAC/DC actuators shall operate on Class 2 wiring and shall not require more than 10 VA or AC. Actuators operating on 120 VAC power shall not require more than 10 VA. Actuators operating on 230 VAC power shall not require more than 11 VA.
  - k. All modulating actuators shall have an external, built-in switch to allow the reversing of direction of rotation.
  - l. Actuators shall be provided with a conduit fitting on a minimum three-foot electrical cable and shall be pre-wired to eliminate the necessity of opening the actuator housing to make electrical connections.
  - m. Where fail-open or fail-closed position is required, an internal mechanical, spring return mechanism shall be built into the actuator housing. All spring return actuators shall be capable of either clockwise or counterclockwise spring return operation by simply changing the mounting orientation.
  - n. Actuators shall be capable of being mechanically and electrically paralleled to increase torque where required.
  - o. All non-spring return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring return actuators with more than 60 inch-pound torque capacity shall have a manual crank for this purpose.
  - p. Actuators shall be designed for a minimum of 60,000 full cycles at full torque and be UL 873 listed.

- q. Actuators shall clearly indicate position of damper/valve.
- 3. Electric Actuators for Large Butterfly Valves
  - a. Entire actuator shall be UL or CSA approved by a National Recognized Testing Laboratory.
  - b. The valve actuator shall consist of a capacitor-type reversible electric motor, gear train, limit switches and terminal block, all contained in a die cast aluminum enclosure.
  - c. Enclosure shall meet NEMA 4X weatherproof requirements for outdoor applications.
  - d. Output shaft shall be electroless nickel plated to prevent corrosion.
  - e. Actuator shall have a motor rated for a minimum 75% duty cycle. Duty cycle shall be defined as running time divided by installed time at maximum torque.
  - f. Actuator shall be suitable for operation in ambient temperature ranging from -22 deg. F to +150 deg. F.
  - g. A pre-wired cable shall bring wiring outside enclosure to avoid necessity of opening cover.
  - h. Gears shall be hardened alloy steel, permanently lubricated. A self-locking gear assembly or a brake shall be supplied.
  - i. Actuator shall be equipped with a hand wheel for manual override to permit operation of the valve in the event of electrical power failure or system malfunction. Hand wheel must be permanently attached to the actuator. When in manual operation electrical power to the actuator will be permanently interrupted.
  - j. The hand wheel will not rotate while the actuator is electrically driven.
  - k. Actuator shall have heater and thermostat to minimize condensation within the actuator housing.
  - l. Provide limit (end) positing switches as required by the points list in the sequence of operation.

4. Normal Position

- a. Except as specified otherwise in the sequence of operation, the requirement for spring return actuators and the normal positions of control devices shall be as indicated in table below. For actuators indicated as Spring Return Required in the table, normal position refers to the position with zero control signal and with no power to the actuators. For actuators not indicated as Spring Return Required in the table, non-spring return style actuators are acceptable and normal position refers to the position with zero control signal.

Device	Normal Position	Spring Return Required
Outside air damper	CLOSED	Yes
Return air damper	OPEN	Yes
Exhaust/relief air damper	CLOSED	Yes
AHU cooling coil valves	CLOSED	
Equipment isolation valves	OPEN	
VAV box dampers	OPEN	

5. Valve Actuator Selection

- a. Modulating actuators for valves shall have a minimum rangeability of 50 to 1.
- b. Water:
  - 1) 2-way and two-position valves
    - a) Tight closing against 125% of the system pump shut-off head.
    - b) Modulating duty against 90% of the system pump shut-off head.
  - 2) 3-way shall have close-off against twice the full open differential pressure for which they are sized.

6. Damper Actuator Selection

- a. Actuators shall be direct coupled. For multiple sections, provide one actuator for each section; linking or jack-shafting damper sections shall not be allowed.
- b. Provide sufficient torque as velocity, static, or side seals require per damper manufacturer's recommendations and the following:
  - 1) Torque shall be a minimum 5 inch-pound per square foot for opposed blade dampers and 7 inch-pound per square foot for parallel blade dampers.

- 2) The total damper area operated by an actuator shall not exceed 80% of the manufacturer's maximum area rating.

B. Control Dampers

1. The BAS Contractor shall furnish all automatic dampers. All automatic dampers shall be sized for the application by the BAS Contractor or as specifically indicated on the Drawings.
2. All dampers used for throttling airflow shall be of the opposed blade type arranged for normally open or normally closed operation, as required. The damper is to be sized so that, when wide open, the pressure drop is a sufficient amount of its close-off pressure drop to shift the characteristic curve to near linear.
3. All dampers used for two-position, open/close control shall be parallel blade type arranged for normally open or closed operation, as required.
4. Damper frames and blades shall be constructed of either galvanized steel or aluminum. Maximum blade length in any section shall be 60 inches. Damper blades shall be 16-gauge minimum and shall not exceed eight (8) inches in width. Damper frames shall be 16-gauge minimum hat channel type with corner bracing. All damper bearings shall be made of reinforced nylon, stainless steel or oil-impregnated bronze. Dampers shall be tight closing, low leakage type, with synthetic elastomer seals on the blade edges and flexible stainless steel side seals. Dampers of 48 inches by 48 inches size shall not leak in excess of 8.0 cfm per square foot when closed against 4 inches w.g. static pressure when tested in accordance with AMCA Std. 500.
5. Airfoil blade dampers of double skin construction with linkage out of the air stream shall be used whenever the damper face velocity exceeds 1500 FPM or system pressure exceeds 2 ½ inches w.g., but no more than 4000 FPM or 6 inches w.g.
6. One piece rolled blade dampers with exposed or concealed linkage may be used with face velocities of 1500 FPM or below.
7. Multiple section dampers may be jack-shafted to allow mounting of piston pneumatic actuators and direct connect electronic actuators. Each end of the jackshaft shall receive at least one actuator to reduce jackshaft twist.

C. Control Relays

1. Control Pilot Relays
  - a. Control pilot relays shall be of a modular plug-in design with retaining springs or clips.
  - b. Mounting Bases shall be snap-mount.
  - c. DPDT, 3PDT, or 4PDT relays shall be provided, as appropriate for application.
  - d. Contacts shall be rated for 10 amps at 120VAC.
  - e. Relays shall have an integral indicator light and check button.

D. Control Valves

1. All automatic control valves shall be fully proportioning and provide near linear heat transfer control. The valves shall be quiet in operation and fail-safe open, closed, or in their last position. All valves shall operate in sequence with another valve when required by the sequence of operations. All control valves shall be sized by the control manufacturer, and shall be guaranteed to meet the heating and cooling loads, as specified. All control valves shall be suitable for the system flow conditions and close against the differential pressures involved. Body pressure rating and connection type (sweat, screwed, or flanged) shall conform to the pipe schedule elsewhere in this Specification.
2. Plug-Type Globe
  - a. Valves shall have cage-type trim, providing seating and guiding surfaces for plug on top-and-bottom guided plugs.
  - b. Temperature Rating: 25 deg. F minimum, 250 deg. F maximum
  - c. Body: Cast Iron, flanged
  - d. Valve Trim: Bronze; Stem: Polished stainless steel
  - e. Packing: Spring Loaded Teflon or Synthetic Elastomer U-cups, self-adjusting
  - f. Plug: Brass, bronze or stainless steel, Seat: Brass
  - g. Disc: Replaceable Composition or Stainless Steel Filled PTFE
  - h. Ambient Operating Temperature Limits: -10 to 150 deg. F
3. High Performance Butterfly Type (HPB)
  - a. Body: Extended neck epoxy coated cast or ductile iron with full lug pattern, ANSI Class bolt pattern to match specified flanges.

- b. Seat: Reinforced PTFE
  - c. Disc: Polished aluminum bronze or stainless steel, pinned or mechanically locked to shaft. Sanded castings are not acceptable.
  - d. Bearings: Bronze or stainless steel.
  - e. Shaft: 416 stainless steel supported at three locations with PTFE bushings for positive shaft alignment.
  - f. Close Off: Bubble-tight shutoff at rated differential pressure.
4. Characterized Ball Type
- a. Valves shall be specifically designed for modulating duty in control application with guaranteed average leak-free life span over 200,000 full stroke cycles.
  - b. Industrial quality with nickel plated forged brass body and female NPT threads.
  - c. Blowout proof stem design, glass-reinforced Teflon thrust seal washer and stuffing box ring with minimum 600 psi rating (2-way valves) or 400 psi rating (3-way valves). The stem packing shall consist of two lubricated O-rings designed for On-Off, floating, or modulating service and requiring no maintenance.
  - d. Valves suitable for water or low-pressure steam shall incorporate an anti-condensation cap thermal break in stem design.
  - e. Ball: Stainless Steel
  - f. Stem: Stainless Steel
  - g. Characterizing disk held securely by a keyed ring providing equal percentage characteristic.
5. Minimum valve assembly pressure ratings:
- a. Chilled Water: 125 psi at 60 deg. F
6. Valve Selection
- a. Valve Type
    - 1) Modulating 2-way or 3-way valves
      - a) 3 inches and smaller: characterized ball type
      - b) 4 inches and larger: Butterfly or globe type
    - 2) Bypass valve at primary-only variable flow pumping system outlet: Pressure independent globe type.
    - 3) Chiller head pressure control: high performance butterfly
    - 4) Cooling Tower bypass: high performance butterfly
    - 5) Two-position isolation: high performance butterfly or ball valves
  - b. Valve Characteristic
    - 1) 2-way valves: equal percentage or modified equal percentage
    - 2) 3-way valves controlling cooling coils and condenser water heat exchangers: linear.
    - 3) 3-way valves controlling heating coils: equal percentage or modified equal percentage
    - 4) Two-position valves: not applicable
  - c. Valve Sizing
    - 1) Modulating Water: Size valve to achieve the following full open pressure drop:
      - a) Minimum pressure drop: equal to half the pressure drop of the coil or heat exchanger.
      - b) Maximum pressure drop:
        - i. Hot water at coils: 2 psi
        - ii. Chilled water at coils: 5 psi
        - iii. Chiller head pressure control: 1 psi
      - c) 3-way valves shall be selected for near minimum pressure drop. 2-way valves shall be selected near maximum pressure drop.
      - d) Flow coefficient (Cv) shall not be less than 1.0 (to avoid clogging) unless protected by strainer. Verify from piping schematics that a strainer is being provided.
    - 2) Two-position valves: Line size unless otherwise indicated on drawings.
- E. Electronic Signal Isolation Transducers

1. A signal isolation transducer shall be provided whenever an analog output signal from the BAS is to be connected to an external control system as an input (such as a chiller control panel), or is to receive as an input signal from a remote system.
2. The signal isolation transducer shall provide ground plane isolation between systems.
3. Signals shall provide optical isolation between systems.

## 2.20 VALVE ACCESSORIES

### A. Valve Limit Switches – Chiller Plant Applications

1. Two-position valves shall be equipped with open/closed limit switches.
2. The limit switch package shall have the following characteristics:
  - a. Mechanical Switches: 2 DPDT
  - b. Visual Display: 90° Green (open), Red (closed)
  - c. Shaft: Stainless Steel, O-ring seal
  - d. Conduit Entry: 2 @ ¾ inch NPT

## 2.21 MISCELLANEOUS DEVICES

### A. Local Control Panels

1. All control panels shall be factory constructed, incorporating the BAS manufacturer's standard designs and layouts. All control panels shall be UL inspected and listed as an assembly and carry a UL 508 label listing compliance. Control panels shall be fully enclosed, with perforated sub-panel, hinged door, and slotted flush latch.
2. In general, the control panels shall consist of the DDC controller(s), display module as specified and indicated on the plans, and I/O devices—such as relays, transducers, and so forth—that are not required to be located external to the control panel due to function. Where specified the display module shall be flush mounted in the panel face unless otherwise noted.
3. All I/O connections on the DDC controller shall be extended to a numbered, color-coded, and labeled terminal strip for ease of maintenance and expansion. Wiring to I/O devices shall be made from this terminal strip.
4. All other wiring in the panel, internal and external, shall be made to additional line or low voltage color-coded and labeled terminal strips. Low and line voltage wiring shall be segregated. All terminal strips and wiring shall be UL listed 300-volt service and provide adequate clearance for field wiring.
5. All wiring for every control panel shall follow a common color-coded format. All terminal strip color coding and numbering shall follow a common format. All wiring shall be neatly installed in plastic trays or tie-wrapped.
6. Panels installed indoors shall be NEMA 1. Panels installed outdoors shall be NEMA 4. Panels installed in environments susceptible to excessive moisture shall be NEMA 4.
7. A convenience 120 VAC duplex receptacle shall be provided in each enclosure, fused on/off power switch, and required transformers.

### B. Power Supplies

1. DC power supplies shall be sized for the connected device load. Total rated load shall not exceed 75% of the rated capacity of the power supply.
2. Input: 120 VAC +10%, 60Hz.
3. Output: 24 VDC.
4. Line Regulation: +0.05% for 10% line change.
5. Load Regulation: +0.05% for 50% load change.
6. Ripple and Noise: 1 mV RMS, 5 mV peak to peak.
7. An appropriately sized fuse and fuse block shall be provided and located next to the power supply.
8. A power disconnect switch shall be provided next to the power supply.

### C. Network Switches

1. The Switch will be DIN rail mountable out of the box, without the requirement to add or assemble any adaptor or similar mounting plate.
2. DIN rail mounted switches shall be capable of being installed side by side, with no gap or air space required for heat dissipation, with no loss of accuracy.

3. DIN rail mounted switches will be installed in BAS panels that provide appropriate protection from environmental influences. All network switches shall be installed indoors. Connections to outdoor equipment shall be protected from lightning surges.
  4. All switch connectors will be clearly labeled to provide easy reference.
  5. The switch shall have an operating temperature range of 0 deg. C to +55 deg. C.
  6. The switch will withstand a maximum continuous operating humidity of 95% without condensation.
  7. Units should be of fan-less design to increase reliability.
- D. Thermostats
1. Electric room thermostats of the heavy-duty type shall be provided for unit heaters, cabinet unit heaters, and ventilation fans, where required. All these items shall be provided with concealed adjustment. Finish of covers for all room-type instruments shall match and, unless otherwise indicated or specified, covers shall be manufacturer's standard finish.

## PART 3 - EXECUTION

### 3.1 BAS SPECIFIC REQUIREMENTS

- A. Graphic Displays
1. Provide a color graphic system flow diagram display for each system with all points as indicated on the point list. All terminal unit graphic displays shall be from a standard design library.
  2. User shall access the various system schematics via a graphical penetration scheme and/or menu selection..

### 3.2 INSTALLATION PRACTICES

- A. BAS Wiring
1. All conduit, wiring, accessories and wiring connections required for the installation of the Building Automation System, as herein specified, shall be provided by the BAS Contractor unless specifically shown on the Electrical Drawings under Division 26 Electrical. All wiring shall comply with the requirements of applicable portions of Division 26 and all local and national electric codes, unless specified otherwise in this Section.
  2. All BAS wiring materials and installation methods shall comply with BAS manufacturer recommendations.
  3. The sizing, type and provision of cable, conduit, cable trays, and raceways shall be the design responsibility of the BAS Contractor. If complications arise, however, due to the incorrect selection of cable, cable trays, raceways and/or conduit by the BAS Contractor, the Contractor shall be responsible for all costs incurred in replacing the selected components.
  4. Class 2 Wiring
    - a. All Class 2 (24VAC or less) wiring shall be installed in conduit unless otherwise specified.
    - b. Conduit is not required for Class 2 wiring in concealed accessible locations. Class 2 wiring not installed in conduit shall be supported every 5 feet from the building structure utilizing metal hangers designed for this application. Wiring shall be installed parallel to the building structural lines. All wiring shall be installed in accordance with local code requirements.
  5. Class 2 signal wiring and 24VAC power can be run in the same conduit. Power wiring 120VAC and greater cannot share the same conduit with Class 2 signal wiring.
  6. Provide for complete grounding of all applicable signal and communications cables, panels and equipment so as to ensure system integrity of operation. Ground cabling and conduit at the panel terminations. Avoid grounding loops.
  7. All wiring in mechanical rooms shall be in conduit. Minimum control wiring conduit size shall be  $\frac{3}{4}$  inch, except runs of less than 10 feet horizontally from a junction box to a single sensor, which may be  $\frac{1}{2}$  inch conduit.
- B. Identification Standards
1. Controller Identification: All controllers shall be identified by a plastic engraved nameplate securely fastened to the outside of the controller enclosure.

2. Panel Identification: All local control panels shall be identified by a plastic engraved nameplate securely fasted to the outside of the controller enclosure.
  3. Field Devices: All field devices shall be identified by a typed (not handwritten) securely attached tag label. Also, written description of components located inside panel, with wiring diagram.
  4. Panel Devices: All panel devices shall be identified by a typed label securely fastened to the backplane of the local control panel. Also, written description of components located inside panel, with wiring diagram.
  5. Raceway Identification: All the covers to junction and pull boxes of the control systems raceways shall be painted blue or have identification labels stating "Control System Wiring" affixed to the covers. Labels shall be typed, not handwritten.
  6. Wire Identification: All low and line voltage control wiring shall be identified by a number, as referenced to the associated control diagram, at each end of the conductor or cable. Identification number shall be permanently secured to the conductor or cable and shall be typed.
  7. All conduit and wire shall be white or painted white.
- C. Dedicated Digital Controller Per Major System
1. Each major system will be provided with its own dedicated BAS controller. Multiple mechanical systems such as ERU's or Chiller Plants shall not share or be controlled from the same BAS controller.
- D. BAS Line Voltage Power Source
1. 120-volt AC circuits used for the Building Automation System shall be taken from panel boards and circuit breakers provided by Division 26.
  2. Circuits used for the BAS shall be dedicated to the BAS and shall not be used for any other purposes.
  3. DDC terminal unit controllers may use AC power from motor power circuits.
- E. BAS Raceway
1. All wiring shall be installed in conduit or raceway except as noted elsewhere in this specification. Minimum control wiring conduit size ½ inch.
  2. Where it is not possible to conceal raceways in finished locations, surface raceway (Wiremold) may be used as approved by the Architect.
  3. All conduits and raceways shall be installed level, plumb, at right angles to the building lines and shall follow the contours of the surface to which they are attached.
  4. Flexible Metal Conduit shall be used for vibration isolation and shall be limited to 3 feet in length when terminating to vibrating equipment. Flexible Metal Conduit may be used within partition walls. Flexible Metal Conduit shall be UL listed.
- F. Penetrations
1. Provide fire stopping for all penetrations used by dedicated BAS conduits and raceways.
  2. All openings in fire proofed or fire stopped components shall be closed by using approved fire resistive sealant.
  3. All wiring passing through penetrations, including walls shall be in conduit or enclosed raceway.
  4. Penetrations of floor slabs shall be by core drilling. All penetrations shall be plumb, true, and square.
- G. BAS Panel Installation
1. The BAS panels and cabinets shall be located as indicated at an elevation of not less than 2 feet from the bottom edge of the panel to the finished floor. Each cabinet shall be anchored per the manufacturer's recommendations.
  2. The BAS contractor shall be responsible for coordinating panel locations with other trades and electrical and mechanical contractors.
- H. HVAC Input Devices – General
1. All Input devices shall be installed per the manufacturer recommendation.
  2. Locate components of the BAS in accessible local control panels wherever possible.
  3. The mechanical contractor shall install all in-line devices such as temperature wells, pressure taps, airflow stations, etc.
  4. Water Differential Pressure Sensors
    - a. Differential pressure transmitters used for flow measurement shall be sized to the flow-sensing device.

- b. Differential pressure transmitters shall be supplied with tee fittings and shut-off valves in the high and low sensing pick-up lines.
      - c. The transmitters shall be installed in an accessible location wherever possible.
    5. Medium to High Differential Water Pressure Applications (Over 21 inches w.c.):
      - a. Air bleed units, bypass valves and compression fittings shall be provided.
    6. Air Flow Measuring Stations:
      - a. Where the stations are installed in insulated ducts, the airflow passage of the station shall be the same size as the inside airflow dimension of the duct.
      - b. Station flanges shall be two inch to three inch to facilitate matching connecting ductwork.
      - c. Stations shall be installed in strict accordance with the manufacturer's published requirements, and with ASME Guidelines affecting non-standard approach conditions.
    7. Duct Temperature Sensors:
      - a. Duct mount sensors shall mount in an electrical box through a hole in the duct and be positioned so as to be easily accessible for repair or replacement.
      - b. The sensors shall be insertion type and constructed as a complete assembly including lock nut and mounting plate.
      - c. For ductwork greater in any dimension than 48 inches or where air temperature stratification exists such as a mixed air plenum, utilize an averaging sensor.
      - d. The sensor shall be mounted to suitable supports using factory approved element holders.
    8. Space Sensors:
      - a. Shall be mounted per ADA requirements.
      - b. Provide lockable tamper-proof covers in public areas and/or where indicated on the plans.
    9. Outside Air Humidity Sensors:
      - a. Outside air relative humidity sensors shall be installed with a rain proof, perforated cover.
      - b. The transmitter shall be installed in a NEMA IV enclosure with sealtite fittings and stainless steel bushings.
    10. Outside Air Temperature Sensors:
      - a. Outside air sensors shall be mounted on the North wall to minimize solar radiant heat impact or located in a continuous intake flow adequate to monitor outside air temperatures accurately.
      - b. Sensors exposed to solar radiation must be installed with solar shields. Sensors exposed to wind velocity pressure shall be shielded by a perforated plate surrounding the sensor element.
    11. Low Temperature Limit Switches:
      - a. Install on the discharge side of the first water coil in the air stream.
      - b. Mount element horizontally across duct in a serpentine pattern insuring each square foot of coil is protected by 1 foot of sensor.
      - c. For large duct areas where the sensing element does not provide full coverage of the air stream, provide additional switches as required to provide full protection of the air stream.
    12. Air Differential Pressure Status Switches:
      - a. Install with static pressure tips, tubing, fittings, and air filter.
    13. Water Differential Pressure Status Switches:
      - a. Install with shut off valves for isolation.
      - b. Provide complete installation kit including; static pressure tops, tubing, fittings and air filters. Provide appropriate scale range and differential adjustment for intended service.
    14. Valve Limit Switches:
      - a. Mount limit switch on valve yolk as recommended by switch manufacturer. Provide valve limit switches that will indicate both 100% Open and 100% Closed positions.
  - I. HVAC Output Devices
    1. All output devices shall be installed per the manufacturers recommendation. The mechanical contractor shall install all in-line devices such as control valves, dampers, airflow stations, pressure wells, etc.
    2. Actuators: All control actuators shall be sized capable of closing against the maximum system shut-off pressure. The actuator shall modulate in a smooth fashion through the entire stroke.
    3. Control Dampers: Shall be opposed blade for modulating control of airflow. Parallel blade dampers shall be installed for two position applications.



4. Control Valves: Shall be sized for proper flow control with equal percentage valve plugs. The maximum pressure drop for water applications shall be 5 PSI.
5. Electronic Signal Isolation Transducers: Whenever an analog output signal from the Building Automation System is to be connected to an external control system as an input (such as a chiller control panel), or is to receive as an input a signal from a remote system, provide a signal isolation transducer. Signal isolation transducer shall provide ground plane isolation between systems. Signals shall provide optical isolation between systems.

### 3.3 TRAINING

#### A. General

1. The controls contractor shall provide the following training services.
2. Operator Training (provide 16 hours): Operator training shall include the detailed review of the control installation drawings, points list, and equipment list. The instructor shall then walk through the building identifying the location of the control devices installed. For each type of systems, the instructor shall demonstrate how the system accomplishes the sequence of operation.
  - a. From the workstation, the operator shall demonstrate the software features of the system. As a minimum, the operator demonstrate and explain logging on, setting passwords, setting up a schedule, trend, point history, alarm, and archiving the database.
  - b. One day (8 hours) of the 16 hours will be devoted to on-site orientation by a field engineer who is fully knowledgeable of the specific installation details of the project. This orientation shall, at a minimum, consist of a review of the project as-built drawings, the control system software layout and naming conventions, and a walk through of the facility to identify panel and device locations.

### 3.4 COMMISSIONING & TESTING

#### A. General

1. Commissioning the Building automation System is a mandatory documented performance requirement of the selected BAS Contractor for all control systems detailed in this Specification and sequence of operations. Commissioning shall include verification of proper installation practices by the BAS Contractor and subcontractors under the BAS Contractor, point verification and calibration, system/sequence of operation verification with respect to specified operation, and network/workstation verification. Documentation shall be presented upon completion of each commissioning step and final completion to ensure proper operation of the Building automation System.
2. BAS commissioning and testing documentation is to be provided separately to the Owner.

#### B. Testing Requirements

1. Intent: Demonstrate to satisfaction of authorized representative that BAS is performing in accordance with specification requirements.
2. Logs of Tests: Complete logs of tests retained by Contractor for inspection and review of authorized representative at any time after testing started. Upon final completion of system tests log records submitted.
3. Witness of Tests: At time directed by authorized representative complete functional, operational test shall be performed by contractor. Test witnessed by personnel directed by authorized representative. Tests continue until functions of points, of alarms and command functions are proven to satisfaction of authorized representative.
4. Performance of Field Tests: Complete tests required at different and distinct times for various phases of construction as designated by authorized representative.

#### C. Testing Procedure

1. Upon completion of the installation, the BAS Contractor shall start-up the system and perform all necessary testing and run diagnostic tests to ensure proper operation. The BAS Contractor shall be responsible for generating all software and entering all database information necessary to perform existing control sequences.

#### D. Testing Documentation

1. Prior to acceptance testing, BAS Contractor shall create, on an individual system basis, trend logs of input and output points, or have an automatic Point History feature for documentation purposes.
- E. Field Points Testing
1. This step shall verify that all of the installed points receive or transmit the correct information prior to loading/activating the system software.
  2. ON/OFF commands from the workstation shall be performed in order to verify each binary output point.
  3. All binary input points are to be tested by observing a change of state upon command at PC workstation or locally in the field.
  4. All analog output points shall be tested using a command from the PC workstation to modulate the output device from minimum calibrated signal to maximum calibrated output.
  5. All analog input points are to be tested by comparing the reading obtained through the workstations to the value of an independent testing meter.
  6. All two-way communication interfaces (Modbus, BACNet, etc) tested and monitored values and commanded verified at the BAS workstation and in the field.
- F. Verify that activation of site related alarms specifically identifies and notifies the Owner remote monitoring sites and selected personnel.
- G. Non-Compliant Terms
1. The Contractor shall remove and replace, at its expense, all items that are not in compliance with the Specification requirements.
- H. VAV box performance verification and documentation:
1. The BAS Contractor shall test each VAV box for operation and correct flow. At each step, after a settling time, box air flows and damper positions will be sampled. Following the tests, a pass/fail report indicating results shall be produced. Possible results are Pass, No change in flow between full open and full close, Reverse operation or Maximum flow not achieved. The report shall be submitted as documentation of the installation.
  2. The BAS Contractor shall issue a report based on a sampling of the VAV calculated loop performance metrics. The report shall indicate performance criteria, include the count of conforming and non-conforming boxes, list the non-conforming boxes along with their performance data, and shall also include graphical representations of performance.

**END OF SECTION 23 09 00**

**SECTION 23 23 00 - REFRIGERANT 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. Refrigerant pipes and fittings.
  - 2. Refrigerants.

## 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of valve, refrigerant piping, and piping specialty.

## 1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

## 1.5 QUALITY ASSURANCE

- A. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- B. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

## 1.6 PRODUCT STORAGE AND HANDLING

- A. Store piping with end caps in place to ensure that piping interior and exterior are clean when installed.

## PART 2 - PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

- A. Line Test Pressure for Refrigerant R-410A:
  - 1. Suction Lines for Air-Conditioning Applications: 300 psig.
  - 2. Suction Lines for Heat-Pump Applications: 535 psig.
  - 3. Hot-Gas and Liquid Lines: 535 psig.

## 2.2 COPPER TUBE AND FITTINGS

- A. Copper Tube: ASTM B 88, Type K or L or ASTM B 280, Type ACR.
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.
- E. Brazing Filler Metals: AWS A5.8/A5.8M.
- F. Flexible Connectors:
  - 1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
  - 2. End Connections: Socket ends.
  - 3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch- long assembly.

4. Working Pressure Rating: Factory test at minimum 500 psig.
5. Maximum Operating Temperature: 250 deg F.

### 2.3 REFRIGERANTS

- A. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

## PART 3 - EXECUTION

### 3.1 PIPING APPLICATIONS FOR REFRIGERANT R-410A

- A. Suction Lines NPS 4 and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, Type K, or Type L, drawn-temper tubing and wrought-copper fittings with soldered joints.
- B. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Application: Copper, Type ACR or Type L, annealed- or drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.

### 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 Shop Drawings.
- B. Install refrigerant piping according to ASHRAE 15.
- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- D. 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.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping adjacent to machines to allow service and maintenance.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- K. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Section 08 31 13 "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.
- L. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- M. Slope refrigerant piping as follows:
  1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
  2. Install horizontal suction lines with a uniform slope downward to compressor.
  3. Install traps and double risers to entrain oil in vertical runs.
  4. Liquid lines may be installed level.
- N. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
- O. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- P. Identify refrigerant piping and valves according to Section 23 05 53 "Identification for HVAC Piping and Equipment."
- Q. 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."
- R. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 23 05 17 "Sleeves and Sleeve Seals for HVAC Piping."

### 3.3 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. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation.
- D. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
  - 1. Use Type BCuP (copper-phosphorus) alloy for joining copper socket fittings with copper pipe.
  - 2. Use Type BA9 (cadmium-free silver) alloy for joining copper with bronze or steel.

### 3.4 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for seismic restraints in Section 23 05 48 "Vibration and Seismic Controls for HVAC."
- B. Comply with Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment" for hangers, supports, and anchor devices.
- C. Install the following pipe attachments:
  - 1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
  - 2. Spring hangers to support vertical runs.
  - 3. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- D. Install hangers for copper tubing, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- E. Support horizontal piping within 12 inches of each fitting.
- F. Support vertical runs of copper tubing to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

### 3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. Comply with ASME B31.5, Chapter VI.
  - 2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
  - 3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in "Performance Requirements" Article.
    - a. Fill system with nitrogen to the required test pressure.
    - b. System shall maintain test pressure at the manifold gage throughout duration of test.
    - c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
    - d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.
- B. Prepare test and inspection reports.

### 3.6 SYSTEM CHARGING

- A. Charge system using the following procedures:
  - 1. Install core in filter dryers after leak test but before evacuation.
  - 2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
  - 3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
  - 4. Charge system with a new filter-dryer core in charging line.

## 3.7 ADJUSTING

- A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.
- B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
- C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.
- D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
  - 1. Open shutoff valves in condenser water circuit.
  - 2. Verify that compressor oil level is correct.
  - 3. Open compressor suction and discharge valves.
  - 4. Open refrigerant valves except bypass valves that are used for other purposes.
  - 5. Check open compressor-motor alignment and verify lubrication for motors and bearings.
- E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

**END OF SECTION 23 23 00**

**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. Sheet metal materials.
  - 4. Duct liner.
  - 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, sound-control devices, 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.
- B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of the following products:
  - 1. Liners and adhesives.
  - 2. Sealants and gaskets.
- B. Shop Drawings:
  - 1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
  - 2. Factory- and shop-fabricated ducts and fittings.
  - 3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
  - 4. Elevation of top of ducts.
  - 5. Dimensions of main duct runs from building grid lines.
  - 6. Fittings.
  - 7. Reinforcement and spacing.
  - 8. Seam and joint construction.
  - 9. Penetrations through fire-rated and other partitions.
  - 10. Equipment installation based on equipment being used on Project.
  - 11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
  - 12. Hangers and supports, including methods for duct and building attachment and vibration isolation.
- C. Delegated-Design Submittal:
  - 1. Sheet metal thicknesses.
  - 2. Joint and seam construction and sealing.

3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.
5. Design Calculations: Calculations for selecting hangers and supports.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
  2. Suspended ceiling components.
  3. Structural members to which duct will be attached.
  4. Size and location of initial access modules for acoustical tile.
  5. Penetrations of smoke barriers and fire-rated construction.
  6. Items penetrating finished ceiling including the following:
    - a. Lighting fixtures.
    - b. Air outlets and inlets.
    - c. Speakers.
    - d. Sprinklers.
    - e. Access panels.

## 1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
  2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
  3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."
- C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

## 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, Oval, 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 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. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.
- D. 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.
- E. 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.

## 2.4 DUCT LINER

- A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. CertainTeed Corporation; Insulation Group.
    - b. Johns Manville.
    - c. Knauf Insulation.
    - d. Owens Corning.
    - e. Maximum Thermal Conductivity:
      - 1) Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
      - 2) Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
  - 2. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
  - 3. Solvent or Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
- B. Insulation Pins and Washers:

1. 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.
  2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick galvanized steel ; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."
1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
  2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
  3. Butt transverse joints without gaps, and coat joint with adhesive.
  4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
  5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
  6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.
  7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
  8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
    - a. Fan discharges.
    - b. Intervals of lined duct preceding unlined duct.
    - c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.
  9. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

## 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. Water-Based Joint and Seam Sealant:
  1. Application Method: Brush on.
  2. Solids Content: Minimum 65 percent.
  3. Shore A Hardness: Minimum 20.
  4. Water resistant.
  5. Mold and mildew resistant.
  6. VOC: Maximum 75 g/L (less water).
  7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
  8. Service: Indoor or outdoor.
  9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- 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 leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

## 2.6 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. 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."
- C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- D. 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.
- E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- F. 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. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

### 3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

### 3.3 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
  - 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 2. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
  - 3. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
  - 4. Unconditioned Space, Exhaust Ducts: Seal Class C.
  - 5. Unconditioned Space, Return-Air Ducts: Seal Class B.
  - 6. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
  - 7. Conditioned Space, Supply-Air Ducts in Pressure Classes Between 2-Inch wg and 4-inch wg: Seal Class B.
  - 8. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 4-Inch wg: Seal Class A.
  - 9. Conditioned Space, Exhaust Ducts: Seal Class B.
  - 10. Conditioned Space, Return-Air Ducts: Seal Class C.

### 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. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
  - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
  - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
  - 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 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. Paint materials and application requirements are specified in Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."

### 3.7 DUCT CLEANING

- A. Clean existing duct system(s) before testing, adjusting, and balancing.
- B. Use service openings for entry and inspection.
  - 1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 23 33 00 "Air Duct Accessories" for access panels and doors.
  - 2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
  - 3. Remove and reinstall ceiling to gain access during the cleaning process.
- C. Particulate Collection and Odor Control:
  - 1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
  - 2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.
- D. Clean the following components by removing surface contaminants and deposits:
  - 1. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
  - 2. Supply-air ducts, dampers, actuators, and turning vanes.
  - 3. Dedicated exhaust and ventilation components and makeup air systems.
- E. Mechanical Cleaning Methodology:
  - 1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
  - 2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
  - 3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
  - 4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
  - 5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
  - 6. Provide drainage and cleanup for wash-down procedures.
  - 7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

### 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 except as otherwise indicated.
- B. Supply Ducts:
  - 1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

- a. Pressure Class: Positive 2-inch wg.
- b. Minimum SMACNA Seal Class: C.
- c. SMACNA Leakage Class for Rectangular: 24.
- d. SMACNA Leakage Class for Round and Flat Oval: 12.
- 2. Ducts Connected to Variable-Air-Volume Air-Handling Units:
  - a. Pressure Class: Positive 4-inch wg.
  - b. Minimum SMACNA Seal Class: A.
  - c. SMACNA Leakage Class for Rectangular: 6.
  - d. SMACNA Leakage Class for Round and Flat Oval: 3.
- C. Return Ducts:
  - 1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
    - a. Pressure Class: Positive or negative 2-inch wg.
    - b. Minimum SMACNA Seal Class: C.
    - c. SMACNA Leakage Class for Rectangular: 24.
    - d. SMACNA Leakage Class for Round and Flat Oval: 12.
  - 2. Ducts Connected to Air-Handling Units:
    - a. Pressure Class: Positive or negative 3-inch wg.
    - b. Minimum SMACNA Seal Class: B.
    - c. SMACNA Leakage Class for Rectangular: 12.
    - d. SMACNA Leakage Class for Round and Flat Oval: 6.
- D. Exhaust Ducts:
  - 1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
    - a. Pressure Class: Negative 2-inch wg.
    - b. Minimum SMACNA Seal Class: C if negative pressure, and A if positive pressure.
    - c. SMACNA Leakage Class for Rectangular: 24.
    - d. SMACNA Leakage Class for Round and Flat Oval: 12.
  - 2. Ducts Connected to Air-Handling Units :
    - a. Pressure Class: Positive or negative 3-inch wg.
    - b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
    - c. SMACNA Leakage Class for Rectangular: 12.
    - d. SMACNA Leakage Class for Round and Flat Oval: 6.
- E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:
  - 1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units :
    - a. Pressure Class: Positive or negative 1-inch wg.
    - b. Minimum SMACNA Seal Class: C.
    - c. SMACNA Leakage Class for Rectangular: 24.
    - d. SMACNA Leakage Class for Round and Flat Oval: 12.
  - 2. Ducts Connected to Air-Handling Units :
    - a. Pressure Class: Positive or negative 3-inch wg.
    - b. Minimum SMACNA Seal Class: B.
    - c. SMACNA Leakage Class for Rectangular: 12.
    - d. SMACNA Leakage Class for Round and Flat Oval: 6.
- F. Intermediate Reinforcement:
  - 1. Galvanized-Steel Ducts: Galvanized steel.
- G. Liner:
  - 1. Supply Air Ducts: Fibrous glass, Type I, 1 inch thick.
  - 2. Return Air Ducts: Fibrous glass, Type I, 1 inch thick.
  - 3. Supply Air Plenums: Fibrous glass, Type II, 1 inch thick.
  - 4. Return- and Exhaust-Air Plenums: Fibrous glass, Type II, 2 inches thick.
  - 5. Transfer Ducts: Fibrous glass, Type I, 1 inch thick.
- H. Elbow Configuration:
  - 1. 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."
  2. 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) Radius-to Diameter Ratio: 1.5.
    - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
    - c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.
- I. 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 only 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 23 31 13**

**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. Backdraft and pressure relief dampers.
  - 2. Barometric relief dampers.
  - 3. Manual volume dampers.
  - 4. Control dampers.
  - 5. Fire dampers.
  - 6. Smoke dampers.
  - 7. Combination fire and smoke dampers.
  - 8. Flange connectors.
  - 9. Turning vanes.
  - 10. Remote damper operators.
  - 11. Duct-mounted access doors.
  - 12. Flexible connectors.
  - 13. Duct accessory hardware.
- B. Related Requirements:
  - 1. Section 23 33 46 "Flexible Ducts" for insulated and non-insulated flexible ducts.
  - 2. Section 23 37 23 "HVAC Gravity Ventilators" for roof-mounted ventilator caps.
  - 3. Section 28 46 21.11 "Addressable Fire-Alarm Systems" 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. Special fittings.
    - b. Manual volume damper installations.
    - c. Control-damper installations.
    - d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
    - e. Wiring Diagrams: For power, signal, and control wiring.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.
- B. Source quality-control reports.



## 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

## 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 A653/A653M.
  - 1. Galvanized Coating Designation: G60.
  - 2. Exposed-Surface Finish: Mill phosphatized.
- B. Stainless-Steel Sheets: Comply with ASTM A480/A480M, Type 304, and having a No. 2 finish for concealed and exposed ducts.
- C. Aluminum Sheets: Comply with ASTM B209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- D. Extruded Aluminum: Comply with ASTM B221, Alloy 6063, Temper T6.
- E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- F. 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 BACKDRAFT AND PRESSURE RELIEF DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Greenheck Fan Corporation.
  - 2. Nailor Industries Inc.
  - 3. Ruskin Company.
- B. Description: Gravity balanced.
- C. Maximum Air Velocity: 2000 fpm.
- D. Maximum System Pressure: 3-inch wg.
- E. Frame: Hat-shaped, 0.094-inch-thick, galvanized sheet steel, with welded corners or mechanically attached and mounting flange.
- F. Blades: Multiple single-piece blades, center pivoted, maximum 6-inch width, 0.050-inch-thick aluminum sheet with sealed edges.
- G. Blade Action: Parallel.
- H. Blade Seals: Vinyl foam.
- I. Blade Axles:
  - 1. Material: Nonferrous metal.
  - 2. Diameter: 0.20 inch.
- J. Tie Bars and Brackets: Aluminum.
- K. Return Spring: Adjustable tension.
- L. Bearings: Steel ball or synthetic pivot bushings.
- M. Accessories:
  - 1. Adjustment device to permit setting for varying differential static pressure.
  - 2. Counterweights and spring-assist kits for vertical airflow installations.

3. Electric actuators.
4. Chain pulls.
5. Screen Mounting: Front mounted in sleeve.
  - a. Sleeve Thickness: 20 gauge (1.0 mm) minimum.
  - b. Sleeve Length: 6 inches (152 mm) minimum.
6. Screen Mounting: Rear mounted.
7. Screen Material: Galvanized steel.
8. Screen Type: Bird.
9. 90-degree stops.

#### 2.4 BAROMETRIC RELIEF DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Greenheck Fan Corporation.
  2. Nailor Industries Inc.
  3. Ruskin Company.
- B. Suitable for horizontal or vertical mounting.
- C. Maximum Air Velocity: 2000 fpm.
- D. Maximum System Pressure: 3-inch wg.
- E. Frame: Hat-shaped, 0.094-inch-thick, galvanized sheet steel, with welded corners or mechanically attached and mounting flange.
- F. Blades:
  1. Multiple, 0.050-inch- thick aluminum sheet.
  2. Maximum Width: 6 inches.
  3. Action: Parallel.
  4. Balance: Gravity.
  5. Eccentrically pivoted.
- G. Blade Seals: Vinyl.
- H. Blade Axles: Galvanized steel.
- I. Tie Bars and Brackets:
  1. Material: Aluminum.
  2. Rattle free with 90-degree stop.
- J. Return Spring: Adjustable tension.
- K. Bearings: Synthetic.
- L. Accessories:
  1. Flange on intake.
  2. Adjustment device to permit setting for varying differential static pressures.

#### 2.5 MANUAL VOLUME DAMPERS

- A. Low-Leakage, Steel, Manual Volume Dampers:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Nailor Industries Inc.
    - b. Ruskin Company.
    - c. Trox USA Inc.
  2. Comply with AMCA 500-D testing for damper rating.
  3. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
  4. Suitable for horizontal or vertical applications.
  5. Frames:
    - a. 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.
  6. Blades:
    - a. Multiple or single blade.

- b. Parallel- or opposed-blade design.
- c. Stiffen damper blades for stability.
- d. Galvanized, roll-formed steel, 0.064 inch thick.
- 7. Blade Axles: Galvanized steel.
- 8. 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.
- 9. Blade Seals: Vinyl.
- 10. Jamb Seals: Cambered stainless steel.
- 11. Tie Bars and Brackets: Galvanized steel.
- 12. Accessories:
  - a. Include locking device to hold single-blade dampers in a fixed position without vibration.
- B. Low-Leakage, Aluminum, Manual Volume Dampers:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Nailor Industries Inc.
    - b. Pottorff.
    - c. Ruskin Company.
  - 2. Comply with AMCA 500-D testing for damper rating.
  - 3. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
  - 4. Suitable for horizontal or vertical applications.
  - 5. Frames: 0.10-inch- thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
  - 6. Blades:
    - a. Multiple or single blade.
    - b. Parallel- or opposed-blade design.
    - c. Roll-Formed Aluminum Blades: 0.10-inch- thick aluminum sheet.
    - d. Extruded-Aluminum Blades: 0.050-inch- thick extruded aluminum.
  - 7. Blade Axles: Galvanized steel.
  - 8. 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.
  - 9. Blade Seals: Vinyl.
  - 10. Jamb Seals: Cambered stainless steel.
  - 11. Tie Bars and Brackets: Galvanized steel.
  - 12. Accessories:
    - a. Include locking device to hold single-blade dampers in a fixed position without vibration.
- C. Jackshaft:
  - 1. Size: 0.5-inch diameter.
  - 2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
  - 3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.
- D. Damper Hardware:
  - 1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
  - 2. Include center hole to suit damper operating-rod size.
  - 3. Include elevated platform for insulated duct mounting.

## 2.6 CONTROL DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Greenheck Fan Corporation.

2. Nailor Industries Inc.
3. Ruskin Company.
- B. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
- C. Frames:
  1. 0.05-inch- thick stainless steel.
  2. Mitered and welded corners.
- D. Blades:
  1. Multiple blade with maximum blade width of 6 inches.
  2. Parallel- and opposed-blade design.
  3. Aluminum.
  4. 0.064 inch thick single skin or 0.0747-inch- thick dual skin.
  5. Blade Edging: Closed-cell neoprene.
  6. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.
- E. Blade Axles: 1/2-inch- diameter; stainless steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.
  1. Operating Temperature Range: From minus 40 to plus 200 deg F.
- F. Bearings:
  1. Molded synthetic.
  2. 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.
  3. Thrust bearings at each end of every blade.

## 2.7 FIRE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Greenheck Fan Corporation.
  2. Nailor Industries Inc.
  3. Ruskin Company.
- B. Type: Dynamic; rated and labeled according to UL 555 by an NRTL.
- C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.
- D. Fire Rating: 1-1/2 and 3 hours.
- E. Frame: Curtain type with blades outside airstream; fabricated with roll-formed galvanized steel; with mitered and interlocking corners; gauge in accordance with UL listing.
- F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel; gauge in accordance with UL listing.
- G. Mounting Orientation: Vertical or horizontal as indicated.
- H. Blades: Roll-formed, interlocking, galvanized sheet steel; gauge in accordance with UL listing.
- I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
- J. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

## 2.8 SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Greenheck Fan Corporation.
  2. Nailor Industries Inc.
  3. Ruskin Company.
- B. General Requirements: Label according to UL 555S by an NRTL.
- C. Smoke Detector: Integral, factory wired for single-point connection.
- D. Frame: Hat-shaped, galvanized sheet steel, with welded or mechanically attached corners and mounting flange; gauge in accordance with UL listing.
- E. Blades: Roll-formed, horizontal, interlocking, galvanized sheet steel; gauge in accordance with UL listing.
- F. Leakage: Class I.
- G. Rated pressure and velocity to exceed design airflow conditions.
- H. Mounting Sleeve: Factory-installed, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone caulking; gauge in accordance with UL listing.

- I. Damper Motors: two-position action.
- J. 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 23 "Direct Digital Control (DDC) System 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. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
  - 6. Nonspring-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 .
  - 7. Electrical Connection: 115 V, single phase, 60 Hz.
- K. Accessories:
  - 1. Auxiliary switches for signaling or position indication.
  - 2. Test and reset switches, damper mounted.

## 2.9 COMBINATION FIRE AND SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Greenheck Fan Corporation.
  - 2. Nailor Industries Inc.
  - 3. Ruskin Company.
- B. Type: Dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL.
- C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.
- D. Fire Rating: 1-1/2 and 3 hours.
- E. Frame: Hat-shaped, galvanized sheet steel, with welded or mechanically attached corners and mounting flange; gauge in accordance with UL listing.
- F. Heat-Responsive Device: Electric resettable device and switch package, factory installed, rated.
- G. Smoke Detector: Integral, factory wired for single-point connection.
- H. Blades: Roll-formed, horizontal, interlocking, galvanized sheet steel; gauge in accordance with UL listing.
- I. Leakage: Class I .
- J. Rated pressure and velocity to exceed design airflow conditions.
- K. Mounting Sleeve: Factory-installed, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone caulking; gauge in accordance with UL listing.
- L. Master control panel for use in dynamic smoke-management systems.
- M. Damper Motors: Two-position action.
- N. 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 23 "Direct Digital Control (DDC) System 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. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
  6. Nonspring-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.
  7. Electrical Connection: 115 V, single phase, 60 Hz.
- O. Accessories:
1. Auxiliary switches for signaling or position indication.
  2. Test and reset switches, damper mounted.

## 2.10 FLANGE CONNECTORS

- A. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- B. Material: Galvanized steel.
- C. Gauge and Shape: Match connecting ductwork.

## 2.11 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.
  1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- B. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- C. 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."
- D. Vane Construction: Single wall.
- E. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

## 2.12 REMOTE DAMPER OPERATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Durodyne.
  2. Young Regulator.
  3. Greenheck.
- B. Description: Cable system designed for remote manual damper adjustment.
- C. Tubing: Brass.
- D. Cable: Stainless steel.
- E. Wall-Box Mounting: Recessed.
- F. Wall-Box Cover-Plate Material: Steel.

## 2.13 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-inch butt 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: Two hinges and two sash locks.
  - c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
  - d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

B. Pressure Relief Access Door:

1. Door and Frame Material: Galvanized sheet steel.
2. Door: Double wall with insulation fill with metal thickness applicable for duct pressure class.
3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
4. Factory set at 3.0- to 8.0-inch wg.
5. Doors close when pressures are within set-point range.
6. Hinge: Continuous piano.
7. Latches: Cam.
8. Seal: Neoprene or foam rubber.
9. Insulation Fill: 1-inch- thick, fibrous-glass or polystyrene-foam board.

#### 2.14 DUCT ACCESS PANEL ASSEMBLIES

- A. Labeled according to UL 1978 by an NRTL.
- B. Panel and Frame: Minimum thickness 0.0528-inch carbon steel.
- C. Fasteners: Carbon steel. Panel fasteners shall not penetrate duct wall.
- D. Minimum Pressure Rating: 10-inch wg (2500 Pa), positive or negative.

#### 2.15 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. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
  1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
  2. Outdoor 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 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.
  7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

#### 2.16 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install backdraft and/or control dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
1. Install steel volume dampers in steel ducts.
  2. Install aluminum volume dampers in aluminum ducts.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install test holes at fan inlets and outlets and elsewhere as indicated.
- G. Install fire and smoke dampers according to UL listing.
- H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
1. On both sides of duct coils.
  2. Upstream and downstream from duct filters.
  3. At outdoor-air intakes and mixed-air plenums.
  4. At drain pans and seals.
  5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
  6. 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.
  7. At each change in direction and at maximum 50-foot (15-m) spacing.
  8. Upstream and downstream from turning vanes.
  9. Control devices requiring inspection.
  10. Elsewhere as indicated.
- I. Install access doors with swing against duct static pressure.
- J. 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.
- K. Label access doors according to Section 23 05 53 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- L. Install flexible connectors to connect ducts to equipment.
- M. Install duct test holes where required for testing and balancing purposes.
- N. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

### 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.
5. Operate remote damper operators to verify full range of movement of operator and damper.

**END OF SECTION 23 33 00**

**SECTION 23 33 46 - FLEXIBLE 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. Insulated flexible ducts.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: For flexible ducts.
  - 1. Include plans showing locations and mounting and attachment details.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from installers of the items involved.

**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.
- C. Comply with the Air Diffusion Council's "ADC Flexible Air Duct Test Code FD 72-R1."
- D. Comply with ASTM E 96/E 96M, "Test Methods for Water Vapor Transmission of Materials."

**2.2 INSULATED FLEXIBLE DUCTS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Flexmaster U.S.A. Inc.
  - 2. JP Lamborn Co.
  - 3. McGill Airflow LLC.
  - 4. Thermaflex; a Flex-Tek Group company.
- B. Insulated, Flexible Duct: UL 181, Class 1, black polymer film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.
  - 1. Pressure Rating: 4-inch wg positive and 0.5-inch wg negative.
  - 2. Maximum Air Velocity: 4000 fpm.
  - 3. Temperature Range: Minus 20 to plus 175 deg .
  - 4. Insulation R-Value: Comply with ASHRAE/IES 90.1.

## 2.3 FLEXIBLE DUCT CONNECTORS

- A. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.
- B. Non-Clamp Connectors: Liquid adhesive plus tape.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install flexible ducts 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 in indoor applications only. Flexible ductwork should not be exposed to UV lighting.
- C. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- D. Connect diffusers or light troffer boots to ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- E. Connect flexible ducts to metal ducts with liquid adhesive plus tape.
- F. Install duct test holes where required for testing and balancing purposes.
- G. Installation:
  - 1. Install ducts fully extended.
  - 2. Do not bend ducts across sharp corners.
  - 3. Bends of flexible ducting shall not exceed a minimum of one duct diameter.
  - 4. Avoid contact with metal fixtures, water lines, pipes, or conduits.
  - 5. Install flexible ducts in a direct line, without sags, twists, or turns.
- H. Supporting Flexible Ducts:
  - 1. Suspend flexible ducts with bands 1-1/2 inches wide or wider and spaced a maximum of 48 inches apart. Maximum centerline sag between supports shall not exceed 1/2 inch per 12 inches.
  - 2. Install extra supports at bends placed approximately one duct diameter from center line of the bend.
  - 3. Ducts may rest on ceiling joists or truss supports. Spacing between supports shall not exceed the maximum spacing per manufacturer's written installation instructions.
  - 4. Vertically installed ducts shall be stabilized by support straps at a maximum of 72 inches o.c.

**END OF SECTION 23 33 46**

**SECTION 23 34 23 - HVAC POWER VENTILATORS****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. Belt drive centrifugal downblast exhaust fans.
  - 2. Direct drive axial roof supply fans.
  - 3. Centrifugal ceiling exhaust fans.

**1.3 PERFORMANCE REQUIREMENTS**

- A. Project Altitude: Base fan-performance ratings on actual Project site elevations.
- B. Operating Limits: Classify according to AMCA 99.

**1.4 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.
- B. Shop Drawings: 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.
- C. Delegated-Design Submittal: For unit hangars and 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. 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.
  - 2. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.

**1.5 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
  - 1. Roof framing and support members relative to duct penetrations.
  - 2. Ceiling suspension assembly members.
  - 3. Size and location of initial access modules for acoustical tile.
  - 4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

## 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

## 1.7 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.

## 1.8 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.

## 1.9 COORDINATION

- A. Coordinate size and location of structural-steel support members.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided.
- C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Acme Engineering and Manufacturing Corporation.
  - 2. Greenheck Fan Corporation.
  - 3. Loren Cook Company.
  - 4. PennBarry.
- B. General:
  - 1. Each fan shall bear a permanently affixed manufacturer's engraved metal nameplate containing the model number and individual serial number.
  - 2. Each fan shall bear the AMCA Sound and Air Performance seal.

### 2.2 BELT DRIVE CENTRIFUGAL DOWNBLAST EXHAUST FANS

- A. Description: The exhaust fan shall be of the spun aluminum, downblast, belt drive type. The fan shall be specifically designed for roof mounted applications exhausting relatively clean air.
- B. Housing:
  - 1. The fan housing shall consist of the motor cover, shroud, curb cap and lower windband, and shall be constructed of heavy-gauge aluminum.
  - 2. The housing shall have a rigid internal support structure and leak-proof design.
  - 3. The fan shroud shall be one piece with a rolled bead for extra strength which directs exhaust air downward. The lower windband shall be one piece with formed edges for added strength and the curb cap shall include prepunched mounting holes to ensure correct attachment.
- C. Wheel:
  - 1. The fan wheel shall be centrifugal non-overloading backward-inclined, constructed of aluminum and shall include a wheel cone matched to the inlet cone for precise running tolerances.
  - 2. The wheel shall be statically and dynamically balanced in accordance to AMCA Standard 204-05.

- D. Motor:
1. The motor shall be heavy-duty ball bearing type, matched to the fan load and furnished at the specified voltage, phase and enclosure.
  2. Drives shall be sized for a minimum of 150% of driven horsepower.
  3. The motor and drive shall be mounted on vibration isolators, out of the airstream. Vibration isolators shall be double-studded or pedestal mount with no metal-to-metal contact. Each vibration isolator shall be sized to match the weight of the fan.
  4. Fresh air for motor cooling shall be readily drawn into the motor compartment from an area free of discharge contaminants.
  5. Motor shall be readily accessible for maintenance.
- E. Fan Shaft:
1. Fan shaft shall be precision ground and polished solid steel with an anti-corrosive coating.
  2. Fan shaft shall be mounted in permanently sealed, lubricated pillow block ball bearings.
  3. The first critical speed on the fan shaft shall be at least 25% over maximum operating speed.
  4. Bearings shall be selected for a minimum L<sub>10</sub> life in excess of 100,000 hours (L<sub>50</sub> life of 500,000 hours) at maximum cataloged operating speed. All bearings shall be 100% factory tested.
- F. Disconnect switch: A standard disconnect switch shall be provided. The disconnect switch is a positive electrical shutoff and shall be wired from the fan motor to a junction box installed within the motor compartment. Factory standard shall be a NEMA-1 disconnect switch with other NEMA rated options available (refer to the equipment schedule on the plans additional NEMA requirements). Disconnect switches may be factory mounted and/or shipped loose for field mounting.
- G. Accessories: Refer to the equipment schedule on the plans for all required accessories and options.

### 2.3 DIRECT DRIVE AXIAL SUPPLY FANS

- A. Description: The exhaust fan shall be of the spun aluminum, direct drive type. The fan shall be specifically designed for roof mounted applications supplying outside air.
- B. Housing:
1. The fan housing shall consist of the motor cover, shroud, curb cap and lower windband, and shall be constructed of heavy-gauge aluminum.
  2. The housing shall have a rigid internal support structure and leak-proof design.
  3. The fan shroud shall be one piece with a rolled bead for extra strength. The lower windband shall be one piece with formed edges for added strength and the curb cap shall include prepunched mounting holes to ensure correct attachment.
- C. Wheel:
1. The fan wheel shall be propeller type, constructed of aluminum and shall include a wheel cone matched to the inlet cone for precise running tolerances.
  2. The wheel shall be statically and dynamically balanced in accordance to AMCA Standard 204-05.
- D. Motor:
1. The fan shall have a sleeve bearing motor, matched to the fan load, and furnished at specified voltage, phase and enclosure. A heavy-duty ball bearing, type shall be supplied as required for larger fan sizes.
  2. The motor shall be mounted on vibration isolators, out of the airstream. Vibration isolators shall be double-studded with no metal-to-metal contact. Each vibration isolator shall be sized to match the weight of the fan.
  3. Fresh air for motor cooling shall be drawn into the motor compartment from an area free of discharge contaminants.
  4. Motor shall be readily accessible for maintenance.
- E. Accessories: Refer to the equipment schedule on the plans for all required accessories and options.
1. Provide aluminum bird screen on inlet of fan.

### 2.4 CENTRIFUGAL CEILING EXHAUST FANS

- A. Description: The exhaust fan shall be of the ceiling mounted, centrifugal, direct drive type. The fan shall be UL/cUL Listed.
- B. Housing:

1. The fan housing shall be constructed of galvanized steel.
2. The outlet duct collar shall include a backdraft damper.
- C. Fan Wheel: The fan wheel shall be of the forward-curved centrifugal type, constructed of calcium carbonate filled polypropylene and dynamically balanced.
- D. Grille: Unless scheduled otherwise on the plans, the grille shall be constructed of non-yellowing high-impact polystyrene and attached to the housing with hidden attachment screws.
- E. Electrical Requirements:
  1. The fan wiring access shall be external.
  2. The motor disconnect shall be internal and of the plug-in type.
- F. Motor: The motor shall be mounted on vibration isolators.
- G. Accessories: Refer to the equipment schedule on the plans for all required accessories and options.

## 2.5 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: Unless noted otherwise on the plans, enclosure types shall be totally enclosed and fan cooled.

## 2.6 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 and seismic control devices specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC."
- C. Secure roof-mounted fans to roof curbs with cadmium-plated hardware. See Section 07 72 00 "Roof Accessories" for installation of roof curbs.
- D. Ceiling Units: Suspend units from structure; use steel wire or metal straps.
- E. Install units with clearances for service and maintenance.
- F. 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 "Low-Voltage Electrical Power Conductors and Cables."

### 3.3 FIELD QUALITY CONTROL

- A. Tests and Inspections:
1. Verify that shipping, blocking, and bracing are removed.
  2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
  3. Verify that cleaning and adjusting are complete.
  4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
  5. Adjust belt tension.
  6. Adjust damper linkages for proper damper operation.
  7. Verify lubrication for bearings and other moving parts.
  8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
  9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
  10. Shut unit down and reconnect automatic temperature-control operators.
  11. Remove and replace malfunctioning units and retest as specified above.
- B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

### 3.4 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.
- C. Comply with requirements in Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
- D. Replace fan and motor pulleys as required to achieve design airflow.
- E. Lubricate bearings.

**END OF SECTION 23 34 23**



**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:
  - 1. Shutoff, single-duct air terminal units.
  - 2. Parallel, fan-powered air terminal units.
  - 3. Casing liner.

## 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.
- B. Shop Drawings: For air terminal units.
  - 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.
  - 4. Hangers and supports, including methods for duct and building attachment[, **seismic restraints,**] and vibration isolation.
- C. Delegated-Design Submittal:
  - 1. Materials, fabrication, assembly, and spacing of hangers and supports.
  - 2. Include design calculations for selecting hangers and supports.

## 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 assembly members.
  - 2. Size and location of initial access modules for acoustic tile.
  - 3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
- B. Field quality-control reports.

## 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.

## 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. Fan-Powered-Unit Filters: Furnish one spare filter(s) for each filter installed.

## 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.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."
- C. ASHRAE Compliance: Applicable requirements in ASHRAE/IES 90.1, "Section 6 - Heating, Ventilating, and Air Conditioning."

## 2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Carrier Corporation.
  2. Daikin Applied.
  3. Johnson Controls.
  4. Nailor Industries Inc.
  5. Price Industries.
  6. Titus, a division of Air System Components; Johnson Controls, Inc.
  7. Trane.

## 2.3 SHUTOFF, SINGLE-DUCT AIR TERMINAL UNITS

- A. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.
- B. Casing: 0.034-inch-thick galvanized steel, single wall.
1. Casing Liner: Comply with requirements in "Casing Liner" Article for fibrous-glass duct liner.
  2. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
  3. Air Outlet: S-slip and drive connections.
  4. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket.
  5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- C. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.
1. Maximum Damper Leakage: AHRI 880 rated, 2 percent of nominal airflow at 3-inch wg inlet static pressure.
  2. Damper Position: Normally open.
- D. Electric-Resistance Heating Coils: Nickel-chromium heating wire, free of expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with primary automatic, and secondary manual, reset thermal cutouts. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware.
1. Access door interlocked disconnect switch.
  2. Downstream air temperature sensor with local connection to override discharge-air temperature to not exceed a maximum temperature set point (adjustable).
  3. Nickel chrome 80/20 heating elements.
  4. Airflow switch for proof of airflow.
  5. Fuses in terminal box for overcurrent protection (for coils more than 48 A).

- E. Control devices shall be compatible with temperature controls system specified in Section 23 09 00 "Instrumentation and Control for HVAC."
1. Electric Damper Actuator: 24 V, powered open, spring return.
  2. Electric Thermostat: Wall-mounted electronic type with clock display, temperature display in Fahrenheit and Celsius, and space temperature set point.
  3. Terminal Unit Controller: Pressure-independent, variable-air-volume (VAV) controller with electronic airflow transducer with multipoint velocity sensor at air inlet, factory calibrated to minimum and maximum air volumes, and having the following features:
    - a. Occupied and unoccupied operating mode.
    - b. Remote reset of airflow or temperature set points.
    - c. Adjusting and monitoring with portable terminal.
    - d. Communication with temperature-control system specified in Section 23 09 00 "Instrumentation and Control for HVAC."

#### 2.4 PARALLEL FAN-POWERED AIR TERMINAL UNITS

- A. Configuration: Volume-damper assembly and fan in parallel arrangement inside unit casing with control components inside a protective metal shroud. Designed for quiet operation. Low-profile design.
- B. Casing: 0.034-inch-thick galvanized steel, single wall.
1. Casing Liner: Comply with requirements in "Casing Liner" Article for fibrous-glass duct liner.
  2. Air Inlets: Round stub connections or S-slip and drive connections for duct attachment.
  3. Air Outlet: S-slip and drive connections.
  4. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket and quarter-turn latches.
  5. Fan: Forward-curved centrifugal, located at plenum air inlet.
  6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- C. Volume Damper: Galvanized steel with flow-sensing ring and peripheral gasket and self-lubricating bearings.
1. Maximum Damper Leakage: AHRI 880 rated, 2 percent of nominal airflow at 3-inch wg inlet static pressure.
  2. Damper Position: Normally open.
- D. Motor:
1. 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."
  2. Type: Electronically commutated motor.
  3. Fan-Motor Assembly Isolation: Rubber isolators.
- E. Filters:
1. Minimum Efficiency Reporting Value: According to ASHRAE 52.2.
  2. Material: Pleated cotton-polyester media, MERV 7.
  3. Thickness: 1 inch.
- F. Electric-Resistance Heating Coils: Nickel-chromium heating wire, free of expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with primary automatic, and secondary manual, reset thermal cutouts. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware.
1. Location: Plenum air inlet.
  2. Access door interlocked disconnect switch.
  3. Downstream air temperature sensor with local connection to override discharge-air temperature to not exceed a maximum temperature set point (adjustable).
  4. Nickel chrome 80/20 heating elements.
  5. Airflow switch for proof of airflow.
  6. Fan interlock contacts.
  7. Fuses in terminal box for overcurrent protection (for coils more than 48 A).
  8. Magnetic contactor for each step of control (for three-phase coils).
- G. Control devices shall be compatible with temperature controls system specified in Section 23 09 00 "Instrumentation and Control for HVAC."

1. Electric Damper Actuator: 24 V, powered open, spring return.
2. Electric Thermostat: Wall-mounted electronic type with clock display, temperature display in Fahrenheit and Celsius, and space temperature set point.
3. Terminal Unit Controller: Pressure-independent, VAV controller with electronic airflow transducer with multipoint velocity sensor at air inlet, factory calibrated to minimum and maximum air volumes, and having the following features:

## 2.5 CASING LINER

- A. Casing Liner: Fibrous-glass duct liner, complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
  1. Minimum Thickness: 3/4 inch.
    - a. Maximum Thermal Conductivity:
      - 1) Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
      - 2) Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
  2. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
  3. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.

## 2.6 SOURCE QUALITY CONTROL

- A. Factory Tests: Test assembled air terminal units according to AHRI 880.
  1. 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.
  1. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
  2. Use powder-actuated concrete fasteners for standard-weight aggregate concretes and for slabs more than 4 inches (100 mm) thick.
  3. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes and for slabs less than 4 inches (100 mm) 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. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."
- B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.
- C. Install wall-mounted thermostats.

### 3.3 CONNECTIONS

- A. Comply with requirements in Section 23 31 13 "Metal Ducts" for connecting ducts to air terminal units.

- B. 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:
  1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
  2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  3. 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. 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. Train Owner's maintenance personnel to adjust, operate, and maintain air terminal units.

**END OF SECTION 23 36 00**

**SECTION 23 37 13 - DIFFUSERS, REGISTERS, AND GRILLES**

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Section Includes:
  - 1. Perforated diffusers.
  - 2. Louver face diffusers.
  - 3. Linear slot diffusers.
  - 4. Ceiling-integral continuous diffusers.
  - 5. Adjustable bar registers and grilles.
- B. Related Sections:
  - 1. Section 23 33 00 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

## 1.3 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.
- B. Samples for Initial Selection: For diffusers, registers, and grilles with factory-applied color finishes.
- C. Samples for Verification: For diffusers, registers, and grilles, in manufacturer's standard sizes to verify color selected.

## 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 assembly members.
  - 2. Method of attaching hangers to building structure.
  - 3. Size and location of initial access modules for acoustical tile.
  - 4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
  - 5. Duct access panels.
- B. Source quality-control reports.

## PART 2 - PRODUCTS

## 2.1 CEILING DIFFUSERS

- A. Manufacturers
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Hart & Cooley Inc.
    - b. METALAIRE, Inc.
    - c. Nailor Industries Inc.
    - d. Price Industries.

- e. Titus.
- f. Tuttle & Bailey.
- B. Perforated Diffuser RG-1:
  1. Devices shall be specifically designed for variable-air-volume flows.
  2. Material: Steel backpan and pattern controllers, with aluminum face.
  3. Finish: Baked enamel, color selected by Architect.
  4. Face Size: 24 by 24 inches.
  5. Duct Inlet: Square.
  6. Face Style: Flush.
  7. Mounting: Coordinate with ceiling type.
- C. Louver Face Diffuser SD-X:
  1. Devices shall be specifically designed for variable-air-volume flows.
  2. Material: Aluminum.
  3. Finish: Baked enamel, color selected by Architect.
  4. Face Size: 24 by 24 inches.
  5. Mounting: Coordinate with ceiling type..
  6. Pattern: Four-way core style. Pattern shall be full size of diffuser face, regardless of neck size.
  7. Dampers: Butterfly.
  8. Accessories:
    - a. Square to round neck adaptor.

## 2.2 CEILING LINEAR SLOT OUTLETS

- A. Linear Slot Diffuser LD-X:
  1. Devices shall be specifically designed for variable-air-volume flows.
  2. Material - Shell: Aluminum, insulated.
  3. Material - Pattern Controller and Tees: Aluminum.
  4. Finish - Face and Shell: Baked enamel, black.
  5. Finish - Pattern Controller: Baked enamel, black.
  6. Finish - Tees: Baked enamel, color selected by Architect.
  7. Accessories: Coordinate with ceiling type..
- B. Ceiling-Integral Continuous Diffuser LD-X, where noted:
  1. Straight and curved sections as required to accommodate layout.
  2. Mitered tees and corners.
  3. Material: Aluminum, extruded, heavy wall.
  4. Finishes:
    - a. Exterior: Standard white.
    - b. Interior: Standard black.
  5. Throw: High.
  6. Mounting: Ceiling.
  7. Plenum: Insulated.
  8. Other Features:
    - a. Painted interior.
    - b. Blank-offs.

## 2.3 REGISTERS AND GRILLES

- A. Adjustable Bar Grille SG-1:
  1. Material: Aluminum.
  2. Finish: Baked enamel, color selected by Architect.
  3. Face Blade Arrangement: Horizontal spaced 3/4 inch apart.
  4. Rear-Blade Arrangement: Vertical spaced 3/4 inch apart.
  5. Mounting: Countersunk screw.
  6. Damper Type: Adjustable opposed blade.

## 2.4 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 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 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.

### 3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

**END OF SECTION 23 37 13**



**SECTION 23 37 23 - HVAC GRAVITY VENTILATORS****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 hoods.

**1.3 PERFORMANCE REQUIREMENTS**

- A. Structural Performance: Ventilators shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of ventilator components, noise or metal fatigue caused by ventilator blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.
- B. Water Entrainment: Limit water penetration through unit to comply with ASHRAE 62.1.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For gravity ventilators. Include plans, elevations, sections, details, ventilator attachments to curbs, and curb attachments to roof structure.
  - 1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.

**1.5 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Roof framing plans and other details, 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. Structural members to which roof curbs and ventilators will be attached.
  - 2. Sizes and locations of roof openings.

**1.6 QUALITY ASSURANCE**

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
  - 2. AWS D1.3, "Structural Welding Code - Sheet Steel."

**1.7 COORDINATION**

- A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

**PART 2 - PRODUCTS****2.1 MATERIALS**

- A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5 or T-52.
- B. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with temper as required for forming or as otherwise recommended by metal producer for required finish.
- C. Galvanized-Steel Sheet: ASTM A 653/A 653M, G90 zinc coating, mill phosphatized.

- D. Stainless-Steel Sheet: ASTM A 666, Type 304, with No. [4] [6] finish.
- E. Fasteners: Same basic metal and alloy as fastened metal or 300 Series stainless steel unless otherwise indicated. Do not use metals that are incompatible with joined materials.
  - 1. Use types and sizes to suit unit installation conditions.
  - 2. Use Hex-head or Phillips pan-head screws for exposed fasteners unless otherwise indicated.

## 2.2 FABRICATION, GENERAL

- A. Factory or shop fabricate gravity ventilators to minimize field splicing and assembly. Disassemble units to the minimum extent as necessary for shipping and handling. Clearly mark units for reassembly and coordinated installation.
- B. Fabricate frames, including integral bases, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
- C. Fabricate units with closely fitted joints and exposed connections accurately located and secured.
- D. Fabricate supports, anchorages, and accessories required for complete assembly.
- E. Perform shop welding by AWS-certified procedures and personnel.

## 2.3 ROOF HOODS

- 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. Acme Engineering & Mfg. Corporation.
  - 2. Aerovent.
  - 3. Carnes.
  - 4. Greenheck Fan Corporation.
  - 5. JencoFan.
  - 6. Loren Cook Company.
  - 7. PennBarry.
- B. Factory or shop fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figures 6-6 and 6-7.
- C. Materials: Aluminum sheet, minimum 0.063-inch- thick base and 0.050-inch- thick hood; suitably reinforced.
- D. Roof Curbs: Galvanized-steel sheet; with 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 fit roof opening and ventilator base.
  - 1. Overall Height: 12 inches.
- E. Bird Screening: Aluminum, 1/2-inch- square mesh, 0.063-inch wire.
- F. Galvanized-Steel Sheet Finish:
  - 1. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil for topcoat and an overall minimum dry film thickness of 2 mils.
    - a. Color and Gloss: As selected by Architect from manufacturer's full range.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install gravity ventilators level, plumb, and at indicated alignment with adjacent work.
- B. Install gravity ventilators with clearances for service and maintenance.
- C. Install perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- D. Install concealed gaskets, flashings, joint fillers, and insulation as installation progresses. Comply with Section 07 92 00 "Joint Sealants" for sealants applied during installation.
- E. Label gravity ventilators according to requirements specified in Section 23 05 53 "Identification for HVAC Piping and Equipment."

- F. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.
- G. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

### 3.2 CONNECTIONS

- A. Duct installation and connection requirements are specified in Section 23 31 13 "Metal Ducts" and Section 23 31 16 "Nonmetal Ducts." Drawings indicate general arrangement of ducts and duct accessories.

### 3.3 ADJUSTING

- A. Adjust damper linkages for proper damper operation.

**END OF SECTION 23 37 23**

**SECTION 23 81 26 - SPLIT-SYSTEM AIR-CONDITIONERS****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 split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
- B. Shop Drawings: 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.
- C. Samples for Initial Selection: For units with factory-applied color finishes.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Field quality-control reports.
- B. Warranty: Sample of special warranty.

**1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For split-system air-conditioning units 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. Filters: One set(s) for each air-handling unit.
  - 2. Gaskets: One set(s) for each access door.
  - 3. Fan Belts: One set(s) for each air-handling unit fan.

**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. ASHRAE Compliance:
  - 1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."

2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Procedures," and Section 7 - "Construction and System Start-up."

- C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

## 1.8 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Section 03 30 00 "Cast-in-Place Concrete."
- B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

## 1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
  1. Warranty Period:
    - a. For Compressor: Five year(s) from date of Substantial Completion.
    - b. For Parts: Five year(s) from date of Substantial Completion.
    - c. For Labor: Five year(s) 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. Carrier Corporation; Home Comfort and HVAC Building & Industrial Systems.
  2. Daikin Applied
  3. Trane; a business of American Standard companies.
  4. YORK; a Johnson Controls company.

### 2.2 INDOOR UNITS (6 TONS OR MORE)

- A. Floor Mounted Air Handler Components:
  1. Arrangement: Unit shall be arranged with rear return and top supply to match existing unit layout.
  2. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
  3. Insulation: Faced, glass-fiber duct liner.
  4. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
  5. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements; with refractory ceramic support bushings, automatic-reset thermal cutout, built-in magnetic contactors, manual-reset thermal cutout, airflow proving device, and one-time fuses in terminal box for overcurrent protection.
  6. Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.
  7. Fan Motors:
    - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 23 05 13 "Common Motor Requirements for HVAC Equipment."
    - b. Three-phase, permanently lubricated, ball-bearing motors with built-in thermal-overload protection.

- c. Wiring Terminations: Connect motor to chassis wiring with plug connection.
- 8. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- 9. Filters: 2 inch thick, in fiberboard frames.
- 10. Condensate Drain Pans:
  - a. Fabricated with two percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.
    - 1) Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.
    - 2) Depth: A minimum of 2 inches deep.
  - b. Single-wall, stainless-steel sheet.
  - c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.
    - 1) Minimum Connection Size: NPS 1.
  - d. Pan-Top Surface Coating: Asphaltic waterproofing compound.
  - e. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.

### 2.3 OUTDOOR UNITS (6 TONS OR MORE)

- A. Air-Cooled, Compressor-Condenser Components:
  - 1. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
  - 2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
    - a. Compressor Type: Scroll.
    - b. Refrigerant Charge: R-410A.
    - c. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.
  - 3. Fan: Aluminum-propeller type, directly connected to motor.
  - 4. Motor: Permanently lubricated, with integral thermal-overload protection.
  - 5. Low Ambient Kit: Permits operation down to 45 deg F.
  - 6. Mounting Base: Polyethylene.

### 2.4 ACCESSORIES

- A. Control equipment and sequence of operation are specified in Section 23 09 00 "Instrumentation and Control for HVAC" and Section 23 09 93 "Sequence and Operations for HVAC Controls."
- B. Automatic-reset timer to prevent rapid cycling of compressor.
- C. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.
- D. Drain Hose: For condensate.
- E. Additional Monitoring:
  - 1. Monitor constant and variable motor loads.
  - 2. Monitor variable-frequency-drive operation.
  - 3. Monitor economizer cycle.
  - 4. Monitor cooling load.
  - 5. Monitor air distribution static pressure and ventilation air volumes.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install units level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Install roof-mounted, compressor-condenser components on equipment supports specified in Section 07 72 00 "Roof Accessories." Anchor units to supports with removable, cadmium-plated fasteners.
- D. Equipment Mounting:
  - 1. Install ground-mounted, compressor-condenser components on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete." or Section 033053 "Miscellaneous Cast-in-Place Concrete."
  - 2. Comply with requirements for vibration isolation and seismic control devices specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC."
- E. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

### 3.2 CONNECTIONS

- A. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.
- B. Duct Connections: Duct installation requirements are specified in Section 23 31 13 "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply and return ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Section 23 33 00 "Air Duct Accessories."

### 3.3 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. 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.
- C. Tests and Inspections:
  - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.

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.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

**END OF SECTION 23 81 26**



**SECTION 23 81 27 - MINI SPLIT-SYSTEM AIR-CONDITIONERS AND HEAT PUMPS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes mini split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

**1.2 ACTION SUBMITTALS**

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

**1.3 INFORMATIONAL SUBMITTALS**

- A. Warranty: Sample of special warranty.

**1.4 CLOSEOUT SUBMITTALS**

- A. Operation and maintenance data.

**1.5 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. ASHRAE Compliance:
  - 1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
  - 2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Procedures," and Section 7 - "Construction and System Start-up."
- C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.
- D. The units shall be tested by a Nationally Recognized Testing Laboratory (NRTL) and shall bear the ETL label.
- E. All wiring shall be in accordance with the National Electrical Code (N.E.C.) and local codes as required.
- F. The units shall be rated in accordance with Air-conditioning, Heating, and Refrigeration Institute's (AHRI) Standard 240 and bear the ARI Certification label. The units shall be manufactured in a facility registered to ISO 9001 and ISO 14001, which is a set of standards applying to environmental protection set by the International Standard Organization (ISO).
- G. A dry air holding charge shall be provided in the indoor section.
- H. The outdoor unit shall be pre-charged with R-410a refrigerant for 70 feet (20 meters) of refrigerant tubing.

**1.6 WARRANTY**

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period:
    - a. For Compressor: Five year(s) from date of Substantial Completion.
    - b. For Parts: One year(s) from date of Substantial Completion.
    - c. For Labor: One year(s) 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. Carrier Corporation; Home Comfort and HVAC Building & Industrial Systems.
  2. Daikin.
  3. Gree
  4. Mitsubishi Electric & Electronics USA, Inc.; HVAC Advanced Products Division.

## 2.2 SYSTEM DESCRIPTION

- A. The Heat Pump system shall be a split system with Variable Speed Inverter Compressor technology. The system shall consist of a horizontal discharge, single phase outdoor unit, a matched capacity indoor section that shall be equipped with a wired wall-mounted, wireless wall-mounted or wireless handheld remote controller.

## 2.3 OUTDOOR UNIT

- A. The outdoor unit shall be compatible with the four different types of indoor units (ceiling suspending, ducted, wall mounted and four way recessed ceiling cassette). The connected indoor unit shall be of the same capacity as the outdoor unit.
- B. The outdoor unit shall be equipped with an electronic control board that interfaces with the indoor unit to perform all necessary operation functions.
- C. The outdoor unit shall be capable of cooling operation down to 0°F (-18°C) ambient temperature without additional low ambient controls (optional wind baffle shall be required).
- D. The outdoor unit shall be able to operate with a maximum height difference of 100 feet (30 meters) between indoor and outdoor units.
- E. System shall operate at up to a maximum refrigerant tubing length of 100 feet (30 meters) for the 18,000 and 165 feet (50 meters) for the 24,000, 30,000, 36,000, and 42,000 BTU/h units between indoor and outdoor units without the need for line size changes, traps or additional oil.
- F. The outdoor unit shall be completely factory assembled, piped, and wired. Each unit must be test run at the factory.
- G. Outdoor units sound level shall not exceed 51 dB(A) in cooling mode or 55 dB(A) in heating mode.
- H. Cabinet:
1. The casing shall be constructed from galvanized steel plate, finished with an electrostatically applied, thermally fused acrylic or polyester powder coating for corrosion protection and have a Munsell 3Y 7.8/1.1 finish.
  2. Mounting feet shall be provided and shall be welded to the base of the cabinet and be of sufficient size to afford reliable equipment mount and stability.
  3. Easy access shall be afforded to all serviceable parts by means of removable panel sections.
  4. The fan grill shall be of ABS plastic.
  5. Cabinet mounting and construction shall be sufficient to withstand 155 MPH wind speed conditions for use in Hurricane condition areas. Mounting, base support, and other installation to meet Hurricane Code Conditions shall be by others.
- I. Fan:
1. The units shall be furnished with a one (1) or two (2) DC fan motors as required.
  2. The fan blade(s) shall be of aerodynamic design for quiet operation, and the fan motor bearings shall be permanently lubricated.
  3. The outdoor unit shall have horizontal discharge airflow. The fan shall be mounted in front of the coil, pulling air across it from the rear and dispelling it through the front. The fan shall be provided with a raised guard to prevent external contact with moving parts.
- J. Coil:
1. The condenser coil shall be of copper tubing with flat aluminum fins. The coil shall be protected with an integral metal guard.

2. Refrigerant flow from the condenser shall be controlled by means of an electronic linear expansion valve (LEV) metering device. The LEV shall be control by a microprocessor controlled step motor.
3. All refrigerant lines between outdoor and indoor units shall be of annealed, refrigeration grade copper tubing, ARC Type, meeting ASTM B280 requirements, individually insulated in twin-tube, flexible, closed-cell, CFC-free (ozone depletion potential of zero), elastomeric material for the insulation of refrigerant pipes and tubes with thermal conductivity equal to or better than 0.27 BTU-inch/hour per Sq Ft / °F, a water vapor transmission equal to or better than 0.08 Perm-inch and superior fire ratings such that insulation will not contribute significantly to fire and up to 1” thick insulation shall have a - Flame-Spread Index of less than 25 and a Smoke-development Index of less than 50 as tested by ASTM E 84 and CAN / ULC S-102.

K. Compressor:

1. The compressor shall be either a DC twin-rotor rotary compressor with Variable Speed Inverter Drive Technology or a Frame Compliant Scroll compressor with Variable Speed Inverter Drive Technology.
2. The compressor shall be driven by inverter circuit to control compressor speed. The compressor speed shall dynamically vary to match the room load for significantly increasing the efficiency of the system which shall result in significant energy savings.
3. To prevent liquid from accumulating in the compressor during the off cycle, a minimal amount of current shall be automatically, intermittently applied to the compressor motor windings to maintain sufficient heat to vaporize any refrigerant. No crankcase heater is to be used.
4. The outdoor unit shall have an accumulator and high pressure safety switch. The compressor shall be mounted to avoid the transmission of vibration.

L. Electrical:

1. The electrical power of the unit shall be 208volts or 230 volts, single phase, 60 hertz. The unit shall be capable of satisfactory operation within voltage limits of 187 volts to 253 volts.
2. Power for the indoor unit shall be supplied from the outdoor unit using three (3) fourteen (14) gauge AWG conductors plus ground wire connecting the units.
3. The outdoor unit shall be controlled by the microprocessor located in the indoor unit. The control signal between the indoor unit and the outdoor unit shall be pulse signal 24 volts DC.
4. The unit shall have Pulse Amplitude Modulation circuit to utilize 98% of input power supply.
5. Unit shall be able to provide 100% capacity when operating at 0°F outdoor air temperature and a wind baffle is used.

## 2.4 INDOOR UNIT

A. Wall Mounted Type:

1. The indoor unit shall be factory assembled, wired and tested. Contained within the unit shall be all factory wiring and internal piping, control circuit board and fan motor. The unit, in conjunction with the wired wall-mounted, wireless wall-mounted or wireless handheld controller, shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, and a test run switch. Indoor unit and refrigerant pipes shall be purged with dry air before shipment from the factory.
2. Unit Cabinet: The cabinet shall be formed from high strength molded plastic with smooth finish, flat front panel design with access for filter. Cabinet color shall be white – Munsell 1.0Y 9.2/0.2. The unit shall be wall mounted by means of a factory supplied, pre-drilled, mounting plate.
3. Fan: The indoor unit fan shall be high performance, double inlet, forward curve, direct drive sirocco fan with a single motor. The fans shall be statically and dynamically balanced and run on a motor with permanently lubricated bearings. The indoor fan shall consist of three (3) speeds: Low, Mid, and Hi and Auto. The fan shall have a selectable Auto fan setting that will adjust the fan speed based on the difference between controller set-point and space temperature. Indoor unit sound levels shall not exceed 43 dB(A) at low speed, 46 dB(A) at mid speed and 49 dB(A) at high speed.
4. Vane: There shall be a motorized horizontal vane to automatically direct air flow in a horizontal and downward direction for uniform air distribution. The horizontal vane shall significantly decrease downward air resistance for lower sound levels, and shall close the outlet port when

operation is stopped. There shall also be a set of vertical vanes to provide horizontal swing airflow movement.

5. Filter: Return air shall be filtered by means of an easily removable washable filter.
6. Coil: The evaporator coil shall be of nonferrous construction with pre-coated aluminum strake fins on copper tubing. All tube joints shall be brazed with PhosCopper or silver alloy. The coils shall be pressure tested at the factory. A condensate pan and drain shall be provided under the coil. A drain pan level switch, designed to connect to the control board, shall be provided and installed on the condensate pan to prevent condensate from overflowing. A condensate mini-pump shall be provided to provide a means of condensate disposal when a gravity drain is not available.
7. Electrical: The electrical power of the unit shall be 208 volts or 230 volts, 1 phase, 60 hertz. The system shall be capable of satisfactory operation within voltage limits of 187 volts to 253 volts. The power to the indoor unit shall be supplied from the outdoor unit. A three (3) conductor AWG-14 wire with ground shall provide power feed and bi-directional control transmission between the outdoor and indoor units.

**B. System Control:**

1. The control system, provided for each mini-split system, shall consist of a minimum of two (2) microprocessors, one on each indoor and outdoor unit, interconnected by a single non-polar two-wire cable. The microprocessor located in the indoor unit shall have the capability of monitoring return air temperature and indoor coil temperature, receiving and processing commands from a wireless or wired controller, providing emergency operation and controlling the outdoor unit. The control signal between the indoor and outdoor unit shall be pulse signal 24 volts DC. Indoor units shall have the ability to control supplemental heat via connector and a 12 VDC output.
2. A three (3) conductor 14 gauge AWG wire with ground shall provide power feed and bi-directional control transmission between the outdoor and indoor units. . If code requires a disconnect mounted near the indoor unit, a 3-Pole Disconnect shall be used – all three conductors must be interrupted. Refer to the electrical design documents for requirements.
3. The system shall be capable of automatic restart when power is restored after power interruption. The system shall have self-diagnostics ability, including total hours of compressor run time. Diagnostics codes for indoor and outdoor units shall be displayed on the wired controller panel.
4. The indoor unit control board shall have auxiliary control contact connectors to provide integration of auxiliary energy recovery unit(s), back-up heat, remote switch, central control and IP Terminal.
5. Remote controllers: Refer to the drawings for the controller type(s) applied.
  - a. Wired Remote Controller: The Wired Remote Controller shall be approximately 5” x 5” in size and white in color with a light-green LCD display. The remote controller shall support a selection from multiple languages (Spanish, German, Japanese, Chinese, English, Russian, Italian, or French) for display information. There shall be a built-in weekly timer with up to 8 pattern settings per day. The controller shall consist of an On/Off button, Increase/Decrease Set Temperature buttons, a Cool/Auto/Fan/Dry mode selector, a Timer Menu button, a Timer On/Off button, Set Time buttons, a Fan Speed selector, a Ventilation button, a Test Run button, and a Check Mode button. The controller shall have a built-in temperature sensor. Temperature shall be displayed in either Fahrenheit (°F) or Celsius (°C), and Temperature changes shall be by increments of 1°F (0.5°C). The control voltage from the wired controller to the indoor unit shall be 12/24 volts, DC. Field wiring shall run directly from the indoor unit to the wall mounted controller with no splices.
6. The microprocessor located in the indoor unit shall have the capability of sensing return air temperature and indoor coil temperature, receiving and processing commands from the wireless or a wired controller, providing emergency operation and controlling the outdoor unit.
7. Where indicated on the drawings, indoor units shall be equipped with an optional sensor kit, providing uniform temperature detection and automatically response to adjust the set temperature to provide uniform comfort from floor to ceiling.

**2.5 CAPACITIES , EFFICIENCIES AND CHARACTERISTICS**

- A. Refer to drawings for all capacities, efficiencies and characteristics.**

**PART 3 - EXECUTION****3.1 DELIVERY, STORAGE AND HANDLING**

- A. Unit shall be stored and handled according to the manufacturer's recommendations.
- B. The controller shall be shipped separately and shall be able to withstand 105°F storage temperatures and 95% relative humidity without adverse effect.

**3.2 INSTALLATION**

- A. Install units level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Install roof-mounted, compressor-condenser components on equipment supports specified in Section 07 72 00 "Roof Accessories." Anchor units to supports with removable, cadmium-plated fasteners.
- D. Equipment Mounting:
  - 1. Comply with requirements for vibration isolation and seismic control devices specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC."
- E. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

**3.3 CONNECTIONS**

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

**3.4 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
  - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. 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 units.

**END OF SECTION 23 81 27**

**SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES**

## 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. Copper building wire rated 600 V or less.
  - 2. Aluminum building wire rated 600 V or less.
  - 3. Metal-clad cable, Type MC, rated 600 V or less.
  - 4. Fire-alarm wire and cable.
  - 5. Connectors, splices, and terminations rated 600 V and less.

## 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: Indicate type, use, location, and termination locations.

## 1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

## PART 2 - PRODUCTS

## 2.1 COPPER BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Alpha Wire Company.
  - 2. American Bare Conductor.
  - 3. Cerro Wire LLC.
  - 4. General Cable Technologies Corporation.
  - 5. Okonite Company (The).
  - 6. Southwire Company.
  - 7. WESCO.
- C. Standards:
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
  - 2. RoHS compliant.
  - 3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- D. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.
- E. Conductor Insulation:
  - 1. Type NM: Comply with UL 83 and UL 719.
  - 2. Type THHN and Type THWN-2: Comply with UL 83.
  - 3. Type XHHW-2: Comply with UL 44.

## 2.2 ALUMINUM BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn aluminum current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Alpha Wire Company.
  - 2. American Bare Conductor.
  - 3. Cerro Wire LLC.
  - 4. General Cable Technologies Corporation.
  - 5. Okonite Company (The).
  - 6. Southwire Company.
  - 7. WESCO.
- C. Standards:
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
  - 2. RoHS compliant.
  - 3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- D. Conductors: Aluminum, complying with ASTM B 800 and ASTM B 801.
- E. Conductor Insulation:
  - 1. Type SE: Comply with UL 854.
  - 2. Type THHN and Type THWN-2: Comply with UL 83.
  - 3. Type XHHW-2: Comply with UL 44.

## 2.3 METAL-CLAD CABLE, TYPE MC

- A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Alpha Wire Company.
  - 2. American Bare Conductor.
  - 3. General Cable Technologies Corporation.
  - 4. Okonite Company (The).
  - 5. Southwire Company.
  - 6. WESCO.
- C. Standards:
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
  - 2. Comply with UL 1569.
  - 3. RoHS compliant.
  - 4. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- D. Circuits:
  - 1. Single 20 Amp, 120 Volt circuit.
  - 2. Power-Limited Fire-Alarm Circuits: Comply with UL 1424.
- E. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.
- F. Ground Conductor: Insulated.
- G. Conductor Insulation:
  - 1. Type TFN/THHN/THWN-2: Comply with UL 83.
- H. Armor: Steel, interlocked.

## 2.4 FIRE-ALARM WIRE AND CABLE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Allied Wire & Cable Inc.

2. Genesis Cable Products; Honeywell International, Inc.
  3. Superior Essex Inc.
  4. West Penn Wire.
- B. Signaling Line Circuits: Twisted, shielded pair, not less than No. 18 AWG.
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°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, NRTL listed for fire-alarm and cable tray installation, plenum rated.

## 2.5 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. 3M Electrical Products.
  2. Gardner Bender.
  3. Hubbell Power Systems, Inc.
  4. Ideal Industries, Inc.
  5. ILSCO.
  6. Thomas & Betts Corporation; A Member of the ABB Group.
- C. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.
- D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
1. Material: Aluminum.
  2. Type: Two hole with long barrels.
  3. Termination: Compression.

## PART 3 - EXECUTION

### 3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Feeders: Copper for feeders smaller than No. 4 AWG; copper or aluminum for feeders No. 4 AWG and larger. Conductors shall be solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- C. Branch Circuits: Copper. Solid or Stranded for No. 10 AWG and smaller; Stranded for No. 8 AWG and larger.
- D. Variable Frequency Controller Output Circuits Cable: Extra-flexible stranded for all sizes.
- E. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.

### 3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type XHHW-2, single conductors in raceway.
- B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway or Type XHHW-2, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN/THWN-2, single conductors in raceway.



- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway.
- E. Exposed Branch Circuits, Including in Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway; or Metal-clad cable, Type MC; or Nonmetallic-sheathed cable, Type NM. See Drawing notes for more on use applicability.
- G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.
- H. Branch Circuits Installed below Raised Flooring: Type THHN/THWN-2, single conductors in raceway.
- I. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
- J. VFC Output Circuits: Type XHHW-2 in metal conduit.

### 3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 26 05 33 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Section 26 05 29 "Hangers and Supports for Electrical Systems."

### 3.4 INSTALLATION OF FIRE-ALARM WIRING

- A. Comply with NECA 1 and NFPA 72.
- B. Wiring Method:
  - 1. Cables and pathways used for fire-alarm circuits, and equipment control wiring associated with fire-alarm system, may not contain any other wire or cable.
  - 2. Where accessible and not subject to physical damage or exposed to open public view, Fire-Alarm circuits may be installed as exposed plenum cable in environmental airspaces, including plenum ceilings. In all other cases, all circuit and control wiring shall be installed in dedicated pathway systems, not shared with any other systems.
  - 3. Signaling Line Circuits: Power-limited fire-alarm cables shall not be installed in the same cable or pathway as signaling line circuits.
- C. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with fire-alarm system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- D. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes; cabinets; or equipment enclosures where circuit connections are made.
- E. Color-Coding: Color-code fire-alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire-alarm system junction boxes and covers red.
- F. Risers: Where required for Class A circuits, install at least two vertical cable risers to serve the fire-alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent receipt or transmission of signals from other floors or zones.

### 3.5 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
  - 1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.
- D. Comply with requirements in Section 28 46 21.11 "Addressable Fire-Alarm Systems" for connecting, terminating, and identifying wires and cables.

### 3.6 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 26 05 53 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor and identify as spare conductor.

### 3.7 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 Section 26 05 44 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

### 3.8 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 07 84 13 "Penetration Firestopping."

### 3.9 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
  - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
  - 2. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
  - 3. Perform each of the following visual and electrical tests:
    - a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
    - b. Test bolted connections for high resistance using one of the following:
      - 1) A low-resistance ohmmeter.
      - 2) Calibrated torque wrench.
      - 3) Thermographic survey.
    - c. Inspect compression-applied connectors for correct cable match and indentation.
    - d. Inspect for correct identification.
    - e. Inspect cable jacket and condition.
    - f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.
    - g. Continuity test on each conductor and cable.
    - h. Uniform resistance of parallel conductors.
  - 4. Initial Infrared Scanning: After Substantial Completion, but before Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.

- a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
  - b. 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.
- B. Cables will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports to record the following:
1. Procedures used.
  2. Results that comply with requirements.
  3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

**END OF SECTION 26 05 19**

**SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Section includes grounding and bonding systems and equipment.

## 1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

## 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.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

## 2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Burndy; Part of Hubbell Electrical Systems.
  - 2. ERICO International Corporation.
  - 3. ILSCO.
  - 4. O-Z/Gedney; a brand of Emerson Industrial Automation.
  - 5. Thomas & Betts Corporation; A Member of the ABB Group.

## 2.3 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
  - 1. Stranded Conductors: ASTM B8.
  - 2. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor, or as otherwise specified.
  - 3. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1 5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick or as otherwise specified.
- C. Grounding Bus: Unless otherwise specified on Drawings, shall be predrilled rectangular bars of annealed copper, ¼ inch by 4 inches (6.3 mm by 100 mm) in cross section, with 9/32 inch (7.14 mm) dual-holes spaced 1 1/8 inches (28 mm) apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

## 2.4 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

- C. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
- D. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.
- E. Cable-to-Cable Connectors: Compression type, copper or copper alloy.
- F. Cable Tray Ground Clamp: Mechanical type, zinc-plated malleable iron.
- G. Conduit Hubs: Mechanical type, terminal with threaded hub.
- H. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.
- I. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.
- J. Signal Reference Grid Clamp: Mechanical type, stamped-steel terminal with hex head screw.
- K. Straps: Solid copper, cast-bronze clamp. Rated for 600 A.
- L. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.
- M. Water Pipe Clamps:
  - 1. Mechanical type, two pieces with stainless-steel bolts.
    - a. Material: Die-cast zinc alloy.
    - b. Listed for direct burial.
  - 2. U-bolt type with malleable-iron clamp and copper ground connector rated for direct burial.

## 2.5 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; ¾ inch by 10 feet (19 mm by 3 m).

## PART 3 - EXECUTION

### 3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 6 AWG and smaller, and stranded conductors for No. 4 AWG and larger unless otherwise indicated.
- B. Grounding Conductors: Green-colored insulation.
- C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- D. Grounding Bus: Install in all electrical equipment rooms, in rooms housing service equipment, in all data or telecommunications rooms, and elsewhere as indicated on Drawings.
  - 1. Install bus horizontally, on insulated spacers 2 inches (50 mm) minimum from wall, 6 inches (150 mm) above finished floor unless otherwise indicated.
  - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.
- E. Conductor Terminations and Connections:
  - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
  - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
  - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
  - 4. Connections to Structural Steel: Welded connectors.

### 3.2 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

### 3.3 GROUNDING SEPARATELY DERIVED SYSTEMS

- A. Generator: When any generator is considered a separately derived system, utilizing a 4-Pole Transfer Switch, install grounding electrode(s) at the generator location. The electrode shall be connected to the equipment grounding conductor and to the frame of the generator, as well as bonded to generator neutral conductor.

- B. Transformers: Install grounding electrode(s) at any transformer locations on the project. The electrode shall be connected to the transformer frame, X0 terminal, and equipment grounding conductor.

### 3.4 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- C. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- D. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.
- E. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.
- F. If Project scope includes poles supporting outdoor lighting fixtures, install a grounding electrode adjacent to the pole and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

### 3.5 INSTALLATION

- A. 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.
- B. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade unless otherwise indicated.
  - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
  - 2. Use exothermic welds for all below-grade connections.
  - 3. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
  - 4. Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
- C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
  - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
  - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
  - 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- D. Grounding and Bonding for Piping:
  - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- E. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; use a minimum of 20 feet (6 m) of bare copper conductor not smaller than No. 4 AWG.
  1. If concrete foundation is less than 20 feet (6 m) long, coil excess conductor within base of foundation.
  2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.
- F. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.
  1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
  2. Make connections with clean, bare metal at points of contact.
  3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
  4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
  5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

### 3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
  2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
  3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before any conductors are connected.
    - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    - b. Perform tests by fall-of-potential method according to IEEE 81.
- C. Grounding system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Report measured ground resistances that exceed the following values:
  1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
  2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
  3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
  4. Power Distribution Units or Panelboards Serving Electronic Equipment: 1 ohm.
  5. Substations and Pad-Mounted Equipment: 5 ohms.
- F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Engineer promptly and include recommendations to reduce ground resistance.

**END OF SECTION 26 05 26**

**SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS**

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Section Includes:
  - 1. Steel slotted support systems.
  - 2. Conduit and cable support devices.
  - 3. Support for conductors in vertical conduit.
  - 4. Structural steel for fabricated supports and restraints.
  - 5. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
  - 6. Fabricated metal equipment support assemblies.

## 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 the following:
    - a. Slotted support systems, hardware, and accessories.
    - b. Clamps.
    - c. Hangers.
  - 2. Include rated capacities and furnished specialties and accessories.

## PART 2 - PRODUCTS

## 2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32 inch (10 mm) diameter holes at a maximum of 8 inches (200 mm) o.c. in at least one surface.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. B-line, an Eaton business.
    - b. ERICO International Corporation.
    - c. Thomas & Betts Corporation; A Member of the ABB Group.
    - d. Unistrut; Part of Atkore International.
  - 2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
  - 3. Material for Channel, Fittings, and Accessories: Plain steel.
  - 4. Channel Width: Selected for applicable load criteria.
  - 5. Metallic Coatings: Hot-dip galvanized after fabrication, applied according to MFMA-4.
- B. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.
- D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.



- E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened Portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Hilti, Inc.
      - 2) ITW Ramset/Red Head; Illinois Tool Works, Inc.
      - 3) MKT Fastening, LLC.
  2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened Portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) B-line, an Eaton business.
      - 2) Hilti, Inc.
      - 3) ITW Ramset/Red Head; Illinois Tool Works, Inc.
      - 4) MKT Fastening, LLC.
  3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
  4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
  5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F 3125/F 3125M, Grade A325 (Grade A325M).
  6. Toggle Bolts: All-steel springhead type.
  7. Hanger Rods: Threaded steel.

## PART 3 - EXECUTION

### 3.1 APPLICATION

- A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:
1. NECA 1.
  2. NECA 101.
- B. Comply with requirements in Section 07 84 13 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- C. Comply with requirements for raceways and boxes specified in Section 26 05 33 "Raceways and Boxes for Electrical Systems."
- D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be ¼ inch (6 mm) in diameter.
- E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other 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 or single-bolt conduit clamps using spring friction action for retention in support channel.

### 3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT may be supported by openings through structure members, according to NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
1. To Wood: Fasten with lag screws or through bolts.
  2. To New Concrete: Bolt to concrete inserts.
  3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
  4. To Existing Concrete: Expansion anchor fasteners.
  5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
  6. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
  7. To Light Steel: Sheet metal screws.
  8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that comply with seismic-restraint strength and anchorage requirements.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

### 3.3 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000 psi (20.7 MPa), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 03 30 00 "Cast-in-Place Concrete."
- C. Anchor equipment to concrete base as follows:
1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  2. Install anchor bolts to elevations required for proper attachment to supported equipment.
  3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

**END OF SECTION 26 05 29**

**SECTION 26 05 33 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS**

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Section Includes:
  - 1. Metal conduits and fittings.
  - 2. Nonmetallic conduits and fittings.
  - 3. Boxes, enclosures, and cabinets.
- B. Related Requirement:
  - 1. Section 07 84 13 "Penetration Firestopping" for firestopping at conduit and box entrances.

## 1.3 DEFINITIONS

- A. GRC: Galvanized rigid steel conduit.
- B. IMC: Intermediate metal conduit.

## 1.4 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
  - 1. Structural members in paths of conduit groups with common supports.
  - 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

## PART 2 - PRODUCTS

## 2.1 METAL CONDUITS AND FITTINGS

- A. Metal Conduit:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Allied Tube & Conduit; a part of Atkore International.
    - b. FSR Inc.
    - c. O-Z/Gedney; a brand of Emerson Industrial Automation.
    - d. Republic Conduit.
    - e. Thomas & Betts Corporation; A Member of the ABB Group.
  - 2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 3. GRC: Comply with ANSI C80.1 and UL 6.
  - 4. IMC: Comply with ANSI C80.6 and UL 1242.
  - 5. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
    - a. Comply with NEMA RN 1.
    - b. Coating Thickness: 0.040 inch (1 mm), minimum.

6. EMT: Comply with ANSI C80.3 and UL 797.
  7. FMC: Comply with UL 1; zinc-coated steel.
  8. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- B. Metal Fittings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Allied Tube & Conduit; a part of Atkore International.
    - b. FSR Inc.
    - c. O-Z/Gedney; a brand of Emerson Industrial Automation.
    - d. Republic Conduit.
    - e. Thomas & Betts Corporation; A Member of the ABB Group.
  2. Comply with NEMA FB 1 and UL 514B.
  3. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  4. Fittings, General: Listed and labeled for type of conduit, location, and use.
  5. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
  6. Fittings for EMT:
    - a. Material: Steel.
    - b. Type: Setscrew or Compression.
  7. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
  8. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.
- C. Joint Compound for IMC, GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

## 2.2 NONMETALLIC CONDUITS AND FITTINGS

- A. Nonmetallic Conduit:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CANTEX INC.
    - b. CertainTeed Corporation.
    - c. RACO; Hubbell.
    - d. Thomas & Betts Corporation; A Member of the ABB Group.
  2. Listing and Labeling: Nonmetallic conduit shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  3. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- B. Nonmetallic Fittings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CANTEX INC.
    - b. CertainTeed Corporation.
    - c. RACO; Hubbell.
    - d. Thomas & Betts Corporation; A Member of the ABB Group.
  2. Fittings, General: Listed and labeled for type of conduit, location, and use.
  3. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
  4. Solvents and Adhesives: As recommended by conduit manufacturer.

## 2.3 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Crouse-Hinds, an Eaton business.
  2. Erickson Electrical Equipment Company.
  3. FSR Inc.

4. Hoffman; a brand of Pentair Equipment Protection.
  5. Hubbell Incorporated.
  6. MonoSystems, Inc.
  7. O-Z/Gedney; a brand of Emerson Industrial Automation.
  8. RACO; Hubbell.
  9. Thomas & Betts Corporation; A Member of the ABB Group.
  10. Wiremold / Legrand.
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
1. Nonmetallic device boxes shall be single or double gang as required.
- F. Metal Floor Boxes:
1. Material: Cast metal.
  2. Type: Fully adjustable.
  3. Shape: Rectangular.
  4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- G. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb (23 kg). Outlet boxes designed for attachment of luminaires weighing more than 50 lb (23 kg) shall be listed and marked for the maximum allowable weight.
- H. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb (32 kg).
1. Listing and Labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- I. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- J. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- K. Device Box Dimensions: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep) for metallic boxes.
- L. Gangable boxes are allowed.
- M. Cabinets:
1. NEMA 250, Type 1 or Type 3R galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
  2. Hinged door in front cover with flush latch and concealed hinge.
  3. Key latch to match panelboards.
  4. Metal barriers to separate wiring of different systems and voltage.

### PART 3 - EXECUTION

#### 3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed Conduit: GRC, IMC.
  2. Concealed Conduit, Aboveground: GRC, IMC, or EMT.
  3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried.
  4. Underground Utility Service Conduit: GRC, IMC, RNC, Type EPC-80-PVC, direct buried.
  5. Final Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
  6. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed, Not Subject to Physical Damage: EMT.
  2. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include, but not limited to, the following:
    - a. Loading dock.
    - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.

- c. Mechanical rooms.
- d. Gymnasiums.
- e. Machine rooms.
- 3. Concealed in Ceilings and Interior Walls and Partitions: EMT.
- 4. Final Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
- 5. Damp or Wet Locations: GRC or IMC.
- 6. Boxes and Enclosures: NEMA 250, Type 1 or Type 3R as required, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens.
- C. Minimum Raceway Size: ½ inch (16 mm) trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
  - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
  - 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
  - 3. EMT: Use setscrew or compression, steel fittings. Comply with NEMA FB 2.10.
  - 4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

### 3.2 INSTALLATION

- A. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for hangers and supports.
- B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- C. Do not install raceways or electrical items on any "explosion-relief" walls or rotating equipment.
- D. Do not fasten conduits onto the bottom side of a metal deck roof.
- E. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- F. Complete raceway installation before starting conductor installation.
- G. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- H. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.
- I. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- J. Support conduit within 12 inches (300 mm) of enclosures to which attached.
- K. Raceways Embedded in Slabs:
  - 1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot (3-m) intervals.
  - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
  - 3. Arrange raceways to keep a minimum of 2 inches (50 mm) of concrete cover in all directions.
  - 4. Do not embed threadless fittings in concrete unless specifically approved by Architect or Engineer for each specific location.
  - 5. Change from RNC Type EPC-40-PVC to GRC or EMT before rising above floor.
- L. Stub-Ups to Above Recessed Ceilings:
  - 1. Use EMT, IMC, or GRC for raceways.
  - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
  - 3. Stub-ups shall terminate in accessible locations. Stub-ups at hard gypsum ceilings shall extend to nearest accessible location.

- M. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- N. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- O. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch (35mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- P. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- Q. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- R. Cut conduit perpendicular to the length. For conduits 2-inch (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- S. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- T. Surface Raceways:
  - 1. Install surface raceway with a minimum 2-inch (50-mm) radius control at bend points.
  - 2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- U. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.
- V. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
  - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  - 2. Where an underground service raceway enters a building or structure.
  - 3. Conduit extending from interior to exterior of building.
  - 4. Conduit extending into pressurized duct and equipment.
  - 5. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
  - 6. Where otherwise required by NFPA 70.
- W. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- X. Expansion-Joint Fittings:
  - 1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C) and that has straight-run length that exceeds 25 feet (7.6 m). Install in each run of aboveground GRC and EMT conduit that is located where environmental temperature change may exceed 100 deg F (55 deg C) and that has straight-run length that exceeds 100 feet (30 m).
  - 2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
    - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.
    - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
    - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
    - d. Attics: 135 deg F (75 deg C) temperature change.
  - 3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least

0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.

4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
  5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- Y. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches (1830 mm) of flexible conduit for recessed and semi-recessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations subject to severe physical damage.
  2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- Z. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- AA. 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.
- BB. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- CC. Locate boxes so that cover or plate will not span different building finishes.
- DD. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- EE. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- 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.

### 3.3 INSTALLATION OF UNDERGROUND CONDUIT

- A. Direct-Buried Conduit:
1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 31 20 00 "Earth Moving" for pipe less than 6 inches (150 mm) in nominal diameter.
  2. Install backfill as specified in Section 31 20 00 "Earth Moving."
  3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 31 20 00 "Earth Moving."
  4. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
    - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete for a minimum of 12 inches (300 mm) on each side of the coupling.
    - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
  5. Underground Warning Tape: Comply with requirements in Section 26 05 53 "Identification for Electrical Systems."

### 3.4 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 Section 26 05 44 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."



3.5 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 07 84 13 "Penetration Firestopping."

3.6 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.

**END OF SECTION 26 05 33**

**SECTION 26 05 44 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING**

## 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 for raceway and cable penetration of non-fire-rated construction walls and floors.
  - 2. Sleeve-seal systems.
  - 3. Sleeve-seal fittings.
  - 4. Grout.
  - 5. Silicone sealants.
- B. Related Requirements:
  - 1. Section 07 84 13 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

## 1.3 ACTION SUBMITTALS

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

## PART 2 - PRODUCTS

## 2.1 SLEEVES

- A. Wall Sleeves:
  - 1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
  - 2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239 inch (0.6 mm) minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.
- C. Sleeves for Rectangular Openings:
  - 1. Material: Galvanized sheet steel.
  - 2. Minimum Metal Thickness:
    - a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and with no side larger than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
    - b. For sleeve cross-section rectangle perimeter 50 inches (1270 mm) or more and one or more sides larger than 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

## 2.2 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Advance Products & Systems, Inc.
    - b. Metraflex Company (The).
    - c. Proco Products, Inc.

2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Stainless steel.
4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

### 2.3 SLEEVE-SEAL FITTINGS

- A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. HOLDRITE.

### 2.4 GROUT

- A. Description: Nonshrink; recommended 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 (34.5-MPa), 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

### 2.5 SILICONE SEALANTS

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
  1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
- B. Silicone Foams: 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 FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. 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 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."
    - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
  2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
  3. Size pipe sleeves to provide ¼ inch (6.4 mm) annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed or unless 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.
- D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
  2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
- E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1 inch (25 mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1 inch (25 mm) annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

### 3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- 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.

### 3.3 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. Using grout, seal the space around outside of sleeve-seal fittings.

**END OF SECTION 26 05 44**

**SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Color and legend requirements for raceways, conductors, and warning labels and signs.
  - 2. Labels.
  - 3. Bands and tubes.
  - 4. Tapes and stencils.
  - 5. Tags.
  - 6. Signs.
  - 7. Cable ties.
  - 8. Paint for identification.
  - 9. Fasteners for labels and signs.

**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 electrical identification products.

**PART 2 - PRODUCTS****2.1 PERFORMANCE REQUIREMENTS**

- A. Comply with ASME A13.1.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Comply with NFPA 70E requirements for arc-flash warning labels.
- F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.
- G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
  - 1. Temperature Change: 120°F (67°C), ambient; 180°F (100°C), material surfaces.

**2.2 COLOR AND LEGEND REQUIREMENTS**

- A. Raceways and Cables Carrying Circuits at 600 V or Less:
  - 1. Black letters on an orange field.
  - 2. Legend: Indicate voltage and system or service type.
- B. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder, and branch-circuit conductors.
  - 1. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
  - 2. Colors for 208/120-V Circuits:
    - a. Phase A: Black.
    - b. Phase B: Red.
    - c. Phase C: Blue.

- d. Neutral: White
- 3. Colors for 240-V Circuits:
  - a. Phase A: Black.
  - b. Phase B: Red.
- 4. Colors for 480/277-V Circuits:
  - a. Phase A: Brown.
  - b. Phase B: Orange.
  - c. Phase C: Yellow.
  - d. Neutral: Gray.
- 5. Color for Equipment Grounds: Green.
- 6. Colors for Isolated Grounds: Green with yellow stripe.
- C. Raceways and Cables Carrying Circuits at More Than 600 V:
  - 1. Black letters on an orange field.
  - 2. Legend: "DANGER - CONCEALED HIGH VOLTAGE WIRING."
- D. Warning Label Colors:
  - 1. Identify system voltage with black letters on an orange background.
- E. Warning labels and signs shall include, but are not limited to, the following legends:
  - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
  - 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."
  - 3. Provide Arc Flash Warning labels on all Switchboards, Panelboards, and similar equipment.
- F. Equipment Identification Labels:
  - 1. Black letters on a white field, engraved plastic laminate.
  - 2. Unless otherwise indicated or directed by Owner, provide a single line of text with ½ inch high lettering on a 1 ½ inches high nameplate.
  - 3. Apply labels for each unit of the following categories of equipment and similar devices using mechanical fasteners:
    - a. Panelboards, electrical cabinets, and enclosures.
    - b. Access doors and panels for concealed electrical items.
    - c. Electrical switchgear and switchboards.
    - d. Emergency system boxes and enclosures.
    - e. Disconnect switches.
    - f. Enclosed circuit breakers.
    - g. Generating Equipment
    - h. Power transfer equipment.
    - i. Contactors.
    - j. Remote-controlled switches.
    - k. Dimmer Cabinets and controllers.
    - l. Control devices.
    - m. Transformers.

## 2.3 LABELS

- A. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3 mil (0.08 mm) thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Brady Corporation.
    - b. Brother International Corporation.
    - c. Ideal Industries, Inc.
    - d. Panduit Corp.
  - 2. Minimum Nominal Size:
    - a. 1 ½ inches by 6 inches (37 mm by 150 mm) for raceway and conductors.
    - b. 3 ½ inches by 5 inches (76 mm by 127 mm) for equipment.
    - c. As required by authorities having jurisdiction.

## 2.4 TAPES AND STENCILS

- A. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide; compounded for outdoor use.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Brady Corporation.
    - b. Carlton Industries, LP.
    - c. emedco.
    - d. 3M Scotch.
- B. Underground-Line Warning Tape:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Brady Corporation.
    - b. Ideal Industries, Inc.
    - c. LEM Products Inc.
    - d. Seton Identification Products.
  2. Tape:
    - a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical utility lines.
    - b. Printing on tape shall be permanent and shall not be damaged by burial operations.
    - c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
  3. Color and Printing:
    - a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
    - b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE".
    - c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE".
  4. Tape:
    - a. Pigmented polyolefin, bright colored, continuous-printed on one side with the type and name of the utility, compounded for direct-burial service.
    - b. Width: 3 inches (75 mm).
    - c. Thickness: 4 mils (0.1 mm).
    - d. Weight: 18.5 lb/1000 sq. ft. (9.0 kg/100 sq. m).
    - e. Tensile according to ASTM D882: 30 lbf (133.4 N) and 2500 psi (17.2 MPa).
- C. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch (25 mm).

## 2.5 SIGNS

- A. Laminated Acrylic or Melamine Plastic Signs:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Brady Corporation.
    - b. Carlton Industries, LP.
    - c. emedco.
  2. Engraved legend.
  3. Thickness:
    - a. For signs up to 20 sq. in. (129 sq. cm), minimum 1/16 inch (1.6 mm) thick.
    - b. For signs larger than 20 sq. in. (129 sq. cm), 1/8 inch (3.2 mm) thick.
    - c. Engraved legend with black letters on white face.

## 2.6 CABLE TIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ideal Industries, Inc.

2. Marking Services, Inc.
3. Panduit Corp.
- B. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
  1. Minimum Width: 3/16 inch (5 mm).
  2. Tensile Strength at 73°F (23°C) according to ASTM D638: 12,000 psi (82.7 MPa).
  3. Temperature Range: Minus 40 to plus 185°F (Minus 40 to plus 85°C).
  4. Color: Black, except where used for color-coding.
- C. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
  1. Minimum Width: 3/16 inch (5 mm).
  2. Tensile Strength at 73°F (23°C) according to ASTM D638: 12,000 psi (82.7 MPa).
  3. Temperature Range: Minus 40 to plus 185°F (Minus 40 to plus 85°C).
  4. Color: Black.
- D. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.
  1. Minimum Width: 3/16 inch (5 mm).
  2. Tensile Strength at 73°F (23°C) according to ASTM D638: 7000 psi (48.2 MPa).
  3. UL 94 Flame Rating: 94V-0.
  4. Temperature Range: Minus 50 to plus 284°F (Minus 46 to plus 140°C).
  5. Color: Black.

## 2.7 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

## PART 3 - EXECUTION

### 3.1 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 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.
- C. Verify identity of each item before installing identification products.
- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
- G. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
  1. Secure tight to surface of conductor, cable, or raceway.
- H. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.



- I. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer, load shedding, and similar gear requiring Owner operation.
- J. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.
- K. Accessible Fittings for Raceways: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage. System legends shall be as follows:
  - 1. "EMERGENCY POWER."
  - 2. "POWER."
- L. Self-Adhesive Wraparound Labels: Secure tight to surface at a location with high visibility and accessibility.
- M. Self-Adhesive Labels:
  - 1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
  - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.
- N. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.
- O. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.
- P. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.
  - 1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.
- Q. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.
- R. Underground Line Warning Tape:
  - 1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches (400 mm) overall.
  - 2. Install underground-line warning tape for direct-buried cables and cables in raceways.
- S. Nonmetallic Preprinted Tags:
  - 1. Place in a location with high visibility and accessibility.
  - 2. Secure using general-purpose cable ties or other appropriate means.
- T. Laminated Acrylic or Melamine Plastic Signs:
  - 1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
  - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2 inch (38 mm) high sign; where two lines of text are required, use labels 2 inches (50 mm) high.
- U. Cable Ties: General purpose, for attaching tags, except as listed below:
  - 1. Outdoors: UV-stabilized nylon.
  - 2. In Spaces Handling Environmental Air: Plenum rated.

### 3.3 IDENTIFICATION SCHEDULE

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
- B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.
- C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120 V to Ground: Identify with self-adhesive raceway labels.
  - 1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

- D. Accessible Fittings for Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive labels containing the wiring system legend and system voltage. System legends shall be as follows:
  - 1. "EMERGENCY POWER."
  - 2. "POWER."
- E. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use self-adhesive vinyl tape to identify the phase.
  - 1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.
- F. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with the conductor or cable designation, origin, and destination.
- G. Control-Circuit Conductor Termination Identification: For identification at terminations, provide self-adhesive labels with the conductor designation.
- H. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.
- I. Locations of Underground Lines: Underground-line warning tape for utility service(s), power, lighting, communication, and control wiring and optical-fiber cable.
- J. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.
- K. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive labels.
  - 1. Apply to exterior of door, cover, or other access.
  - 2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:
    - a. Power-transfer switches.
    - b. Controls with external control power connections.
- L. Arc Flash Warning Labeling: Self-adhesive labels.
- M. Operating Instruction Signs: Laminated acrylic or melamine plastic signs.
- N. Emergency Operating Instruction Signs: Laminated acrylic or melamine plastic signs with white legend on a red background with minimum 3/8 inch (10 mm) high letters for emergency instructions at equipment used for power transfer, load shedding, etc.
- O. Equipment Identification Labels:
  - 1. Indoor Equipment: Laminated acrylic or melamine plastic sign.
  - 2. Outdoor Equipment: Stenciled legend 4 inches (100 mm) high.
  - 3. Equipment to Be Labeled:
    - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be in the form of a self-adhesive, engraved, laminated acrylic or melamine label.
    - b. Enclosures and electrical cabinets.
    - c. Access doors and panels for concealed electrical items.
    - d. Switchboards.
    - e. Transformers: Label that includes tag designation indicated on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
    - f. Substations.
    - g. Emergency system boxes and enclosures.
    - h. Enclosed switches.
    - i. Enclosed circuit breakers.
    - j. Enclosed controllers.
    - k. Variable-speed controllers.
    - l. Push-button stations.
    - m. Power-transfer equipment.
    - n. Contactors.
    - o. Battery-inverter units.
    - p. Power-generating units.
    - q. Monitoring and control equipment.

**END OF SECTION 26 05 53**

**SECTION 26 05 73.13 - SHORT-CIRCUIT STUDIES**

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Section includes a computer-based, fault-current study to determine the minimum interrupting capacity of circuit protective devices.

## 1.3 DEFINITIONS

- A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed and salvaged, or removed and reinstalled. Existing to remain items shall remain functional throughout the construction period.
- B. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- C. Power System Analysis Software Developer: An entity that commercially develops, maintains, and distributes computer software used for power system studies.
- D. Power Systems Analysis Specialist: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located.
- E. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion of the circuit from the system.
- F. SCCR: Short-circuit current rating.
- G. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.
- H. Single-Line Diagram: See "One-Line Diagram."

## 1.4 ACTION SUBMITTALS

- A. Product Data:
  - 1. For computer software program to be used for studies.
  - 2. Submit the following after the approval of system protective devices submittals. Submittals shall be in digital form.
    - a. Short-circuit study input data, including completed computer program input data sheets.
    - b. Short-circuit study and equipment evaluation report; signed, dated, and sealed by a qualified professional engineer.
      - 1) 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 Engineer for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.
      - 2) Revised one-line diagram, reflecting field investigation results and results of short-circuit study.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data:
  - 1. For Power Systems Analysis Software Developer.
  - 2. For Power System Analysis Specialist.
  - 3. For Field Adjusting Agency.

- B. Product Certificates: For short-circuit study software, certifying compliance with IEEE 399.

## 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data:
  - 1. For overcurrent protective devices to include in emergency, operation, and maintenance manuals.
  - 2. The following are from the Short-Circuit Study Report:
    - a. Final one-line diagram.
    - b. Final Short-Circuit Study Report.
    - c. Short-circuit study data files.
    - d. Power system data.

## 1.7 QUALITY ASSURANCE

- A. Study shall be performed using commercially developed and distributed software designed specifically for power system analysis.
- B. Software algorithms shall comply with requirements of standards and guides specified in this Section.
- C. Manual calculations are unacceptable.
  - 1. Power System Analysis Software Qualifications: Computer program shall be designed to perform short-circuit studies or have a function, component, or add-on module designed to perform short-circuit studies.
  - 2. Computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.
- D. Power Systems Analysis Specialist Qualifications: Professional engineer licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.
- E. Short-Circuit Study Certification: Short-Circuit Study Report shall be signed and sealed by Power Systems Analysis Specialist.

## PART 2 - PRODUCTS

### 2.1 POWER SYSTEM ANALYSIS SOFTWARE DEVELOPERS

- A. Manufacturers: Subject to compliance with requirements, utilize products by one of the following:
  - 1. Operation Technology, Inc.
  - 2. Power Analytics, Corporation.
  - 3. SKM Systems Analysis, Inc.
- B. Comply with IEEE 399 and IEEE 551.
  - 1. Analytical features of power systems analysis software program shall have capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output.

### 2.2 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 kilovolt ampere (kVA) and voltage ratings.
  - 4. Motor and generator designations and kVA ratings.
  - 5. Switchgear, switchboard, motor-control center, and panelboard designations and ratings.
  - 6. Derating factors and environmental conditions.

7. Any revisions to electrical equipment required by the study.
- D. Comments and recommendations for system improvements or revisions in a written document, separate from one-line diagram.
- E. 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.
- F. 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.
- 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:
      - 1) Based on fault-point X/R ratio.
      - 2) Based on calculated symmetrical value multiplied by 1.6.
      - 3) 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 a symmetrical basis.
    - g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

## PART 3 - EXECUTION

### 3.1 POWER SYSTEM DATA

- A. Obtain all data necessary for conduct of the study.
  1. Verify completeness of data supplied on one-line diagram. Call any discrepancies to Engineer's attention.

2. For equipment included as Work of this Project, use characteristics submitted under provisions of action submittals and information submittals for this Project.
  3. For any relocated existing equipment and that which is existing to remain, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers. Qualifications of technicians and engineers shall be as defined by NFPA 70E.
- B. Gather and tabulate the required input data to support the short-circuit study. Comply with requirements in Section 01 78 39 "Project Record Documents" for recording circuit protective device characteristics. Record data on a Record Document copy of one-line diagram. Comply with recommendations in IEEE 551 as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under direct supervision and control of the engineer in charge of performing the study and shall be by the engineer or its representative. Data include, but are not limited to, the following:
1. Product Data for 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.
  2. Obtain electrical power utility impedance at the service.
  3. Power sources and ties.
  4. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
  5. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
  6. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.
  7. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
  8. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
  9. Motor horsepower and NEMA MG 1 code letter designation.
  10. Conductor sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
  11. Derating factors.

### 3.2 SHORT-CIRCUIT STUDY

- A. Perform study following the general study procedures contained in IEEE 399.
- B. Calculate short-circuit currents according to IEEE 551.
- C. Base study on device characteristics supplied by device manufacturer.
- D. Extent of electrical power system is indicated on Drawings.
- E. Begin short-circuit current analysis at the service, extending down to system overcurrent protective devices as follows:
  1. To normal system low-voltage load buses where fault current is 10 kA or less.
  2. Exclude equipment rated 240 V ac or less when supplied by a single transformer rated less than 30 kVA.
- F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.
- G. Include the 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 the fault-current dc decrement to address asymmetrical requirements of interrupting equipment.
- H. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and a single line-to-ground fault at each equipment indicated on one-line diagram.
  1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.
- I. Include in the report identification of any protective device applied outside its capacity.
  1. Identify corrective steps required to remediate noncompliant devices found.
  2. Include corrective measures in scope.

**END OF SECTION 26 05 73.13**



**SECTION 26 09 23 - LIGHTING CONTROL DEVICES****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Photoelectric switches.
  - 2. Standalone daylight-harvesting switching and dimming controls.
  - 3. Indoor occupancy and vacancy sensors.
  - 4. Switchbox-mounted occupancy sensors.
  - 5. Lighting contactors.
- B. Related Requirements:
  - 1. Section 26 27 26 "Wiring Devices" for wall-box dimmers and manual light switches.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings:
  - 1. Show installation details for the following:
    - a. Occupancy sensors.
    - b. Vacancy sensors.
  - 2. Interconnection diagrams showing field-installed wiring.
  - 3. Include diagrams for power, signal, and control wiring.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Reflected ceiling plan(s) and elevations, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Suspended ceiling components.
  - 2. Structural members to which equipment will be attached.
  - 3. Items penetrating finished ceiling, including the following:
    - a. Luminaires.
    - b. HVAC Supply & Return devices.
    - c. Speakers.
    - d. Sprinkler Heads.
    - e. Access panels.
    - f. Control modules.
- B. Field quality-control reports.
- C. Sample Warranty: For manufacturer's warranties.

**1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For each type of lighting control device to include in operation and maintenance manuals.

**1.6 WARRANTY**

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace lighting control devices that fail(s) in materials or workmanship within specified warranty period.

1. Warranty Period: One year(s) from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 OUTDOOR PHOTOELECTRIC SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper Industries, Inc.
  2. Intermatic, Inc.
  3. Leviton Manufacturing Co., Inc.
  4. NSi Industries LLC.
- B. Description: Solid state, with SPST dry contacts rated for or 1800 VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A, and compatible with ballasts and LED lamps.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  2. Light-Level Monitoring Range: 1.5 to 10 fc (16.14 to 108 lux), with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of the photocell to prevent fixed light sources from causing turn-off.
  3. Time Delay: Fifteen-second minimum, to prevent false operation.
  4. Surge Protection: Metal-oxide varistor.
  5. Mounting: Twist lock complies with NEMA C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.
  6. Failure Mode: Luminaire stays ON.

### 2.2 DAYLIGHT-HARVESTING SWITCHING CONTROLS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper Industries, Inc.
  2. Hubbell Building Automation, Inc.
  3. Leviton Manufacturing Co., Inc.
  4. Lithonia Lighting; Acuity Brands Lighting, Inc.
  5. NSi Industries LLC.
  6. WattStopper; a Legrand® Group brand.
- B. Description: System operates indoor lighting.
- C. Sequence of Operation: As daylight increases, the lights are turned off at a predetermined level. As daylight decreases, the lights are turned on at a predetermined level.
1. Lighting control set point is based on two lighting conditions:
    - a. When no daylight is present.
    - b. When significant daylight is present (target level).
    - c. System programming is done with two hand-held, remote-control tools.
- D. Ceiling-Mounted Switching Controls: Solid-state, light-level sensor unit, with integrated power pack, that detects changes in indoor lighting levels that are perceived by the eye.
- E. Electrical Components, Devices, and Accessories:
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F (0 to 49 deg C).
  3. Sensor Output: Digital signal compatible with power pack.
  4. Sensor type: Closed loop.
  5. Zone: Single.
  6. Power Pack: Dry contacts rated for 20-A ballast or LED load at 120- and 277-V ac.
    - a. LED status lights to indicate load status.
    - b. Plenum rated.
  7. General Space Sensors Light-Level Monitoring Range: 10 to 200 fc (108 to 2152 lux), with an adjustment for turn-on and turn-off levels within that range.
  8. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling.

9. Set-Point Adjustment: Equip with deadband adjustment of 25, 50, and 75 percent above the "on" set point, or provide with separate adjustable "on" and "off" set points.
10. Test Mode: User selectable, overriding programmed time delay to allow settings check.
11. Control Load Status: User selectable to confirm that load wiring is correct.
12. Indicator: Two digital displays to indicate the beginning of on-off cycles.

### 2.3 DAYLIGHT-HARVESTING DIMMING CONTROLS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper Industries, Inc.
  2. Hubbell Building Automation, Inc.
  3. Leviton Manufacturing Co., Inc.
  4. Lithonia Lighting; Acuity Brands Lighting, Inc.
  5. WattStopper; a Legrand® Group brand.
- B. Description: Sensing daylight and electrical lighting levels, the system adjusts the indoor electrical lighting levels. As daylight increases, the lights are dimmed.
1. Lighting control set point is based on two lighting conditions:
    - a. When no daylight is present (target level).
    - b. When significant daylight is present.
  2. System programming is done with two hand-held, remote-control tools.
    - a. Initial setup tool.
    - b. Tool for occupants to adjust the target levels by increasing the set point up to 25 percent, or by minimizing the electric lighting level.
- C. Ceiling-Mounted Dimming Controls: Solid-state, light-level sensor unit, with separate power pack, to detect changes in indoor lighting levels that are perceived by the eye.
- D. Electrical Components, Devices, and Accessories:
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  2. Sensor Output: 0- to 10-V dc to operate luminaires. Sensor is powered by controller unit.
  3. Light-Level Sensor Set-Point Adjustment Range: 20 to 60 fc (120 to 640 lux).
- E. Power Pack: Digital controller capable of accepting 4 RJ45 inputs with two outputs rated for 20-A ballast load or LED load at 120- and 277-V ac. Sensor has 24-V dc Class 2 power source, as defined by NFPA 70.
1. With integral current monitoring
    - a. Compatible with digital addressable lighting interface.
      - 1) Plenum rated.

### 2.4 INDOOR OCCUPANCY AND VACANCY SENSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper Industries, Inc.
  2. Hubbell Building Automation, Inc.
  3. Intermatic, Inc.
  4. Leviton Manufacturing Co., Inc.
  5. Lithonia Lighting; Acuity Brands Lighting, Inc.
  6. Lutron Electronics Co., Inc.
  7. NSi Industries LLC.
  8. WattStopper; a Legrand® Group brand.
- B. General Requirements for Sensors:
1. Ceiling-mounted, solid-state indoor occupancy and vacancy sensors.
  2. Dual technology.
  3. Separate power pack.
  4. Hardwired connection to switch.
  5. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  6. Operation:

- a. Combination Sensor: Unless otherwise indicated, sensor may be programmed to turn lights ON automatically when coverage area is occupied or manually with remote switch. Lights are turned OFF when are is unoccupied.
7. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A Sensor is powered from the power pack.
8. Power: Line voltage.
9. Power Pack: Dry contacts rated for 20-A ballast or LED load at 120- and 277-V ac.
10. Mounting:
  - a. Sensor: Suitable for mounting in any position on a standard outlet box.
  - b. Relay: Externally mounted through a 1/2-inch (13-mm) knockout in a standard electrical enclosure.
  - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
11. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
12. Bypass Switch: Override the "on" function in case of sensor failure.
- C. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.
  1. Sensitivity Adjustment: Separate for each sensing technology.
  2. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm), and detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
  3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.

## 2.5 SWITCHBOX-MOUNTED STAND-ALONE OCCUPANCY SENSORS

- A. Wall Sensor Light Switch, Passive Infrared
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Cooper Industries, Inc.
  2. Hubbell Building Automation, Inc.
  3. Intermatic, Inc.
  4. Leviton Manufacturing Co., Inc.
  5. Lithonia Lighting; Acuity Brands Lighting, Inc.
  6. Lutron Electronics Co., Inc.
  7. NSi Industries LLC.
  8. WattStopper; a Legrand® Group brand.
- C. Description: Switchbox-mounted, combination, lighting-control sensor and conventional switch lighting-control unit using passive infrared technology.
  1. Standards: Comply with UL 20.
  2. Connections: Hard wired.
  3. Rated 960 W at 10 A at 120 V ac or 10 A at 277 V ac for fluorescent or LED lighting.
  4. Vacancy Sensor Operation: Unless otherwise indicated, turn lights on when switch is pressed, and turn lights off when coverage area is unoccupied; with a time delay for turning lights off,
  5. Adjustable time delay of 10 minutes.
  6. Able to be locked to Manual-On mode.
  7. Color: White or as selected by Architect.
  8. Faceplate: Thermoplastic, color matched to switch.

## 2.6 LIGHTING CONTACTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. ASCO: a brand of Vertiv.
  2. Eaton.
  3. Square D.

- B. Description: Electrically operated and mechanically held, combination-type lighting contactors with nonfused disconnect, complying with NEMA ICS 2 and UL 508.
  - 1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less THD of normal load current).
  - 2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
  - 3. Enclosure: Comply with NEMA 250.

## 2.7 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.
- B. Examine walls and ceilings for suitable conditions where lighting control devices will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 SENSOR INSTALLATION

- A. Comply with NECA 1.
- B. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
- C. Install and aim sensors in locations to achieve not less than 90-percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

### 3.3 WIRING INSTALLATION

- A. Comply with NECA 1.
- B. Wiring Method: Comply with Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch (13 mm).
- C. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- D. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.
- E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

### 3.4 IDENTIFICATION

- A. Identify components and power and control wiring according to Section 26 05 53 "Identification for Electrical Systems."
  - 1. Identify controlled circuits in lighting contactors.
  - 2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.
- B. Label contactors with a unique designation.

### 3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:

1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
  2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Lighting control devices will be considered defective if they do not pass tests and inspections.

### 3.6 ADJUSTING

- A. Occupancy Adjustments: When requested within three months from date of Substantial Completion, provide on-site assistance in adjusting lighting control devices to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.
1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
  2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.

### 3.7 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain all types of lighting control devices.

**END OF SECTION 26 09 23**

**SECTION 26 22 13 - LOW-VOLTAGE DISTRIBUTION TRANSFORMERS**

## 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 distribution, dry-type transformers with a nominal primary and secondary rating of 600 V and less, with capacities up to 1500 kVA.

## 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 and size of transformer.
  - 2. Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer.

## 1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

## 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: On receipt, inspect for and note any 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.
- B. Storage: Store in a warm, dry, and temperature-stable location in original shipping packaging.
- C. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.
- D. Handling: Follow manufacturer's instructions for lifting and transporting transformers.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Eaton.
  - 2. General Electric Company.
  - 3. Siemens Industry, Inc., Energy Management Division.
  - 4. Square D; by Schneider Electric.
- B. Source Limitations: Obtain each transformer type from single source from single manufacturer.

## 2.2 GENERAL TRANSFORMER REQUIREMENTS

- A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.
- B. Comply with NFPA 70.

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 use.
- C. Transformers Rated 15 kVA and Larger:
  1. Comply with 10 CFR 431 (DOE 2016) efficiency levels.
  2. Marked as compliant with DOE 2016 efficiency levels by an NRTL.
- D. Shipping Restraints: Paint or otherwise color-code bolts, wedges, blocks, and other restraints that are to be removed after installation and before energizing. Use fluorescent colors that are easily identifiable inside the transformer enclosure.

### 2.3 DISTRIBUTION TRANSFORMERS

- A. Comply with NFPA 70, and list and label as complying with UL 1561.
- B. Cores: Electrical grade, non-aging silicon steel with high permeability and low hysteresis losses.
  1. One leg per phase.
  2. Core volume shall allow efficient transformer operation at 10 percent above the nominal tap voltage.
  3. Grounded to enclosure.
- C. Coils: Continuous windings without splices except for taps.
  1. Coil Material: Aluminum.
  2. Internal Coil Connections: Brazed or pressure type.
  3. Terminal Connections: Bolted.
- D. Enclosure: Ventilated.
  1. NEMA 250, Type 2: Core and coil shall be encapsulated within resin compound to seal out moisture and air.
  2. KVA Ratings: Based on convection cooling only and not relying on auxiliary fans.
  3. Wiring Compartment: Sized for conduit entry and wiring installation.
  4. Finish: Comply with NEMA 250.
- E. Taps for Transformers 3 kVA and Smaller: None.
- F. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.
- G. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and four 2.5 percent taps below normal full capacity.
- H. Insulation Class, Smaller Than 30 kVA: 180 deg C, UL-component-recognized insulation system with a maximum of 115 deg C rise above 40 deg C ambient temperature.
- I. Insulation Class, 30 kVA and Larger: 220 deg C, UL-component-recognized insulation system with a maximum of 115 deg C rise above 40 deg C ambient temperature.
- J. Grounding: Provide ground-bar kit or a ground bar installed on the inside of the transformer enclosure.
- K. Electrostatic Shielding: Each winding shall have an independent, single, full-width copper electrostatic shield arranged to minimize interwinding capacitance.
  1. Arrange coil leads and terminal strips to minimize capacitive coupling between input and output terminals.
  2. Include special terminal for grounding the shield.
- L. Wall Brackets: Manufacturer's standard brackets.
- M. Low-Sound-Level Requirements: Maximum sound levels when factory tested according to IEEE C57.12.91, as follows:
  1. 9.00 kVA and Less: 40 dBA.
  2. 9.01 to 30.00 kVA: 45 dBA.
  3. 30.01 to 50.00 kVA: 45 dBA for K-factors of 1, 4, and 9.
  4. 50.01 to 150.00 kVA: 50 dBA for K-factors of 1, 4, and 9.
  5. 150.01 to 300.00 kVA: 55 dBA for K-factors of 1, 4, and 9.
  6. 300.01 to 500.00 kVA: 60 dBA for K-factors of 1, 4, and 9.

### 2.4 IDENTIFICATION

- A. Nameplates: Self-adhesive label for each distribution transformer. Self-adhesive labels are specified in Section 26 05 53 "Identification for Electrical Systems."



## 2.5 SOURCE QUALITY CONTROL

- A. Test and inspect transformers according to IEEE C57.12.01 and IEEE C57.12.91.
  - 1. Resistance measurements of all windings at rated voltage connections and at all tap connections.
  - 2. Ratio tests at rated voltage connections and at all tap connections.
  - 3. Phase relation and polarity tests at rated voltage connections.
  - 4. No load losses, and excitation current and rated voltage at rated voltage connections.
  - 5. Impedance and load losses at rated current and rated frequency at rated voltage connections.
  - 6. Applied and induced tensile tests.
  - 7. Regulation and efficiency at rated load and voltage.
  - 8. Insulation-Resistance Tests:
    - a. High-voltage to ground.
    - b. Low-voltage to ground.
    - c. High-voltage to low-voltage.
  - 9. Temperature tests.
- B. Factory Sound-Level Tests: Conduct prototype sound-level tests on production-line products.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.
- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written 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 shall be 5 ohms at location of transformer.
- E. 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 by transformer manufacturer.
  - 1. Coordinate installation of wall-mounted and structure-hanging supports with actual transformer provided.
- B. Install transformers level and plumb on a concrete base with vibration-dampening supports. Locate transformers away from corners and not parallel to adjacent wall surface.
- C. Construct concrete bases according to Section 03 30 00 "Cast-in-Place Concrete" and anchor floor-mounted transformers according to manufacturer's written instructions, seismic codes applicable to Project, 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.
- D. Secure transformer to concrete base according to manufacturer's written instructions.
- E. Secure covers to enclosure and tighten all bolts to manufacturer-recommended torques to reduce noise generation.
- F. Remove shipping bolts, blocking, and wedges.

### 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 "Low-Voltage Electrical Power Conductors and Cables."
- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- D. Provide flexible connections at all conduit and conductor terminations and supports to eliminate sound and vibration transmission to the building structure.

### 3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections with the assistance of a factory-authorized service representative.
- B. Small (Up to 167-kVA Single-Phase or 500-kVA Three-Phase) Dry-Type Transformer Field Tests:
  - 1. Visual and Mechanical Inspection.
    - a. Inspect physical and mechanical condition.
    - b. Inspect anchorage, alignment, and grounding.
    - c. Verify that resilient mounts are free and that any shipping brackets have been removed.
    - d. Verify the unit is clean.
    - e. Perform specific inspections and mechanical tests recommended by manufacturer.
    - f. Verify that as-left tap connections are as specified.
    - g. Verify the presence of any specified surge arresters and that their ratings are as specified.
  - 2. Electrical Tests:
    - a. Measure resistance at each winding, tap, and bolted connection.
    - b. Verify correct secondary voltage, phase-to-phase and phase-to-neutral, after energization and prior to loading.
- C. Remove and replace units that do not pass tests or inspections and retest as specified above.
- D. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

### 3.5 ADJUSTING

- A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. 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.
- B. Output Settings Report: Prepare a written report recording output voltages and tap settings.

### 3.6 CLEANING

- A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

**END OF SECTION 26 22 13**

**SECTION 26 24 16 - PANELBOARDS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Distribution panelboards.
  - 2. Lighting and appliance branch-circuit panelboards.
  - 3. Load centers.
  - 4. Electronic-grade panelboards.

**1.3 DEFINITIONS**

- A. ATS: Acceptance testing specification.
- B. GFCI: Ground-fault circuit interrupter.
- C. GFEP: Ground-fault equipment protection.
- D. HID: High-intensity discharge.
- E. MCCB: Molded-case circuit breaker.
- F. SPD: Surge protective device.
- G. VPR: Voltage protection rating.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of panelboard.
  - 1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
  - 2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
  - 1. Include dimensioned plans, elevations, sections, and details.
  - 2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
  - 3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
  - 4. Detail bus configuration, current, and voltage ratings.
  - 5. Short-circuit current rating of panelboards and overcurrent protective devices.
  - 6. Include evidence of NRTL listing for Series Rating of installed devices.
  - 7. Include evidence of NRTL listing for SPD as installed in panelboard.
  - 8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
  - 9. Include wiring diagrams for power, signal, and control wiring.
  - 10. Key interlock scheme drawing and sequence of operations.

**1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:
  - 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

## 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. Keys: Two spares for each type of panelboard cabinet lock.
  - 2. Circuit Breakers Including GFCI and GFEP Types: Two spares for each panelboard.

## 1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: ISO 9001 or 9002 certified.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards. If space is not yet protected or conditioned, install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NECA 407.

## 1.9 FIELD CONDITIONS

- A. Environmental Limitations:
  - 1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards 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.
  - 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
    - a. Ambient Temperature: Not exceeding minus 22 deg F (minus 30 deg C) to plus 104 deg F (plus 40 deg C).
    - b. Altitude: Not exceeding 6600 feet (2000 m).
- B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
  - 1. Notify Architect or Construction Manager no fewer than seven days in advance of proposed interruption of electric service.
  - 2. Indicate method of providing temporary electrical service.
  - 3. Do not proceed with interruption of electric service without Architect or Construction Manager's written permission.
  - 4. Comply with NFPA 70E.

## 1.10 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.
  - 1. Panelboard Warranty Period: One year from date of Substantial Completion.
- B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace SPD that fails in materials or workmanship within specified warranty period.
  - 1. SPD Warranty Period: One year from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PANELBOARDS AND LOAD CENTERS COMMON REQUIREMENTS

- A. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA PB 1.
- D. Comply with NFPA 70.
- E. Enclosures: Flush and Surface-mounted, dead-front cabinets.
  - 1. Rated for environmental conditions at installed location. Provide as generally indicated below or as indicated on drawings.
    - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
    - b. Outdoor Locations: NEMA 250, Type 3R.
    - c. Kitchen and Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
    - d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
    - e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
  - 2. Height: 84 inches (2.13 m) maximum.
  - 3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.
  - 4. Finishes:
    - a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
    - b. Back Boxes: Galvanized steel.
- F. Incoming Mains:
  - 1. Location: Top or Bottom as indicated on drawings or as required by Project conditions.
  - 2. Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker.
- G. Phase, Neutral, and Ground Buses:
  - 1. Material: Tin-plated aluminum & Hard-drawn copper, 98 percent conductivity.
    - a. Plating shall run entire length of bus.
    - b. Bus shall be fully rated the entire length.
  - 2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
  - 3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
  - 4. Isolated Ground Bus: Where specifically indicated, provide for branch-circuit isolated ground conductors; insulated from box.
  - 5. Full-Sized Neutral: Equipped with optional full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.
- H. Conductor Connectors: Suitable for use with conductor material and sizes.
  - 1. Material: Tin-plated aluminum.
  - 2. Terminations shall allow use of 75 deg C rated conductors without derating.
  - 3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
  - 4. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
  - 5. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
  - 6. Feed-Through Lugs: Mechanical type, where indicated, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
  - 7. Subfeed (Double) Lugs: Mechanical type, where indicated, suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
- I. NRTL Label: Panelboards or load centers shall be labeled by an NRTL acceptable to authority having jurisdiction when used as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards or load centers shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.

- J. Future Devices: Panelboards or load centers shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
  - 1. Percentage of Future Space Capacity: Ten percent.
- K. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include label or manual with size and type of allowable upstream and branch devices listed and labeled by an NRTL for series-connected short-circuit rating.
  - 1. Panelboards rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
  - 2. Panelboards rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.
- L. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.
  - 1. Panelboards and overcurrent protective devices rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
  - 2. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

## 2.2 PERFORMANCE REQUIREMENTS

- A. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 1.

## 2.3 POWER PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Eaton.
  - 2. General Electric Company; GE Energy Management - Electrical Distribution.
  - 3. Siemens Industry, Inc., Energy Management Division.
  - 4. Square D; by Schneider Electric.
- B. Panelboards: NEMA PB 1, distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
  - 1. For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.
- D. Mains: Circuit breaker or Lugs only as indicated on schedules.
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers or Plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
- F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers or Plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

## 2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Eaton.
  - 2. General Electric Company; GE Energy Management - Electrical Distribution.
  - 3. Siemens Industry, Inc., Energy Management Division.
  - 4. Square D; by Schneider Electric.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- D. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

## 2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton.
  2. General Electric Company; GE Energy Management - Electrical Distribution.
  3. Siemens Industry, Inc., Energy Management Division.
  4. Square D; by Schneider Electric.
- B. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.
1. Thermal-Magnetic Circuit Breakers:
    - a. Inverse time-current element for low-level overloads.
    - b. Instantaneous magnetic trip element for short circuits.
    - c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
  2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
  3. Electronic Trip Circuit Breakers:
    - a. RMS sensing.
    - b. Field-replaceable rating plug or electronic trip.
    - c. Digital display of settings, trip targets, and indicated metering displays.
    - d. Multi-button keypad to access programmable functions and monitored data.
    - e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
    - f. Integral test jack for connection to portable test set or laptop computer.
    - g. Field-Adjustable Settings (where specifically indicated):
      - 1) Instantaneous trip.
      - 2) Long- and short-time pickup levels.
      - 3) Long and short time adjustments.
      - 4) Ground-fault pickup level, time delay, and I squared T response.
  4. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
  5. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
  6. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
  7. Subfeed Circuit Breakers: Vertically mounted.
  8. MCCB Features and Accessories:
    - a. Standard frame sizes, trip ratings, and number of poles.
    - b. Breaker handle indicates tripped status.
    - c. UL listed for reverse connection without restrictive line or load ratings.
    - d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
    - e. Ground-Fault Protection: Integrally or Remote-mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    - f. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
    - g. Rating Plugs: Three-pole breakers with ampere ratings greater than 250 amperes shall have interchangeable rating plugs or electronic adjustable trip units.

## 2.6 IDENTIFICATION

- A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.
- B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.
- C. Circuit Directory: Factory directory card or Contractor-provided computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.
  1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

## 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 according to NECA 407.
- 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. Coordinate layout and installation of panelboards 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. Comply with NECA 1.
- C. Install panelboards and accessories according to NECA 407.
- D. Equipment Mounting:
  - 1. Attach panelboard to the vertical finished or structural surface behind the panelboard.
- E. Mount panelboard cabinet plumb and rigid without distortion of box.
- F. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- G. Mount surface-mounted panelboards to steel slotted supports 5/8 inch (16 mm) in depth. Orient steel slotted supports vertically.
- H. Install overcurrent protective devices and controllers not already factory installed.
  - 1. Set field-adjustable, circuit-breaker trip ranges.
  - 2. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.
- I. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
- J. Install filler plates in unused spaces.
- K. When panelboards are installed flush in finished areas: Stub four 1-inch (25 mm) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (25 mm) empty conduits into raised floor space or below slab not on grade.
- L. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

### 3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 26 05 53 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."
- E. Install warning signs complying with requirements in Section 26 05 53 "Identification for Electrical Systems" identifying source of remote circuit.



### 3.4 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. Perform tests and inspections.
- C. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- D. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers stated in NETA ATS, Paragraph 7.6 Circuit Breakers. Do not perform optional tests. Certify compliance with test parameters.
  - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- E. Panelboards will be considered defective if they do not pass tests and inspections.

### 3.5 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in required Coordination Studies.
- C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Owner of effect on phase color coding.
  - 1. Measure loads during period of normal facility operations.
  - 2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by the Owner. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
  - 3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.
  - 4. Tolerance: Maximum difference between phase loads, within a panelboard, shall not exceed 20 percent.

### 3.6 PROTECTION

- A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

**END OF SECTION 26 24 16**

**SECTION 26 27 26 - WIRING DEVICES****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Refer to the following sections for additional device requirements:
  - 1. Section 26 09 23 "LIGHTING CONTROL DEVICES."

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Standard-grade receptacles, 125 V, 20 A.
  - 2. USB receptacles.
  - 3. GFCI receptacles, 125 V, 20 A.
  - 4. Twist-locking receptacles.
  - 5. Cord and plug sets.
  - 6. Toggle switches, 120/277 V, 20 A.
  - 7. Decorator-style devices, 20 A.
  - 8. Wall-box dimmers.
  - 9. Wall plates.
  - 10. Floor service fittings.
  - 11. Poke-through assemblies.

**1.3 DEFINITIONS**

- A. AFCI: Arc-fault circuit interrupter.
- B. BAS: Building automation system.
- C. EMI: Electromagnetic interference.
- D. GFCI: Ground-fault circuit interrupter.
- E. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- F. RFI: Radio-frequency interference.
- G. SPD: Surge protective device.

**1.4 ACTION SUBMITTALS**

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

**1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

**PART 2 - PRODUCTS****2.1 GENERAL WIRING-DEVICE REQUIREMENTS**

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Comply with NFPA 70.
- C. RoHS compliant.
- D. Comply with NEMA WD 1.

- E. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
  - 1. Connectors shall comply with UL 2459 and shall be made with stranded building wire.
  - 2. Devices shall comply with requirements in this Section.
- F. Devices for Owner-Furnished Equipment:
  - 1. Receptacles: Match plug configurations.
  - 2. Cord and Plug Sets: Match equipment requirements.
- G. Device Color:
  - 1. Wiring Devices Connected to Normal Power System: White, or as selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
  - 2. Wiring Devices Connected to Essential Electrical System: Red.
  - 3. Isolated-Ground Receptacles: Orange.
- H. Wall Plate Color: For thermoplastic or plastic covers, match device color.

## 2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Cooper Wiring Devices; Division of Cooper Industries, Inc. (Cooper).
  - 2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
  - 3. Leviton Mfg. Company Inc. (Leviton).
  - 4. Pass & Seymour/Legrand (Pass & Seymour).
- B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

## 2.3 STANDARD COMMERCIAL-GRADE RECEPTACLES, 125 V, 20 A

- A. Duplex Receptacles, 125 V, 20 A:
  - 1. Description: Two pole, three wire, and self-grounding.
  - 2. Configuration: NEMA WD 6, Configuration 5-20R.
  - 3. Standards: Comply with UL 498 and FS W-C-596.
- B. Isolated-Ground Duplex Receptacles, 125 V, 20 A:
  - 1. Description: Straight blade; equipment grounding contacts shall be connected only to green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts. Two pole, three wire, and self-grounding.
  - 2. Configuration: NEMA WD 6, Configuration 5-20R.
  - 3. Standards: Comply with UL 498 and FS W-C-596.
- C. Tamper-Resistant Duplex Receptacles, 125 V, 20 A:
  - 1. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle.
  - 2. Configuration: NEMA WD 6, Configuration 5-20R.
  - 3. Standards: Comply with UL 498 and FS W-C-596.
  - 4. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.
- D. Weather-Resistant Duplex Receptacle, 125 V, 20 A:
  - 1. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
  - 2. Configuration: NEMA WD 6, Configuration 5-20R.
  - 3. Standards: Comply with UL 498.
  - 4. Marking: Listed and labeled as complying with NFPA 70, "Receptacles in Damp or Wet Locations" Article.
- E. Tamper- and Weather-Resistant Duplex Receptacles, 125 V, 20 A:
  - 1. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
  - 2. Configuration: NEMA WD 6, Configuration 5-20R.
  - 3. Standards: Comply with UL 498.

4. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.

#### 2.4 USB RECEPTACLES

##### A. USB Charging Receptacles

1. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap.
2. USB Receptacles: Dual, Combo USB Type A/Type C, 5 V dc, and 2.1 A per receptacle (minimum).
3. Standards: Comply with UL 1310 and USB 3.0 devices.

#### 2.5 GFCI RECEPTACLES, 125 V, 20 A

##### A. Duplex GFCI Receptacles, 125 V, 20 A

1. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Type: Feed through.
4. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.

#### 2.6 TWIST-LOCKING RECEPTACLES

##### A. Twist-Lock, Single Receptacles, 120 V, 20 A

1. Configuration: NEMA WD 6, Configuration L5-20R.
2. Standards: Comply with UL 498.

##### B. Twist-Lock, Single Receptacles, 250 V, 20 A

1. Configuration: NEMA WD 6, Configuration L6-20R.
2. Standards: Comply with UL 498.

##### C. Twist-Lock, Single Receptacles, 250 V, 30 A

1. Configuration: NEMA WD 6, Configuration L6-30R.
2. Standards: Comply with UL 498.

##### D. Twist-Lock, Isolated-Ground, Single Receptacles, 125 V, 20 A

1. Grounding: Equipment grounding contacts shall be connected only to green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.
2. Configuration: NEMA WD 6, Configuration L5-20R.
3. Standards: Comply with UL 498.

#### 2.7 CORD AND PLUG SETS

- A. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
- B. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.
- C. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

#### 2.8 TOGGLE SWITCHES, 120/277 V, 20 A

##### A. Single-Pole Switches, 120/277 V, 20 A

1. Standards: Comply with UL 20 and FS W-S-896.

##### B. Three-Way Switches, 120/277 V, 20 A

1. Comply with UL 20 and FS W-S-896.

##### C. Key-Operated, Single-Pole Switches, 120/277 V, 20 A

1. Description: Factory-supplied key in lieu of switch handle.

2. Standards: Comply with UL 20 and FS W-S-896.

## 2.9 DECORATOR-STYLE COMMERCIAL-GRADE DEVICES, 20 A

- A. Decorator Duplex Receptacles, 125 V, 20 A
  1. Description: Two pole, three wire, and self-grounding. Square face.
  2. Configuration: NEMA WD 6, Configuration 5-20R.
  3. Standards: Comply with UL 498.
- B. Decorator Tamper-Resistant Duplex Receptacles, 125 V, 20 A
  1. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
  2. Configuration: NEMA WD 6, Configuration 5-20R.
  3. Standards: Comply with UL 498.
  4. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.
- C. Decorator Single-Pole Switches, 120/277 V, 20 A
  1. Comply with UL 20.

## 2.10 DIMMERS

- A. Wall-Box Dimmers:
  1. Description: Modular, full-wave, solid-state dimmer switch with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.
  2. Control: Continuously adjustable slider; with single-pole or three-way switching.
  3. Standards: Comply with UL 1472.
  4. LED Lamp Dimmer Switches: Modular; compatible with LED lamps; trim potentiometer to adjust low-end dimming; capable of consistent dimming with low end not greater than 20 percent of full brightness.

## 2.11 WALL PLATES

- A. Single Source: Obtain wall plates from same manufacturer of wiring devices.
- B. Single and combination types shall match corresponding wiring devices.
  1. Plate-Securing Screws: Metal with head color to match plate finish.
  2. Material for Finished Spaces: Smooth, high-impact thermoplastic.
  3. Material for Unfinished Spaces: Galvanized steel.
- C. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant in-use, die-cast aluminum with lockable cover.

## 2.12 FLOOR SERVICE FITTINGS

- A. Flush-Type Floor Service Fittings:
  1. Description: Type: Modular, flush-type, dual-service units suitable for wiring method used, with cover flush with finished floor.
  2. Compartments: Barrier separates power from voice and data communication cabling.
  3. Service Plate and Cover: Rectangular, solid brass with satin finish.
  4. Power Receptacle: NEMA WD 6 Configuration 5-20R, gray finish, unless otherwise indicated.
  5. Data Communication Outlet: Blank cover with bushed cable opening.

## 2.13 POKE-THROUGH ASSEMBLIES

- A. Description: Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service-outlet assembly.
- B. Standards: Comply with scrub water exclusion requirements in UL 514.
- C. Service-Outlet Assembly: Flush type with two simplex receptacles and space for two RJ-45 jacks

- D. Size: Selected to fit nominal 4-inch (100-mm) cored holes in floor and matched to floor thickness.
- E. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
- F. Closure Plug: Arranged to close unused 4-inch (100-mm) cored openings and reestablish fire

### 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.
  - 4. Existing Conductors:
    - a. Cut back and pigtail, or replace all damaged conductors.
    - b. Straighten conductors that remain and remove corrosion and foreign matter.
    - c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.
- 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 right.
- F. Device Plates: 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, multi-gang wall plates.
- I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

### 3.2 IDENTIFICATION

- A. Comply with Section 26 05 53 "Identification for Electrical Systems."
- B. Identify each receptacle with panelboard identification and circuit number. Use self-adhesive transfer printing tape with black 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.

### 3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. Test Instruments: Use instruments that comply with UL 1436.
  - 2. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- B. 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.
- C. Test straight-blade convenience outlets in patient-care areas for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 oz. (115 g).
- D. Wiring device will be considered defective if it does not pass tests and inspections.

**END OF SECTION 26 27 26**

**SECTION 26 28 16 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Fusible switches.
  - 2. Nonfusible switches.
  - 3. Receptacle switches.
  - 4. Shunt trip switches.
  - 5. Molded-case circuit breakers (MCCBs).
  - 6. Molded-case switches.
  - 7. Enclosures.

**1.3 DEFINITIONS**

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
  - 1. Enclosure types and details for types other than NEMA 250, Type 1.
  - 2. Current and voltage ratings.
  - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
  - 4. Include evidence of a nationally recognized testing laboratory (NRTL) listing for series rating of installed devices.
  - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.

**1.5 INFORMATIONAL SUBMITTALS**

- A. Seismic Qualification Data: Certificates, for enclosed switches and circuit breakers, 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.

**1.6 WARRANTY**

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.



1. Warranty Period: One year(s) from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Enclosed switches and circuit breakers 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."

### 2.2 GENERAL REQUIREMENTS

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- C. Comply with NFPA 70.

### 2.3 FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Eaton.
  2. General Electric Company.
  3. Siemens Industry, Inc., Energy Management Division.
  4. Square D; by Schneider Electric.
- B. Type HD, Heavy Duty:
  1. Single throw.
  2. Three pole.
  3. 240 & 600-V ac.
  4. 1200 A and smaller.
  5. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses.
  6. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories:
  1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
  2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
  3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
  4. Lugs: Mechanical type, suitable for number, size, and conductor material.
  5. Service-Rated Switches: Labeled for use as service equipment where applicable.

### 2.4 NONFUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Eaton.
  2. General Electric Company.
  3. Siemens Industry, Inc., Energy Management Division.
  4. Square D; by Schneider Electric.
- B. Type HD, Heavy Duty, Three Pole, Single Throw, 240 & 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
4. Lugs: Mechanical type, suitable for number, size, and conductor material.

## 2.5 SHUNT TRIP SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Bussmann, an Eaton business.
  2. Littelfuse, Inc.
  3. Mersen USA.
- B. General Requirements: Comply with ASME A17.1, UL 50, and UL 98, with Class J fuse block and 200-kA interrupting and short-circuit current rating.
- C. Type HD, Heavy-Duty, Three Pole, Single-Throw Fusible Switch: rating as indicated on Drawings; UL 98 and NEMA KS 1; integral shunt trip mechanism; horsepower rated, with clips or bolt pads to accommodate indicated fuses; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
- D. Control Circuit: 120-V ac; obtained from integral control power transformer, with primary and secondary fuses, with a control power transformer of enough capacity to operate shunt trip, pilot, indicating and control devices.
- E. Accessories:
  1. Oiltight key switch for key-to-test function.
  2. Oiltight green ON pilot light.
  3. Isolated neutral lug; 100 percent rating.
  4. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.
  5. Form C alarm contacts that change state when switch is tripped.
  6. Three-pole, double-throw, fire-safety and alarm relay; 24-V dc coil voltage.
  7. Three-pole, double-throw, fire-alarm voltage monitoring relay complying with NFPA 72.
  8. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
  9. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
  10. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
  11. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating - 120-V ac.
  12. Lugs: Mechanical type, suitable for number, size, and conductor material.

## 2.6 MOLDED-CASE CIRCUIT BREAKERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Eaton.
  2. General Electric Company.
  3. Siemens Industry, Inc., Energy Management Division.
  4. Square D; by Schneider Electric.
- B. Circuit breakers shall be constructed using glass-reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.
- C. Circuit breakers shall have a toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. The circuit-breaker handle shall be over center, be trip free, and reside in a tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon shall be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit-breaker tripping mechanism for maintenance and testing purposes.
- D. The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker. Circuit

breakers may be series rated. Circuit breaker/circuit breaker combinations for series connected interrupting ratings shall be listed by UL as recognized component combinations. Any series rated combination used shall be marked on the end-use equipment along with the statement "Caution - Series Rated System. \_\_\_\_\_ Amps Available. Identical Replacement Component Required."

- E. MCCBs shall be equipped with a device for locking in the isolated position.
- F. Lugs shall be suitable for 194 deg F (90 deg C) rated wire, sized according to the 167 deg F (75 deg C) temperature rating in NFPA 70.
- G. Standard: Comply with UL 489 with interrupting capacity to comply with available fault currents.
- H. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- I. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings as indicated on Drawings:
  - 1. Instantaneous trip.
  - 2. Long- and short-time pickup levels.
  - 3. Long- and short-time time adjustments.
  - 4. Ground-fault pickup level, time delay, and I-squared t response.
- J. Ground-Fault Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
- K. Ground-Fault Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).
- L. Features and Accessories:
  - 1. Standard frame sizes, trip ratings, and number of poles.
  - 2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
  - 3. Application Listing: Appropriate for application.
  - 4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
  - 5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.

## 2.7 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
- B. Enclosure Finish: The enclosure shall be finished with gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (NEMA 250 Type 1 or Type 3R as indicated on Drawings or as required for installation).
- C. Conduit Entry: NEMA 250 Types 4, 4X, and 12 enclosures shall contain no knockouts. NEMA 250 Types 7 and 9 enclosures shall be provided with threaded conduit openings in both endwalls.
- D. Operating Mechanism: The circuit-breaker operating handle shall be externally operable with the operating mechanism being an integral part of the box, not the cover. The cover interlock mechanism shall have an externally operated override. The override shall not permanently disable the interlock mechanism, which shall return to the locked position once the override is released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.
- E. Enclosures designated as NEMA 250 Type 4, 4X stainless steel, 12, or 12K shall have a dual cover interlock mechanism to prevent unintentional opening of the enclosure cover when the circuit breaker is ON and to prevent turning the circuit breaker ON when the enclosure cover is open.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.
  - 1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

### 3.2 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

- A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.
  - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
  - 2. Outdoor Locations: NEMA 250, Type 3R.
  - 3. Kitchen and Wash-Down Areas: NEMA 250, Type 4X.
  - 4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
  - 5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

### 3.3 INSTALLATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- C. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- D. Install fuses in fusible devices.
- E. Comply with NFPA 70 and NECA 1.

### 3.4 IDENTIFICATION

- A. Comply with requirements in Section 26 05 53 "Identification for Electrical Systems."
  - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
  - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

### 3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections with the assistance of a factory-authorized service representative.
- B. Tests and Inspections for Switches:
  - 1. Visual and Mechanical Inspection:
    - a. Inspect physical and mechanical condition.
    - b. Inspect anchorage, alignment, grounding, and clearances.
    - c. Verify that the unit is clean.
    - d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
    - e. Verify that fuse sizes and types match the Specifications and Drawings.
  - 2. Electrical Tests:
    - a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
- C. Tests and Inspections for Molded Case Circuit Breakers:
  - 1. Visual and Mechanical Inspection:
    - a. Verify that equipment nameplate data are as described in the Specifications and shown on the Drawings.
    - b. Inspect physical and mechanical condition.
    - c. Inspect anchorage, alignment, grounding, and clearances.

- d. Verify that the unit is clean.
  - e. Operate the circuit breaker to ensure smooth operation.
  - f. Perform adjustments for final protective device settings in accordance with the coordination study.
2. Electrical Tests:
- a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
4. Perform the following infrared scan tests and inspections and prepare reports:
- a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. 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 enclosed switch and circuit breaker 11 months after date of Substantial Completion.
  - 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.
5. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.
- 1. Test procedures used.
  - 2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
  - 3. List deficiencies detected, remedial action taken, and observations after remedial action.
- 3.6 ADJUSTING
- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
  - B. Set field-adjustable circuit-breaker trip ranges as required.

**END OF SECTION 26 28 16**

**SECTION 26 32 13.13 – NATURAL GAS EMERGENCY ENGINE GENERATORS****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 packaged natural gas engine generators for emergency use with the following features:
  - 1. Natural Gas engine.
  - 2. Natural Gas fuel-oil system.
  - 3. Control and monitoring.
  - 4. Generator overcurrent and fault protection.
  - 5. Generator, exciter, and voltage regulator.
  - 6. Load banks.
  - 7. Outdoor engine generator enclosure.
  - 8. Remote radiator motors.
  - 9. Vibration isolation devices.
  - 10. Finishes.
- B. Related Requirements:
  - 1. Section 26 36 00 "Transfer Switches" for transfer switches, including sensors and relays to initiate automatic-starting and -stopping signals for engine generators.

**1.3 DEFINITIONS**

- A. EPS: Emergency power supply.
- B. EPSS: Emergency power supply system.
- C. Operational Bandwidth: The total variation, from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

**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.
  - 2. Include thermal damage curve for generator.
  - 3. Include time-current characteristic curves for generator protective device.
  - 4. Include fuel consumption in gallons per hour (liters per hour) at 0.8 power factor at 0.5, 0.75, and 1.0 times generator capacity.
  - 5. Include generator efficiency at 0.8 power factor at 0.5, 0.75, and 1.0 times generator capacity.
  - 6. Include airflow requirements for cooling and combustion air in cubic feet per minute (cubic meters per minute) at 0.8 power factor, with air-supply temperature of 95, 80, 70, and 50 deg F (35, 27, 21, and 10 deg C). Provide Drawings indicating requirements and limitations for location of air intake and exhausts.
  - 7. Include generator characteristics, including, but not limited to, kilowatt rating, efficiency, reactances, and short-circuit current capability.
- B. Shop Drawings:
  - 1. Include plans and elevations for engine generator and other components specified. Indicate access requirements affected by height of subbase fuel tank.
  - 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. Identify fluid drain ports and clearance requirements for proper fluid drain.

4. Design calculations for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
5. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and supported equipment. Include base weights.
6. Include diagrams for power, signal, and control wiring. Complete schematic, wiring, and interconnection diagrams showing terminal markings for EPS equipment and functional relationship between all electrical components.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, manufacturer, and testing agency.
- B. Seismic Qualification Data: Certificates for engine generator, 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: With engine and generator mounted on rails, identify center of gravity and total weight, supplied enclosure, and each piece of equipment not integral to the engine generator, 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. Source Quality-Control Reports: Including, but not limited to, the following:
  1. Certified summary of prototype-unit test report.
  2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
  3. Certified Summary of Performance Tests: Certify compliance with specified requirement to meet performance criteria for sensitive loads.
  4. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
  5. Report of sound generation.
  6. Report of exhaust emissions showing compliance with applicable regulations.
  7. Certified Torsional Vibration Compatibility: Comply with NFPA 110.
- D. Field quality-control reports.
- E. Warranty: For special warranty.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For engine generators 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. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
    - b. Operating instructions laminated and mounted adjacent to generator location.
    - c. Training plan.

#### 1.7 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. Fuses: One for every 10 of each type and rating, but no fewer than one of each.
  2. Indicator Lamps: Two for every six of each type used, but no fewer than two of each.
  3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.
  4. Tools: Each specialty tool listed by part number in operations and maintenance manual.

## 1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- B. Testing Agency Qualifications: Accredited by NETA.
  - 1. 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 packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Two (2) 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. Caterpillar, Inc.; Electric Power Division.
  - 2. Cummins Power Generation.
  - 3. Generac Power Systems, Inc.
  - 4. Kohler Power Systems.
  - 5. MTU Onsite Energy Corporation.
- B. Source Limitations: Obtain packaged engine generators and auxiliary components from single source from single manufacturer.

## 2.2 PERFORMANCE REQUIREMENTS

- A. B11 Compliance: Comply with B11.19.
- B. NFPA Compliance:
  - 1. Comply with NFPA 37.
  - 2. Comply with NFPA 70.
  - 3. Comply with NFPA 110 requirements for Level 1 EPSS.
- C. UL Compliance: Comply with UL 2200.
- D. Engine Exhaust Emissions: Comply with EPA Tier 2 or 3 requirements as required and applicable state and local government requirements.
- E. Noise Emission: Comply with applicable state and local government requirements for maximum noise level at adjacent property boundaries due to sound emitted by engine generator, including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.
- F. Environmental Conditions: Engine generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
  - 1. Ambient Temperature: 5 to 110 deg F (Minus 15 to plus 43 deg C).
  - 2. Altitude: Sea level to 1000 feet (300 m).

## 2.3 ENGINE GENERATOR ASSEMBLY DESCRIPTION

- A. Factory-assembled and -tested, water-cooled engine, with brushless generator and accessories.
- 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. Service Load: see drawings for kVA rating
- D. Power Factor: 0.8, lagging.
- E. Frequency: 60 Hz
- F. Voltage: see drawings for Voltage rating.
- G. Phase: Three-phase, four-wire wye.
- H. Induction Method: Naturally aspirated.



- I. Governor: Adjustable isochronous, with speed sensing.
- J. Mounting Frame: Structural steel framework to maintain alignment of mounted components without depending on concrete foundation. Provide lifting attachments sized and spaced to prevent deflection of base during lifting and moving.
  - 1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and engine generator center of gravity.
- K. Capacities and Characteristics:
  - 1. Power Output Ratings: Nominal ratings as indicated at 0.8 power factor excluding power required for the continued and repeated operation of the unit and auxiliaries, with capacity as required to operate as a unit as evidenced by records of prototype testing.
  - 2. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.
- L. Engine Generator Performance:
  - 1. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage, from no load to full load.
  - 2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
  - 3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency, from no load to full load.
  - 4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
  - 5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.
  - 6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
  - 7. Sustained Short-Circuit Current: For a three-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.
  - 8. Start Time: Comply with NFPA 110, Type 10 system requirements.
- M. Engine Generator Performance for Sensitive Loads:
  - 1. Oversizing generator compared with the rated power output of the engine is permissible to meet specified performance.
    - a. Nameplate Data for Oversized Generator: Show ratings required by the Contract Documents rather than ratings that would normally be applied to generator size installed.
  - 2. Steady-State Voltage Operational Bandwidth: 1 percent of rated output voltage, from no load to full load.
  - 3. Transient Voltage Performance: Not more than 10 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 0.5 second.
  - 4. Steady-State Frequency Operational Bandwidth: Plus or minus 0.25 percent of rated frequency, from no load to full load.
  - 5. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
  - 6. Transient Frequency Performance: Less than 2-Hz variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within three seconds.
  - 7. Output Waveform: At no load, harmonic content, measured line to neutral, shall not exceed 2 percent total with no slot ripple. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
  - 8. Sustained Short-Circuit Current: For a three-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 10

seconds and then clear the fault automatically, without damage to winding insulation or other generator system components.

9. Excitation System: Performance shall be unaffected by voltage distortion caused by nonlinear load.
  - a. Provide permanent magnet excitation for power source to voltage regulator.

10. Start Time: Comply with NFPA 110, Type 10, system requirements.

N. Parallel Engine Generators:

1. Automatic reactive output power control and load sharing between engine generators operated in parallel.
2. Automatic regulation, automatic connection to a common bus, and automatic synchronization, with manual controls and instruments to monitor and control paralleling functions.
3. Protective relays required for equipment and personnel safety.
4. Paralleling suppressors to protect excitation systems.
5. Reverse power protection.
6. Loss of field protection.

## 2.4 NATURAL GASENGINE

- A. Fuel: ASTM D 975 diesel fuel oil, Grade 2-D S15.
- B. Rated Engine Speed: 1800 rpm.
- C. Natural gas engines shall be capable of operating on a supply gas pressure of 0.5 psi -5.0 psi natural gas and shall include a regulator designed to operate on this supply pressure.
- D. Lubrication System: Engine or skid mounted.
  1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
  2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
  3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.
- E. Jacket Coolant Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity and with UL 499.
- F. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine generator mounting frame and integral engine-driven coolant pump.
  1. Radiator shall be sized to effectively cool engine while operating at 100% of nameplate rating whether in an indoor application or outdoors in a weatherproof enclosure. Radiator shall be sized such that no additional cooling fans are required for the application to remove heat rise due to radiation, while operating at 100% load. Radiator sizing shall be based on the ambient temperature defined in this specification and shall also include a minimum of a 7-degree F temperature rise across the genset and no less than 0.5" static restriction.
  2. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
  3. Size of Radiator: Adequate to contain expansion of total system coolant, from cold start to 110 percent load condition.
  4. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
  5. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, UV-, and abrasion-resistant fabric.
    - a. Rating: 50-psig (345-kPa) maximum working pressure with coolant at 180 deg F (82 deg C), and noncollapsible under vacuum.
    - b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.
- G. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.
  1. Minimum sound attenuation of 25 dB at 500 Hz.

2. Sound level measured at a distance of 25 feet (8 m) from exhaust discharge after installation is complete shall be 78 dBA or less.
- H. Air-Intake Filter: Standard-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.
- I. Starting System: 24 V electric, with negative ground.
  1. Components: Sized so they are not damaged during a full engine-cranking cycle, with ambient temperature at maximum specified in "Performance Requirements" Article.
  2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
  3. Cranking Cycle: As required by NFPA 110 for system level specified.
  4. Battery: Lead acid, with capacity within ambient temperature range specified in "Performance Requirements" Article to provide specified cranking cycle at least three times without recharging.
  5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
  6. Battery Stand: Factory-fabricated, two-tier metal with acid-resistant finish designed to hold the quantity of battery cells required and to maintain the arrangement to minimize lengths of battery interconnections.
  7. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
  8. Battery Charger: Current-limiting, automatic-equalizing, and float-charging type designed for lead-acid batteries. Unit shall comply with UL 1236 and include the following features:
    - a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
    - b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg F (minus 40 deg C) to 140 deg F (plus 60 deg C) to prevent overcharging at high temperatures and undercharging at low temperatures.
    - c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
    - d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
    - e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
    - f. Enclosure and Mounting: NEMA 250, Type 1 wall-mounted cabinet.

## 2.5 NATURAL GAS FUEL-OIL SYSTEM

- A. Comply with NFPA 30.
- B. Piping: Fuel-oil piping shall be Schedule 40 black steel, complying with requirements in Section 23 11 13 "Facility Fuel-Oil Piping." Cast iron, aluminum, copper, and galvanized steel shall not be used in the fuel-oil system.
- C. Main Fuel Pump: Mounted on engine to provide primary fuel flow under starting and load conditions.
- D. Fuel Filtering: Remove water and contaminants larger than 1 micron.
- E. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.

## 2.6 CONTROL AND MONITORING

- A. Automatic-Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of engine generator. When mode-selector switch is switched to the on position, engine generator starts. The off position of same switch initiates engine generator shutdown. When engine generator is running, specified system or equipment failures or derangements automatically shut down engine generator and initiate alarms.

- B. Manual-Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position starts engine generator. The off position of same switch initiates engine generator shutdown. When engine generator is running, specified system or equipment failures or derangements automatically shut down engine generator and initiate alarms.
- C. Provide minimum run time control set for 30 minutes, with override only by operation of a remote emergency-stop switch.
- D. Comply with UL 508A.
- E. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the engine generator. Mounting method shall isolate the control panel from engine generator vibration. Panel shall be powered from the engine generator battery.
- F. Control and Monitoring Panel:
  - 1. Digital controller with integrated LCD display, controls, and microprocessor, capable of local and remote control, monitoring, and programming, with battery backup.
  - 2. Instruments: Located on the control and monitoring panel and viewable during operation.
    - a. Engine lubricating-oil pressure gage.
    - b. Engine-coolant temperature gage.
    - c. DC voltmeter (alternator battery charging).
    - d. Running-time meter.
    - e. AC voltmeter, connected to a phase selector switch.
    - f. AC ammeter, connected to a phase selector switch.
    - g. AC frequency meter.
    - h. Generator-voltage-adjusting rheostat.
  - 3. Controls and Protective Devices: Controls, shutdown devices, and common visual alarm indication as required by NFPA 110 for Level 1 system, including the following:
    - a. Cranking control equipment.
    - b. Run-Off-Auto switch.
    - c. Control switch not in automatic position alarm.
    - d. Overcrank alarm.
    - e. Overcrank shutdown device.
    - f. Low water temperature alarm.
    - g. High engine temperature pre-alarm.
    - h. High engine temperature.
    - i. High engine temperature shutdown device.
    - j. Overspeed alarm.
    - k. Overspeed shutdown device.
    - l. Low-fuel main tank.
      - 1) Low-fuel-level alarm shall be initiated when the level falls below that required for operation for the duration required for the indicated EPSS class.
    - m. Coolant low-level alarm.
    - n. Coolant low-level shutdown device.
    - o. Coolant high-temperature prealarm.
    - p. Coolant high-temperature alarm.
    - q. Coolant low-temperature alarm.
    - r. Coolant high-temperature shutdown device.
    - s. EPS load indicator.
    - t. Battery high-voltage alarm.
    - u. Low-cranking voltage alarm.
    - v. Battery-charger malfunction alarm.
    - w. Battery low-voltage alarm.
    - x. Lamp test.
    - y. Contacts for local and remote common alarm.
    - z. Remote manual-stop shutdown device.
    - aa. Air shutdown damper alarm when used.
    - bb. Air shutdown damper shutdown device when used.
    - cc. Generator overcurrent-protective-device not-closed alarm.

- G. Connection to Datalink:
1. A separate terminal block, factory wired to Form C dry contacts, for each alarm and status indication.
  2. Provide connections for datalink transmission of indications to remote data terminals via ModBus or LonWorks. Data system connections to terminals are covered in Section 26 09 13 "Electrical Power Monitoring and Control" or other related sections.
- H. Common Remote Panel with Common Audible Alarm: Comply with NFPA 110 requirements for Level 1 systems. Include necessary contacts and terminals in control and monitoring panel. Remote panel shall be powered from the engine generator battery.
- I. Remote Alarm Annunciator: Comply with NFPA 99. An LED indicator light labeled with proper alarm conditions shall identify each alarm event, and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated.
1. Overcrank alarm.
  2. Coolant low-temperature alarm.
  3. High engine temperature prealarm.
  4. High engine temperature alarm.
  5. Low lube oil pressure alarm.
  6. Overspeed alarm.
  7. Low-fuel main tank pre-alarm.
  8. Low-fuel main tank engine shutdown.
  9. High-fuel main tank alarm.
  10. Low coolant level alarm.
  11. Low-cranking voltage alarm.
  12. Contacts for local and remote common alarm.
  13. Audible-alarm silencing switch.
  14. Air shutdown damper when used.
  15. Run-Off-Auto switch.
  16. Control switch not in automatic position alarm.
  17. Fuel tank derangement alarm.
  18. Fuel tank high-level shutdown of fuel-supply alarm.
  19. Lamp test.
  20. Low-cranking voltage alarm.
  21. Generator overcurrent protective device not closed.
- J. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator unless otherwise indicated.
- K. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

## 2.7 GENERATOR OVERCURRENT AND FAULT PROTECTION

- A. Overcurrent protective devices for the entire EPSS shall be coordinated to optimize selective tripping when a short circuit occurs. Coordination of protective devices shall consider both utility and EPSS as the voltage source.
1. Overcurrent protective devices for the EPSS shall be accessible only to authorized personnel.
- B. Generator Circuit Breaker: Molded-case, thermal-magnetic type; 100 percent rated; complying with UL 489.
1. Tripping Characteristic: Designed specifically for generator protection.
  2. Trip Rating: Matched to generator output rating.
  3. Shunt Trip: Connected to trip breaker when engine generator is shut down by other protective devices.
  4. Mounting: Adjacent to or integrated with control and monitoring panel.
- C. Generator Circuit Breaker: Molded-case, electronic-trip type; 100 percent rated; complying with UL 489.

1. Tripping Characteristics: Adjustable long-time and short-time delay and instantaneous.
  2. Trip Settings: Selected to coordinate with generator thermal damage curve.
  3. Shunt Trip: Connected to trip breaker when engine generator is shut down by other protective devices.
  4. Mounting: Adjacent to or integrated with control and monitoring panel.
- D. Generator Circuit Breaker: Insulated-case, electronic-trip type; 100 percent rated; complying with UL 489.
1. Tripping Characteristics: Adjustable long-time and short-time delay and instantaneous.
  2. Trip Settings: Selected to coordinate with generator thermal damage curve.
  3. Shunt Trip: Connected to trip breaker when engine generator is shut down by other protective devices.
  4. Mounting: Adjacent to or integrated with control and monitoring panel.
- E. Generator Protector: Microprocessor-based unit shall continuously monitor current level in each phase of generator output, integrate generator heating effect over time, and predict when thermal damage of alternator will occur. When signaled by generator protector or other engine generator protective devices, a shunt-trip device in the generator disconnect switch shall open the switch to disconnect the generator from load circuits. Protector performs the following functions:
1. Initiates a generator overload alarm when generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other engine generator malfunction alarms. Contacts shall be available for load shed functions.
  2. Under single- or three-phase fault conditions, regulates generator to 300 percent of rated full-load current for up to 10 seconds.
  3. As overcurrent heating effect on the generator approaches the thermal damage point of the unit, protector switches the excitation system off, opens the generator disconnect device, and shuts down the engine generator.
  4. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot.
- F. Ground-Fault Indication: Comply with NFPA 70, "Emergency System" signals for ground fault.
1. Indicate ground fault with other engine generator alarm indications.

## 2.8 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

- A. Comply with NEMA MG 1.
- B. Comply with UL2200.
- C. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.
- D. Electrical Insulation: Class H.
- E. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required. Provide six-lead alternator.
- F. Range: Provide broad range of output voltage by adjusting the excitation level.
- G. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.
- H. Enclosure: Dripproof.
- I. Instrument Transformers: Mounted within generator enclosure.
- J. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified and as required by NFPA 110.
  1. Adjusting Rheostat on Control and Monitoring Panel: Provide plus or minus 5 percent adjustment of output-voltage operating band.
  2. Maintain voltage within 15 percent on one step, full load.
  3. Provide anti-hunt provision to stabilize voltage.
  4. Maintain frequency within 5 percent and stabilize at rated frequency within two seconds.
- K. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.
- L. Temperature Rise: Shall not exceed 125 degree C rise at 40 degree C ambient.
- M. Subtransient Reactance: 12 percent, maximum.

## 2.9 OUTDOOR ENGINE GENERATOR ENCLOSURE

- A. Description: Vandal-resistant, sound-attenuating, weatherproof steel housing, wind resistant up to 100 mph (160 km/h). Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure.
  - 1. Sound Attenuation Level: Level I.
- B. Structural Design and Anchorage: Comply with ASCE/SEI 7 for wind loads of up to 100 mph (160 km/h).
- C. Hinged Access Doors: With locking provisions.
- D. Muffler Location: External to enclosure.
- E. Engine-Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for two hours with ambient temperature at top of range specified in system service conditions.
  - 1. Louvers: Fixed-engine, cooling-air inlet and discharge. Storm-proof and drainable louvers prevent entry of rain and snow.

## 2.10 FINISHES

- A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

## 2.11 SOURCE QUALITY CONTROL

- A. Prototype Testing: Factory test engine generator using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.
  - 1. Tests: Comply with NFPA 110, Level 1 Energy Converters and with IEEE 115.
- B. Project-Specific Equipment Tests: Before shipment, factory test engine generator and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:
  - 1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
  - 2. Test generator, exciter, and voltage regulator as a unit.
  - 3. Full-load run.
  - 4. Maximum power.
  - 5. Voltage regulation.
  - 6. Transient and steady-state governing.
  - 7. Single-step load pickup.
  - 8. Safety shutdown.
  - 9. Report factory test results within 10 days of completion of test.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine generator performance.
- B. Examine roughing-in for piping systems and electrical connections. Verify actual locations of connections before packaged engine generator installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
1. Notify Architect or Construction Manager no fewer than seven days in advance of proposed interruption of electric service.
  2. Indicate method of providing temporary electrical service.
  3. Do not proceed with interruption of electric service without Architect or Construction Manager's written permission.
  4. Comply with NFPA 70E.

### 3.3 INSTALLATION

- A. Comply with NECA 1 and NECA 404.
- B. Comply with packaged engine generator manufacturers' written installation and alignment instructions and with NFPA 110.
- C. Equipment Mounting:
1. Install packaged engine generators on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 03 30 00 "Cast-in-Place Concrete."
  2. Coordinate size and location of concrete bases for packaged engine generator and any related components. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
  3. Install packaged engine generator with elastomeric isolator pads having a minimum deflection of 1 inch (25 mm) on 4-inch- (100-mm-) high concrete base. Secure generator set to anchor bolts installed in concrete bases.
- D. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.
- E. Exhaust System: Install Schedule 40 black steel piping with welded joints and connect to engine muffler. Install thimble at wall. Piping shall be same diameter as muffler outlet.
1. Piping materials and installation requirements are specified in Section 23 21 13 "Hydronic Piping."
  2. Install flexible connectors and steel piping materials according to requirements in Section 23 21 16 "Hydronic Piping Specialties."
  3. Insulate muffler/silencer and exhaust system components according to requirements in Section 23 07 19 "HVAC Piping Insulation."
  4. Install isolating thimbles where exhaust piping penetrates combustible surfaces with a minimum of 9 inches (225 mm) of clearance from combustibles.
- F. Drain Piping: Install condensate drain piping to muffler drain outlet with a shutoff valve, stainless-steel flexible connector, and Schedule 40 black steel pipe with welded joints.
1. Piping materials and installation requirements are specified in Section 23 21 13 "Hydronic Piping."
  2. Drain piping valves, connectors, and installation requirements are specified in Section 23 21 16 "Hydronic Piping Specialties."
- G. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

### 3.4 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping and specialties.
- B. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables." Provide a minimum of one 90-degree bend in flexible conduit routed to the engine generator from a stationary element.



- D. Balance single-phase loads to obtain a maximum of 10 percent unbalance between any two phases.

### 3.5 IDENTIFICATION

- A. Identify system components according to Section 26 05 53 "Identification for Electrical Systems."
- B. Install a sign indicating the generator neutral is bonded to the main service neutral at the main service location.

### 3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Agency: Contractor will 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.
- E. Tests and Inspections:
  - 1. Perform tests recommended by manufacturer and in "Visual and Mechanical Inspection" and "Electrical and Mechanical Tests" subparagraphs below, as specified in the NETA ATS. Certify compliance with test parameters.
    - a. Visual and Mechanical Inspection:
      - 1) Compare equipment nameplate data with Drawings and the Specifications.
      - 2) Inspect physical and mechanical condition.
      - 3) Inspect anchorage, alignment, and grounding.
      - 4) Verify that the unit is clean.
    - b. Electrical and Mechanical Tests:
      - 1) Perform insulation-resistance tests according to IEEE 43.
        - a) Machines Larger Than 200 hp (150 kW): Test duration shall be 10 minutes. Calculate polarization index.
        - b) Machines 200 hp (150 kW) or Less: Test duration shall be one minute. Calculate the dielectric-absorption ratio.
      - 2) Test protective relay devices.
      - 3) Verify phase rotation, phasing, and synchronized operation as required by the application.
      - 4) Functionally test engine shutdown for low oil pressure, overtemperature, overspeed, and other protection features as applicable.
      - 5) Conduct performance test according to NFPA 110.
      - 6) Verify correct functioning of the governor and regulator.
  - 2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here, including, but not limited to, single-step full-load pickup test.
  - 3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.
    - a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
    - b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
    - c. Verify acceptance of charge for each element of the battery after discharge.
    - d. Verify that measurements are within manufacturer's specifications.
  - 4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
  - 5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine generator system before and during system operation. Check for air, exhaust, and fluid leaks.
  - 6. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.

7. Harmonic-Content Tests: Measure harmonic content of output voltage at 25 percent and 100 percent of rated linear load. Verify that harmonic content is within specified limits.
  8. Noise-Level Tests: Measure A-weighted level of noise emanating from engine generator installation, including engine exhaust and cooling-air intake and discharge, at four locations 25 feet (8 m) from edge of the generator enclosure and on the property line, and compare measured levels with required values.
- F. Coordinate tests with tests for transfer switches, and run them concurrently.
  - G. Test instruments shall have been calibrated within the past 12 months, traceable to NIST Calibration Services, and adequate for making positive observation of test results. Make calibration records available for examination on request.
  - H. Leak Test: After installation, charge exhaust, coolant, and fuel systems and test for leaks. Repair leaks and retest until no leaks exist.
  - I. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation for generator and associated equipment.
  - J. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  - K. Remove and replace malfunctioning units and retest as specified above.
  - L. Retest: Correct deficiencies identified by tests and observations, and retest until specified requirements are met.
  - M. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component, indicating satisfactory completion of tests.
  - N. Infrared Scanning: After Substantial Completion, but not more than 60 days after final acceptance, perform an infrared scan of each power wiring termination and each bus connection while running with maximum load. Remove all access panels, so terminations and connections are accessible to portable scanner.
    1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan 11 months after date of Substantial Completion.
    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 terminations and connections checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

### 3.7 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of manufacturer's authorized service representative. Include quarterly preventive maintenance and exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Parts shall be manufacturer's authorized replacement parts and supplies.

### 3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators.

**END OF SECTION 26 32 13.13**

**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 automatic transfer switches rated 600 V and less, and may including the following:
  - 1. Remote annunciator system.

## 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 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, load, and where present, bypass/isolation switch, power sources, annunciators, and control panels; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.

## 1.4 INFORMATIONAL SUBMITTALS

- A. 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. 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.

## 1.6 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 FIELD CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service:
  - 1. Notify Architect or Construction Manager no fewer than seven days in advance of proposed interruption of electric service.

2. Indicate method of providing temporary electrical service.
3. Do not proceed with interruption of electric service without Architect or Construction Manager's written permission.
4. Comply with NFPA 70E.

## 1.8 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: one year 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. 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. Short-time withstand capability for three 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 unless closed transition.
- J. Service-Rated Transfer Switch:
  1. Comply with UL 869A and UL 489.
  2. Provide terminals for bonding the grounding electrode conductor to the grounded service conductor.
  3. In systems with a neutral, the bonding connection shall be on the neutral bus.
  4. Provide removable link for temporary separation of the service and load grounded conductors.
  5. Surge Protective Device: Service rated.
  6. Ground-Fault Protection: Comply with UL 1008 for normal and alternative buses.
  7. Service Disconnecting Means: Externally operated, manual mechanically actuated.
- 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 tape or shrinkable sleeve 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 CONTACTOR-TYPE AUTOMATIC TRANSFER SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. ASCO.
  2. Caterpillar, Inc.; Electric Power Division.
  3. Cummins Power Generation.
  4. GE Zenith Controls.
  5. Generac Power Systems, Inc.
  6. Kohler Power Systems.
  7. MTU Onsite Energy Corporation.
  8. Russelectric, Inc.
- 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
  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: Tin-plated aluminum.
  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.
  2. Failure of power source serving load initiates automatic break-before-make transfer.
- E. 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.
- F. 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.
- G. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.
- H. 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: 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.
- I. Large-Motor-Load Power Transfer:
1. Programmed Neutral Switch Position: Switch operator with programmed neutral position arranged to provide a midpoint between the two working switch positions, with an intentional, time-controlled pause at midpoint during transfer. Adjustable pause from 0.5 to 30 seconds minimum, and factory set for 0.5 second unless otherwise indicated. Time delay occurs for both transfer directions. Disable pause unless both sources are live.

### 2.3 TRANSFER SWITCH ACCESSORIES

- A. Remote Annunciator System:
1. Source Limitations: Same manufacturer as transfer switch in which installed.
  2. Functional Description: Remote annunciator panel shall annunciate conditions for indicated transfer switches.
  3. Annunciation panel display shall include the following indicators:
    - a. Sources available, as defined by actual pickup and dropout settings of transfer-switch controls.
    - b. Switch position.
    - c. Switch in test mode.
    - d. Failure of communication link.
  4. Annunciator Panel: LED-lamp type with audible signal and silencing switch.
    - a. Indicating Lights: Grouped for each transfer switch monitored.
    - b. Label each group, indicating transfer switch it monitors, location of switch, and identity of load it serves.
    - c. Mounting: Flush, modular, steel cabinet unless otherwise indicated.
    - d. Lamp Test: Push-to-test or lamp-test switch on front panel.

### 2.4 SOURCE QUALITY CONTROL

- A. Prepare test and inspection reports.

1. For each of the tests required by UL 1008, performed on representative devices, for emergency and legally required 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 floor by bolting.
  1. Install transfer switches 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. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.
  3. Provide workspace and clearances required by NFPA 70.
- B. Annunciator and Control Panel Mounting: Flush in wall unless otherwise indicated.
- C. Identify components according to Section 26 05 53 "Identification for Electrical Systems."
- D. Set field-adjustable intervals and delays, relays, and engine exerciser clock.
- E. Comply with NECA 1.

#### 3.2 CONNECTIONS

- A. Wiring to Remote Components: Match type and number of cables and conductors to generator sets and any control or communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to
- 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 "Raceways and Boxes for Electrical Systems."
- 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 for Electrical Systems."
- E. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- F. Route and brace conductors according to manufacturer's written instructions. Do not obscure manufacturer's markings and labels.
- G. Brace and support equipment.
- 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. Perform the following tests and inspections:

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) Verify correct functioning of drawout disconnecting contacts, grounding contacts, and interlocks.
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.
  - e. 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.
5. 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.
  - b. Observe reaction of circuit-interrupting devices when simulated fault current is applied at sensors.



- C. Coordinate tests with tests of generator and run them concurrently.
- D. 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.
- E. Transfer switches will be considered defective if they do not pass tests and inspections.
- F. Remove and replace malfunctioning units and retest as specified above.
- G. Prepare test and inspection reports.

#### 3.4 DEMONSTRATION

- A. 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 26 36 00**

**SECTION 26 51 19 - LED INTERIOR LIGHTING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Interior lighting fixtures, lamps, and ballasts.
  - 2. Interior LED fixtures.
  - 3. Exit signs.
  - 4. Lighting fixture supports.

**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 09 23 "Lighting Control Devices" for automatic control of lighting, including occupancy sensors, and multiple lighting relays and contactors.

**1.3 DEFINITIONS**

- A. BF: Ballast Factor.
- B. CCT: Correlated Color Temperature.
- C. CRI: Color-Rendering Index.
- D. LER: Luminaire Efficacy Rating.
- E. Lumen: Measured output of lamp and luminaire, or both.
- F. Luminaire: Complete lighting unit, including lamp(s), LED's, reflectors, ballast and housing.
- G. Fixture: Refer to "Luminaire".
- H. LED: Light-Emitting Diode.
- I. IP: International Protection or Ingress Protection Rating.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
  - 1. Physical description of lighting fixture including dimensions, weights, mounting and attachment details.
  - 2. Energy-efficiency data and efficacy data.
  - 3. Lamp life; rated lamp life (hours).
  - 4. Light output (lumens, CCT, and CRI).
  - 5. Fixture photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing & Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.
    - a. Testing Agency Certified Data: For indicated fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining fixtures shall be certified by manufacturer.
- B. Installation instructions.
- C. Warranty information.

**1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For lighting equipment and fixtures to include in operation, and maintenance manuals.
  - 1. Provide a list of lamp types used on Project; use ANSI and manufacturers' codes.

## 1.6 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910, complying with the IESNA Lighting Measurements Testing & Calculation Guides.
- 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 NFPA 70.

## 1.7 COORDINATION

- A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.
- B. Confirm fixture mounting hardware is appropriate for type of ceiling being installed.

## 1.8 WARRANTY

- A. Warranty for Lighting Fixtures: Manufacturer's standard form in which manufacturer and installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide product indicated on Drawings. Refer to "LIGHTING FIXTURE SCHEDULE".

### 2.2 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

- A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
- B. Metal Parts: Free of burrs and sharp corners and edges.
- C. LED Fixtures: Comply with NEMA 410-2011 "Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts".
- D. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.
- E. LED fixture housing: Extruded-aluminum housings with heat sink.
- F. Metal Finishes: Metal finishes shall be consistent within each fixture and every fixture type. Variations in finishes are not acceptable. Fixture color selections shall be as determined by the Architect, submit choice of colors, and samples when requested
- G. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- H. Diffusers and Globes:
  - 1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
    - a. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.
    - b. UV stabilized.
  - 2. Glass: Annealed crystal glass unless otherwise indicated.

## 2.3 EXIT SIGNS

- A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

## 2.4 LIGHTING FIXTURE SUPPORT COMPONENTS

- A. Comply with Section 26 05 29 "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
- C. Twin-Stem Hangers: Two, 1/2-inch (13-mm) steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).
- E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage (2.68 mm).
- F. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.
- G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Lighting fixtures:
  - 1. Set level, plumb, and square with ceilings and walls unless otherwise indicated.
  - 2. Install lamps in each luminaire.
- B. Supports: Sized and rated for luminaire weight.
- C. Temporary Lighting: If approved by the Architect to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is substantially complete, clean thoroughly and install new lamps (non-LED fixtures only).
- D. Lay-in Ceiling Lighting Fixtures Supports: Use grid as a support element.
  - 1. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each fixture. Locate not more than 6 inches (150 mm) from lighting fixture corners.
  - 2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
  - 3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch (20-mm) metal channels spanning and secured to ceiling tees.
  - 4. Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.
- E. Suspended Lighting Fixture Support:
  - 1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
  - 2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
  - 3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
  - 4. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.
- F. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- G. Luminaire installation shall be per manufacturer's installation requirements.
- H. Comply with NECA 1.

### 3.2 IDENTIFICATION

- A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

### 3.3 FIELD QUALITY CONTROL

- A. Perform the following test and inspections: Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
- B. Luminaire will be considered defective if it does not pass operation tests and inspections.
- C. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

### 3.4 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting aimable luminaires to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Some of this work may be required after dark.
  - 1. Adjust aimable luminaires in the presence of Architect.

**END OF SECTION 26 51 19**

**SECTION 26 56 19 - LED EXTERIOR LIGHTING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Exterior LED luminaires.
- B. Related Section:
  - 1. Section 26 09 23 "Lighting Control Devices" for automatic control of lighting including photoelectric relays, multipole relays and contactors.

**1.3 DEFINITIONS**

- A. CCT: Correlated Color Temperature.
- B. CRI: Color-Rendering Index.
- C. LER: Luminaire Efficacy Rating.
- D. Luminaire: Complete lighting fixture, including ballast housing if provided.
- E. IP: International Protection of Ingress Protection Rating.
- F. Lumen: Measured output of lamp, luminaire or both.
- G. Fixture: Refer to "Luminaire".

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each luminaire and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:
  - 1. Physical description of luminaire, including materials, dimensions, and verification of indicated parameters.
  - 2. Details of attaching luminaires and accessories.
  - 3. Details of installation and construction.
  - 4. Luminaire materials.
  - 5. Photometric data based on laboratory tests of each luminaire type, complete with indicated lamps, ballasts, and accessories.
    - a. Testing Agency Certified Data: For indicated luminaires, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
    - b. Manufacturer Certified Data: Photometric data shall be certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
  - 6. Photoelectric relays.
  - 7. Ballasts/drivers, including energy-efficiency data.
  - 8. Lamps/LED, including life, output, CCT, CRI, lumens, and energy-efficiency data.
  - 9. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.
- B. Shop Drawings: 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 luminaires and poles 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. Glass and Plastic Lenses, Covers, and Other Optical Parts: One for every 20 of each type and rating installed. Furnish at least one of each type.
  - 2. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

## 1.7 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.
- 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 IEEE C2, "National Electrical Safety Code."
- D. Comply with NFPA 70.

## 1.8 WARRANTY

- A. Warranty for Lighting Fixtures: Manufacturer's standard form in which manufacturer and installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide product indicated on Drawings. Refer to "LIGHTING FIXTURE SCHEDULE".

### 2.2 GENERAL REQUIREMENTS FOR LUMINAIRES

- A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.
- B. Lateral Light Distribution Patterns: Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.
- C. Metal Parts: Free of burrs and sharp corners and edges.
- D. Sheet Metal Components: Corrosion-resistant aluminum unless otherwise indicated. Form and support to prevent warping and sagging.
- E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.
- F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.
- G. Exposed Hardware Material: Stainless steel.

- H. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.
- I. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:
  - 1. White Surfaces: 85 percent.
  - 2. Specular Surfaces: 83 percent.
  - 3. Diffusing Specular Surfaces: 75 percent.
- J. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

### PART 3 - EXECUTION

#### 3.1 LUMINAIRE INSTALLATION

- A. Comply with NECA 1.
- B. Fasten luminaire to indicated structural supports.
  - 1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.
- C. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.

#### 3.2 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems".
- B. Steel Conduits: Comply with Section 26 05 33 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- (0.254-mm-) thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

#### 3.3 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Perform the following test and inspections: Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
- C. Illumination Tests:
  - 1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IESNA testing guide(s):
    - a. IESNA LM-5, "Photometric Measurements of Area and Sports Lighting Installations."
- D. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.
- E. Luminaire will be considered defective if it does not pass operation tests and inspections.

#### 3.4 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain luminaires.

### END OF SECTION 26 56 19



**SECTION 27 11 00 - COMMUNICATIONS EQUIPMENT ROOM FITTINGS****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. Telecommunications mounting elements.
  - 2. Backboards.
  - 3. Telecommunications equipment racks and cabinets.
  - 4. Power strips.
  - 5. Grounding.
- B. Related Requirements:
  - 1. Section 27 15 13 "Communications Copper Horizontal Cabling" for copper data cabling associated with system panels and devices.

**1.3 DEFINITIONS**

- A. BICSI: Building Industry Consulting Service International.
- B. LAN: Local area network.
- C. RCDD: Registered Communications Distribution Designer.

**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 equipment racks and cabinets.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
  - 3. Mark the exact component and all included options of cutsheet includes multiple parts or options.

**1.5 QUALITY ASSURANCE**

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
  - 1. Layout Responsibility: Preparation of Shop Drawings shall be under the direct supervision of Commercial Installer, Level 2.
  - 2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.
  - 3. Field Inspector: Currently registered by BICSI as Commercial Installer, Level 2 to perform the on-site inspection.

**PART 2 - PRODUCTS****2.1 BACKBOARDS**

- A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements for plywood backing panels specified in Section 06 10 00 "Rough Carpentry."

## 2.2 EQUIPMENT FRAMES

- A. 4-Post rack: Panduit R4P36 or approved equivalent from Chatsworth or CommScope
- B. Vertical wire manager: Panduit PR2VD08 or approved equivalent from Chatsworth or CommScope
- C. Horizontal wire manager: Panduit NMF2
- D. 4"x12"x1/4" Ground bar: Chatsworth 40153-012 or approved equivalent
- E. General Frame Requirements:
  - 1. Distribution Frames: Freestanding and wall-mounting, modular-steel units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
  - 2. Module Dimension: Width compatible with EIA 310-D standard, 19-inch (480-mm) panel mounting.
  - 3. Finish: Manufacturer's standard, baked-polyester powder coat.
- F. 4-Post Floor-Mounted Racks: Modular-type, steel construction.
  - 1. Vertical and horizontal cable management channels, top and bottom cable troughs, grounding lug.
  - 2. Baked-polyester powder coat finish.
  - 3. 36" Deep
  - 4. 2,000 lbs. static load capacity
- G. Cable Management for Equipment Frames:
  - 1. Metal, with integral wire retaining fingers.
  - 2. Baked-polyester powder coat finish.
  - 3. Vertical cable management panels shall have front and rear channels, with covers.
  - 4. Provide horizontal crossover cable manager at the top of each relay rack, with a minimum height of two rack units each.

## 2.3 GROUNDING

- A. Comply with requirements in Section 27 05 26 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.
- B. Telecommunications Main Bus Bar:
  - 1. Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
  - 2. Ground Bus Bar: Copper, minimum 1/4 inch thick by 4 inches wide (6 mm thick by 100 mm wide) with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart.
  - 3. Stand-Off Insulators: Comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.
- C. Comply with TIA-607-B.

## 2.4 LABELING

- A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Comply with BICSI TDMM for layout and installation of communications equipment rooms.
- C. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

- D. Coordinate layout and installation of communications equipment with Owner's telecommunications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.
  - 1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
  - 2. Record agreements reached in meetings and distribute them to other participants.
  - 3. Adjust arrangements and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.
  - 4. Adjust arrangements and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in the equipment room.
- E. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

### 3.2 FIRESTOPPING

- A. Comply with requirements in Section 07 84 13 "Penetration Firestopping."
- B. Comply with TIA-569-D, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

### 3.3 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with TIA-607-B.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.
  - 1. Bond the shield of shielded cable to the grounding bus bar in communications rooms and spaces.

### 3.4 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements in Section 26 05 53 "Identification for Electrical Systems."
- B. Comply with requirements in Section 09 91 23 "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- C. Paint and label colors for equipment identification shall comply with TIA-606-B
- D. Labels shall be preprinted or computer-printed type.

## **END OF SECTION 27 11 00**

**SECTION 27 15 13 - COMMUNICATIONS COPPER HORIZONTAL CABLING****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. Category 6a twisted pair cable.
  - 2. Twisted pair cable hardware, including plugs and jacks.
  - 3. Cable management system.
  - 4. Cabling identification products.
  - 5. Grounding provisions for twisted pair cable.

**1.3 DEFINITIONS**

- A. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- B. EMI: Electromagnetic interference.
- C. FTP: Shielded twisted pair.
- D. F/FTP: Overall foil screened cable with foil screened twisted pair.
- E. F/UTP: Overall foil screened cable with unscreened twisted pair.
- F. IDC: Insulation displacement connector.
- G. LAN: Local area network.
- H. Jack: Also commonly called an "outlet," it is the fixed, female connector.
- I. Plug: Also commonly called a "connector," it is the removable, male telecommunications connector.
- J. RCDD: Registered Communications Distribution Designer.
- K. Screen: A metallic layer, either a foil or braid, placed around a pair or group of conductors.
- L. Shield: A metallic layer, either a foil or braid, placed around a pair or group of conductors.
- M. S/FTP: Overall braid screened cable with foil screened twisted pair.
- N. S/UTP: Overall braid screened cable with unscreened twisted pairs.
- O. UTP: Unscreened (unshielded) twisted pair.

**1.4 COPPER HORIZONTAL CABLING DESCRIPTION**

- A. Horizontal cable cabling system shall provide interconnections between Distributor A, Distributor B, or Distributor C, and the equipment outlet, otherwise known as "Cabling Subsystem 1," in the telecommunications cabling system structure. Cabling system consists of horizontal cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for horizontal-to-horizontal cross-connection.
  - 1. TIA-568-C.1 requires that a minimum of two equipment outlets be installed for each work area.
  - 2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications equipment outlet.
  - 3. Bridged taps and splices shall not be installed in the horizontal cabling.
- B. A work area is approximately 100 sq. ft. (9.3 sq. m), and includes the components that extend from the equipment outlets to the station equipment.
- C. The maximum allowable horizontal cable length is 295 feet (90 m). This maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) to the workstation equipment or in the horizontal cross-connect.

## 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product. Mark the exact component and all included options of cutsheet includes multiple parts or options.
- B. Twisted pair cable testing plan.

## 1.6 CLOSEOUT SUBMITTALS

- A. Floor plans in .PDF format showing the outlet locations and cable numbers at least 1 month prior to substantial completion.

## 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
  - 1. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
  - 1. Test each pair of twisted pair cable for open and short circuits.

## 1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

## 1.10 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.
- B. Telecommunications Pathways and Spaces: Comply with TIA-569-D.
- C. Grounding: Comply with TIA-607-B.

### 2.2 GENERAL CABLE CHARACTERISTICS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with the applicable standard and NFPA 70 for the following types:
  - 1. Communications, Plenum Rated: Type CMP complying with UL 1685 or Type CMP in listed plenum communications raceway.
  - 2. Communications, Plenum Rated: Type CM, Type CMG, Type CMP, Type CMR, or Type CMX in metallic conduit installed according to NFPA 70, Article 300.22, "Wiring in Ducts, Plenums, and Other Air-Handling Spaces."
- B. RoHS compliant.

## 2.3 CATEGORY 6a TWISTED PAIR CABLE

- A. Description: Four-pair, balanced-twisted pair cable, certified to meet transmission characteristics of Category 6a cable at frequencies up to 500MHz.
- B. Panduit PUP6XHD04BU-G or equivalent by CommScope or Superior Essex
- C. Standard: Comply with TIA-568-C.2 for Category 6a cables.
- D. Conductors: 100-ohm, 23 AWG solid copper.
- E. Shielding/Screening: Unshielded twisted pairs (UTP).
- F. Cable Rating: Plenum.
- G. Jacket: Blue thermoplastic.

## 2.4 TWISTED PAIR CABLE HARDWARE

- A. Description: Hardware designed to connect, splice, and terminate twisted pair copper communications cable.
- B. General Requirements for Twisted Pair Cable Hardware:
  - 1. Comply with the performance requirements Category 6a.
  - 2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.
  - 3. Cables shall be terminated with connecting hardware of same category or higher.
- C. Source Limitations: Obtain twisted pair cable hardware from single source from single manufacturer.
- D. Angled Patch Panel: Modular panels housing numbered jack units with IDC-type connectors at each jack location for permanent termination of pair groups of installed cables.
  - 1. Panduit DPA48X88TGY or approved equivalent by CommScope or Leviton
  - 2. Features:
    - a. Universal T568A and T568B wiring labels.
    - b. Labeling areas adjacent to conductors.
    - c. Replaceable connectors.
    - d. 24 or 48 ports.
  - 3. Construction: 16-gauge steel and mountable on 19-inch (483 mm) equipment racks.
- E. Patch Cords: Provide (2) for each terminated cable plus 10%. Factory-made, four-pair cables: (50%) in 5-foot and (50%) in 10-foot lengths; terminated with an eight-position modular plug at each end. Confirm lengths and colors with owner before ordering.
  - 1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure performance. Patch cords shall have latch guards to protect against snagging.
  - 2. Patch cords shall have color-coded boots for circuit identification.
- F. Plugs and Plug Assemblies:
  - 1. Male; eight position; color-coded modular telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
  - 2. Standard: Comply with TIA-568-C.2.
  - 3. Marked to indicate transmission performance.
- G. Jacks and Jack Assemblies:
  - 1. Panduit NK6X88MBU or approved equivalent by CommScope or Leviton
  - 2. Female; eight position; modular; fixed telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
  - 3. Designed to snap-in to a patch panel or faceplate.
  - 4. Standard: Comply with TIA-568-C.2.
  - 5. Marked to indicate transmission performance.
- H. Faceplate:
  - 1. Four port, vertical single gang faceplates designed to mount to single gang wall boxes.
  - 2. Plastic Faceplate: High-impact plastic. Coordinate color with Section 26 27 26 "Wiring Devices."
  - 3. Metal Faceplate: Stainless steel, complying with requirements in Section 26 27 26 "Wiring Devices."
    - a. Flush mounting jacks, positioning the cord at a 45-degree angle.

## 2.5 IDENTIFICATION PRODUCTS

- A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

## 2.6 GROUNDING

- A. Comply with requirements in Section 27 05 26 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.
- B. Comply with TIA-607-B.

## 2.7 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test cables on reels according to TIA-568-C.1.
- C. Factory test twisted pair cables according to TIA-568-C.2.
- D. Cable will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

## PART 3 - EXECUTION

### 3.1 WIRING METHODS

- A. Wiring Method: Install cables in raceways and cable trays, except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, attics, and gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables, except in unfinished spaces.
  - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools. Install conductors parallel with or at right angles to sides and back of enclosure.

### 3.2 INSTALLATION OF PATHWAYS

- A. Comply with requirements for demarcation point, cabinets, and racks specified in Section 27 11 00 "Communications Equipment Room Fittings."
- B. Drawings indicate general arrangement of pathways and fittings.

### 3.3 INSTALLATION OF TWISTED-PAIR HORIZONTAL CABLES

- A. Comply with NECA 1 and NECA/BICSI 568.
- B. General Requirements for Cabling:
  - 1. Comply with TIA-568-C.0, TIA-568-C.1, and TIA-568-C.2.
  - 2. Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section.
  - 3. Install 110-style IDC termination hardware unless otherwise indicated.
  - 4. Do not untwist twisted pair cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.
  - 5. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
  - 6. MUTOA shall not be used as a cross-connect point.
  - 7. Consolidation points may be used only for making a direct connection to equipment outlets:
    - a. Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to workstation equipment.

- b. Locate consolidation points for twisted-pair cables at least 49 feet (15 m) from communications equipment room.
- 8. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
- 9. Install lacing bars to restrain cables, prevent straining connections, and prevent bending cables to smaller radii than minimums recommended by manufacturer.
- 10. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section. Use lacing bars and distribution spools.
- 11. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation, and replace it with new cable.
- 12. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
- 13. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.
- 14. Pulling Cable: Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems," "Pulling and Installing Cable" Section. Monitor cable pull tensions.
- C. Open-Cable Installation:
  - 1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
  - 2. Suspend twisted pair cabling, not in a wireway or pathway, a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 60 inches apart.
  - 3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
- D. Group connecting hardware for cables into separate logical fields.
- E. Separation from EMI Sources:
  - 1. Comply with recommendations from BICSI's "Telecommunications Distribution Methods Manual" and TIA-569-D for separating unshielded copper communication cable from potential EMI sources, including electrical power lines and equipment.
  - 2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
    - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
    - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
    - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (600 mm).
  - 3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
    - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
    - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
    - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).
  - 4. Separation between communications cables in grounded metallic raceways, power lines, and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
    - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
    - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
    - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
  - 5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
  - 6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

### 3.4 FIRESTOPPING

- A. Comply with requirements in Section 07 84 13 "Penetration Firestopping."
- B. Comply with TIA-569-D, Annex A, "Firestopping."



- C. Comply with "Firestopping Systems" Article in BISCIS' "Telecommunications Distribution Methods Manual."

### 3.5 GROUNDING

- A. Install grounding according to the "Grounding, Bonding, and Electrical Protection" chapter in BICSI's "Telecommunications Distribution Methods Manual."
- B. Comply with TIA-607-B and NECA/BICSI-607.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall, allowing at least a 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar to suitable electrical building ground, using a minimum No. 4 AWG grounding electrode conductor.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than a No. 6 AWG equipment grounding conductor.

### 3.6 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA-606-B.
- B. Paint and label colors for equipment identification shall comply with TIA-606-B
- C. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- D. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.
- E. Cable and Wire Identification:
  - 1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
  - 2. Each wire connected to building-mounted devices is not required to be numbered at the device if wire color is consistent with associated wire connected and numbered within panel or cabinet.
  - 3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).
  - 4. Label each terminal strip, and screw terminal in each cabinet, rack, or panel.
    - a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group, extended from a panel or cabinet to a building-mounted device, with the name and number of a particular device.
    - b. Label each unit and field within distribution racks and frames.
  - 5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and -connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
- F. Labels shall be preprinted or computer-printed type, with a printing area and font color that contrast with cable jacket color but still comply with TIA-606-B requirements for the following:
  - 1. Cables use flexible vinyl or polyester that flexes as cables are bent.

### 3.7 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.
- E. Tests and Inspections:
  - 1. Visually inspect twisted pair cabling jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA-568-C.1.

2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Test twisted pair cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
  - a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
- F. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similarly to Table 10.1 in BICSI's "Telecommunications Distribution Methods Manual," or shall be transferred from the instrument to the computer, saved as text files, printed, and submitted.
- G. Remove and replace cabling where test results indicate that they do not comply with specified requirements.
- H. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- I. Prepare test and inspection reports.

**END OF SECTION 27 15 13**

**SECTION 28 46 21.11 - ADDRESSABLE FIRE-ALARM 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. Fire-alarm control unit.
  - 2. Manual fire-alarm boxes.
  - 3. System smoke detectors.
  - 4. Air-sampling smoke detectors.
  - 5. Non-system smoke detectors.
  - 6. Heat detectors.
  - 7. Notification appliances.
  - 8. Firefighters' two-way telephone communication service.
  - 9. Firefighters' smoke-control station.
  - 10. Magnetic door holders.
  - 11. Remote annunciator.
  - 12. Graphic annunciator.
  - 13. Addressable interface device.
  - 14. Digital alarm communicator transmitter.
  - 15. Radio alarm transmitter.
  - 16. Network communications.
- B. Related Requirements:
  - 1. Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for cables and conductors for fire-alarm systems.

**1.3 DEFINITIONS**

- A. EMT: Electrical Metallic Tubing.
- B. FACP: Fire Alarm Control Panel.
- C. NICET: National Institute for Certification in Engineering Technologies.
- D. VESDA: Very Early Smoke-Detection Apparatus.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product, including furnished options and accessories.
  - 1. Include construction details, material descriptions, dimensions, profiles, and finishes.
  - 2. Include rated capacities, operating characteristics, and electrical characteristics.
- B. Shop Drawings: For fire-alarm system.
  - 1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
  - 2. Include plans, elevations, sections, details, and attachments to other work.
  - 3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
  - 4. Detail assembly and support requirements.
  - 5. Include voltage drop calculations for notification-appliance circuits.
  - 6. Include battery-size calculations.

7. Include input/output matrix.
  8. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
  9. Include performance parameters and installation details for each detector.
  10. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
  11. Provide program report showing that air-sampling detector pipe layout balances pneumatically within the airflow range of the air-sampling detector.
  12. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale; coordinate location of duct smoke detectors and access to them.
    - a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
    - b. Show field wiring required for HVAC unit shutdown on alarm.
    - c. Show field wiring and equipment required for HVAC unit shutdown on alarm and override by firefighters' control system.
    - d. Show field wiring and equipment required for HVAC unit shutdown on alarm and override by firefighters' smoke-evacuation system.
    - e. Locate detectors according to manufacturer's written recommendations.
    - f. Show air-sampling detector pipe routing.
  13. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
  14. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.
- C. General Submittal Requirements:
1. Submittals shall be approved by Authorities Having Jurisdiction prior to submitting them to Engineer.
  2. Shop Drawings shall be prepared by persons with the following qualifications:
    - a. Trained and certified by manufacturer in fire-alarm system design.
    - b. NICET-certified, fire-alarm technician; Level IV minimum.
    - c. Licensed or certified by authorities having jurisdiction where required.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

## 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.
1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following and deliver copies to authorities having jurisdiction when required:
    - a. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
    - b. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
    - c. Complete wiring diagrams showing connections between all devices and equipment. Each conductor shall be numbered at every junction point with indication of origination and termination points.
    - d. Riser diagram.
    - e. Device addresses.
    - f. Air-sampling system sample port locations and modeling program report showing layout meets performance criteria.
    - g. Record copy of site-specific software.
    - h. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:

- 1) Equipment tested.
- 2) Frequency of testing of installed components.
- 3) Frequency of inspection of installed components.
- 4) Requirements and recommendations related to results of maintenance.
- 5) Manufacturer's user training manuals.
- i. Manufacturer's required maintenance related to system warranty requirements.
- j. Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit.

#### 1.7 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. Strobe Units: One of each type installed.
  2. Smoke Detectors: One of each type installed.
  3. Detector Bases: One of each type installed.
  4. Keys and Tools: One extra set for access to locked or tamperproof components.
  5. Audible and Visual Notification Appliances: One of each type installed.
  6. Fuses: Two of each type installed in the system. Provide in a box or cabinet with compartments marked with fuse types and sizes.
  7. Filters for Air-Sampling Detectors: Quantity equal to two percent of amount of each type installed, but no fewer than one unit of each type.
  8. Air-Sampling Fan: Quantity equal to one for every five detectors, but no fewer than one unit of each type.

#### 1.8 QUALITY ASSURANCE

- A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
- B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level III technician.
- C. NFPA Certification: Obtain certification according to NFPA 72 by an NRTL (nationally recognized testing laboratory).

#### 1.9 PROJECT CONDITIONS

- A. Where project scope includes reuse of or interface with existing equipment or components, contractor shall perform a full test of the existing system prior to starting work. Document any equipment or components not functioning as designed.
- B. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:
1. Notify Architect or Construction Manager no fewer than seven days in advance of proposed interruption of Fire Alarm service.
  2. Indicate method of providing temporary Fire Notification service.
  3. Do not proceed with interruption of Fire Alarm service without Architect or Construction Manager's written permission.
- C. Use of Devices during Construction: Protect devices during construction unless devices are placed in service to protect the facility during construction.

#### 1.10 SEQUENCING AND SCHEDULING

- A. Existing Fire-Alarm Equipment: Maintain existing equipment fully operational until new equipment has been tested and accepted. As new equipment is installed, label it "NOT IN SERVICE" until it is accepted. Remove labels from new equipment when put into service, and label existing fire-alarm equipment "NOT IN SERVICE" until removed from the building.

- B. Equipment Removal: After acceptance of new fire-alarm system, remove existing disconnected fire-alarm equipment and wiring.

#### 1.11 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Extent: All equipment and components not covered in the Maintenance Service Agreement.
  - 2. Warranty Period: Five years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 SYSTEM DESCRIPTION

- A. Source Limitations for Fire-Alarm System and Components: Components shall be compatible with, and operate as an extension of, existing system. Provide system manufacturer's certification that all components provided have been tested as, and will operate as, a system.
- B. The design intent is to re-use the existing fire alarm control panel if possible and relocate to the new location as depicted on the drawing. This contractor shall verify existing conditions prior to bid. Provide a new fire alarm system if required.
- C. Noncoded, UL-certified addressable system, with multiplexed signal transmission and horn/strobe evacuation.
- D. Automatic sensitivity control of certain smoke detectors.
- E. All components provided shall be listed for use with the selected system.
- 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 SYSTEMS OPERATIONAL DESCRIPTION

- A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:
  - 1. Manual stations.
  - 2. Heat detectors.
  - 3. Smoke detectors.
  - 4. Duct smoke detectors.
  - 5. Air-sampling smoke-detection system (VESDA).
  - 6. Carbon monoxide detector system.
  - 7. Combustible gas detector system.
  - 8. Automatic sprinkler system water flow.
  - 9. Preaction system.
  - 10. Fire-extinguishing system operation.
  - 11. Fire standpipe system.
  - 12. Dry system pressure flow switch.
  - 13. Fire pump running.
- B. Fire Alarm signal may initiate one or more of the following actions: (Refer to Drawings for specific Sequence of Operations Matrix)
  - 1. Continuously operate all visual and audible alarm notification appliances.
  - 2. Identify alarm and specific initiating device at fire-alarm control unit and remote annunciators.
  - 3. Transmit an alarm signal to the remote alarm receiving station.
  - 4. Unlock electric door locks in designated and required egress paths.
  - 5. Release fire and smoke doors held open by magnetic door holders.
  - 6. Activate voice/alarm communication system.
  - 7. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
  - 8. Activate smoke-control system (smoke management) at firefighters' smoke-control system panel.
  - 9. Close smoke dampers in air ducts of designated air-conditioning duct systems.

10. Activate preaction system.
  11. Recall elevators to primary or alternate recall floors.
  12. Activate elevator power shunt trip.
  13. Activate emergency shutoffs for nonessential gas and fuel supplies.
  14. Record events in the system memory.
  15. Indicate device in alarm on the graphic annunciator.
- C. Supervisory signal initiation may be by one or more of the following devices and actions: (Refer to Drawings for specific Sequence of Operations Matrix)
1. Valve supervisory switch.
  2. High- or low-air-pressure switch of a dry-pipe or preaction sprinkler system.
  3. Alert and Action signals of air-sampling detector system.
  4. Elevator shunt-trip supervision.
  5. Independent fire-detection and -suppression systems.
  6. User disabling of zones or individual devices.
  7. Loss of communication with any panel on the network.
- D. System trouble signal initiation may be by one or more of the following devices and actions: (Refer to Drawings for specific Sequence of Operations Matrix)
1. Open circuits, shorts, and grounds in designated circuits.
  2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
  3. Loss of communication with any addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
  4. Loss of primary power at fire-alarm control unit.
  5. Ground or a single break in internal circuits of fire-alarm control unit.
  6. Abnormal ac voltage at fire-alarm control unit.
  7. Break in standby battery circuitry.
  8. Failure of battery charging.
  9. Abnormal position of any switch at fire-alarm control unit or annunciator.
  10. Voice signal amplifier failure.
  11. Hose cabinet door open.
- E. System Supervisory Signal Actions:
1. Initiate notification appliances.
  2. Identify specific device initiating the event at fire-alarm control unit and remote annunciators.
  3. After a time delay of 200 seconds, transmit a trouble or supervisory signal to the remote alarm receiving station.
  4. Transmit system status to building management system.
  5. Display system status on graphic annunciator.

### 2.3 FIRE-ALARM CONTROL UNIT – if new FACP will be provided

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Bosch Security Systems, Inc.
  2. Fire-Lite Alarms, Inc.; a Honeywell International company.
  3. Gamewell - FCI by Honeywell.
  4. GE UTC Fire & Security; A United Technologies Company.
  5. Notifier.
  6. Siemens Industry, Inc.; Fire Safety Division.
  7. Silent Knight.
- B. General Requirements for Fire-Alarm Control Unit:
1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864.
    - a. System software and programs shall be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining the information through failure of primary and secondary power supplies.
    - b. Include a real-time clock for time annotation of events on the event recorder and printer.

- c. Provide communication between the FACP and remote circuit interface panels, annunciators, and displays.
- d. The FACP shall be listed for connection to a central-station signaling system service.
- e. Provide nonvolatile memory for system database, logic, and operating system and event history. The system shall require no manual input to initialize in the event of a complete power down condition. The FACP shall provide a minimum 500-event history log.
2. Addressable Initiation Device Circuits: The FACP shall indicate which communication zones have been silenced and shall provide selective silencing of alarm notification appliance by building communication zone.
3. Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: The FACP shall be listed for releasing service.
- C. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
  1. Annunciator and Display: Liquid-crystal type, 80 characters, minimum.
  2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.
- D. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:
  1. Pathway Class Designations: NFPA 72, Class B
  2. Pathway Survivability: Level 1.
  3. Install no more than 256 addressable devices on each signaling-line circuit.
  4. Serial Interfaces:
    - a. One dedicated RS 485 port for remote station operation using point ID DACT.
    - b. One RS 485 port for remote annunciators, Ethernet module, or multi-interface module (printer port).
    - c. One USB port for system configuration and downloads.
    - d. One RS 232 port for VESDA HLI connection.
    - e. One RS 232 port for voice evacuation interface.
- E. Notification-Appliance Circuit:
  1. Audible appliances shall sound in a three-pulse temporal pattern, as defined in NFPA 72.
  2. Where notification appliances provide signals to sleeping areas, the alarm signal shall be a 520-Hz square wave with an intensity 15 dB above the average ambient sound level or 5 dB above the maximum sound level, or at least 75 dBA, whichever is greater, measured at the pillow.
  3. Visual alarm appliances shall flash in synchronization where multiple appliances are in the same field of view, as defined in NFPA 72.
- F. Elevator Recall:
  1. Elevator recall shall be initiated only by one of the following alarm-initiating devices:
    - a. Elevator lobby detectors except the lobby detector on the designated floor.
    - b. Smoke detector in elevator machine room.
    - c. Smoke detectors in elevator hoistway.
  2. Elevator controller shall be programmed to move the cars to the alternate recall floor if lobby detectors located on the designated recall floors are activated.
  3. Water-flow alarm connected to sprinkler in an elevator shaft and elevator machine room shall shut down elevators associated with the location without time delay.
    - a. Water-flow switch associated with the sprinkler in the elevator pit may have a delay to allow elevators to move to the designated floor.
- G. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke-barrier walls shall be connected to fire-alarm system.
- H. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.
- I. Voice/Alarm Signaling Service: Central emergency communication system with redundant microphones, preamplifiers, amplifiers, and tone generators provided as a special module that is part of fire-alarm control unit.
  1. Indicate number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of announcements by use of the central-control microphone. Amplifiers shall comply with UL 1711.



- a. Allow the application of, and evacuation signal to, indicated number of zones and, at the same time, allow voice paging to the other zones selectively or in any combination.
  - b. Programmable tone and message sequence selection.
  - c. Standard digitally recorded messages for "Evacuation" and "All Clear."
  - d. Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification-appliance circuits of fire-alarm control unit.
2. Status Annunciator: Indicate the status of various voice/alarm speaker zones and the status of firefighters' two-way telephone communication zones.
  3. Preamplifiers, amplifiers, and tone generators shall automatically transfer to backup units, on primary equipment failure.
- J. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory signals, and any supervisory, digital alarm communicator transmitters or digital alarm radio transmitters shall be powered by 24-V dc source.
1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.
- K. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.
1. Batteries: Sealed lead calcium.
- L. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

## 2.4 PREACTION SYSTEM

- A. Initiate Presignal Alarm: This function shall cause an audible and visual alarm and indication to be provided at the FACP. Activation of an initiation device connected as part of a preaction system shall be annunciated at the FACP only, without activation of the general evacuation alarm.

## 2.5 MANUAL FIRE-ALARM BOXES

- A. Manufacturers: Subject to compliance with requirements to match existing or provide products by one of the following:
1. Federal Signal Corporation.
  2. Fire-Lite Alarms, Inc.; a Honeywell International company.
  3. Gamewell - FCI by Honeywell.
  4. GE UTC Fire & Security; A United Technologies Company.
  5. Notifier.
  6. Siemens Industry, Inc.; Fire Safety Division.
  7. Silent Knight.
- B. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
1. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
  2. Station Reset: Key- or wrench-operated switch.

## 2.6 SYSTEM SMOKE DETECTORS

- A. Manufacturers: Subject to compliance with requirements to match existing or provide products by one of the following:
1. Fenwal Protection Systems; A UTC Fire & Security Company.
  2. Fire-Lite Alarms, Inc.; a Honeywell International company.

3. Gamewell - FCI by Honeywell.
  4. GE UTC Fire & Security; A United Technologies Company.
  5. Harrington Signal, Inc.
  6. Notifier.
  7. Siemens Industry, Inc.; Fire Safety Division.
  8. Silent Knight.
- B. General Requirements for System Smoke Detectors:
1. Comply with UL 268; operating at 24-V dc, nominal.
  2. Detectors shall be four-wire type.
  3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
  4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
  5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
  6. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
  7. Remote Control: Unless otherwise indicated, detectors shall be digital-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition.
    - a. Multiple levels of detection sensitivity for each sensor.
    - b. Sensitivity levels based on time of day.
- C. Photoelectric Smoke Detectors:
1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
  2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
    - a. Primary status.
    - b. Device type.
    - c. Present average value.
    - d. Present sensitivity selected.
    - e. Sensor range (normal, dirty, etc.).
- D. Duct Smoke Detectors: Photoelectric type complying with UL 268A.
1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
  2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
    - a. Primary status.
    - b. Device type.
    - c. Present average value.
    - d. Present sensitivity selected.
    - e. Sensor range (normal, dirty, etc.).
  3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector for smoke detection in HVAC system ducts.
  4. Each sensor shall have multiple levels of detection sensitivity.
  5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
  6. Relay Fan Shutdown: Fully programmable relay rated to interrupt fan motor-control circuit.

## 2.7 CARBON MONOXIDE DETECTORS

- A. General: Carbon monoxide detector listed for connection to fire-alarm system.
1. Mounting: Adapter plate for outlet box mounting.
  2. Testable by introducing test carbon monoxide into the sensing cell.
  3. Detector shall provide alarm contacts and trouble contacts.
  4. Detector shall send trouble alarm when nearing end-of-life, power supply problems, or internal faults.

5. Comply with UL 2075.
6. Locate, mount, and wire according to manufacturer's written instructions.
7. Provide means for addressable connection to fire-alarm system.
8. Test button simulates an alarm condition.

## 2.8 HEAT DETECTORS

- A. Manufacturers: Subject to compliance with requirements to match existing or provide products by one of the following:
1. Fire-Lite Alarms, Inc.; a Honeywell International company.
  2. Gamewell - FCI by Honeywell.
  3. GE UTC Fire & Security; A United Technologies Company.
  4. Harrington Signal, Inc.
  5. Notifier.
  6. Siemens Industry, Inc.; Fire Safety Division.
  7. Silent Knight.
- B. General Requirements for Heat Detectors: Comply with UL 521.
1. Temperature sensors shall test for and communicate the sensitivity range of the device.
- C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 135 deg F (88 deg C).
1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
  2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

## 2.9 NOTIFICATION APPLIANCES

- A. Manufacturers: Subject to compliance with requirements to match existing or provide products by one of the following:
1. Federal Signal Corporation.
  2. GE UTC Fire & Security; A United Technologies Company.
  3. Harrington Signal, Inc.
  4. Siemens Industry, Inc.; Fire Safety Division.
- B. General Requirements for Notification Appliances: Connected to notification-appliance signal circuits, zoned as indicated, equipped for mounting as indicated, and with screw terminals for system connections.
1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.
- C. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet (3 m) from the horn, using the coded signal prescribed in UL 464 test protocol.
- D. Visible Notification Appliances: Xenon strobe lights complying with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on the lens.
1. Rated Light Output:
    - a. 15/30/75/110 cd, selectable in the field, adjusted per space requirements.
  2. Mounting: Wall mounted unless otherwise indicated.
  3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
  4. Flashing shall be in a temporal pattern, synchronized with other units.
  5. Strobe Leads: Factory connected to screw terminals.
  6. Mounting Faceplate: Factory finished, red.
- E. Voice/Tone Notification Appliances:
1. Comply with UL 1480.
  2. Speakers for Voice Notification: Locate speakers for voice notification to provide the intelligibility requirements of the "Notification Appliances" and "Emergency Communications Systems" chapters in NFPA 72.
  3. High-Range Units: Rated 2 to 15 W or Low-Range Units: Rated 1 to 2 W, as required.

4. Mounting: Flush in ceilings or semi-recessed for wall-mount applications.
5. Matching Transformers: Tap range matched to acoustical environment of speaker location.

## 2.10 EMERGENCY RESPONDER RADIO REPEATER SYSTEM

- A. Provide an in-building radiating cable system or internal antenna system in the Main Building Complex using an FCC approved Output Level Control (OLC) Type bi-directional antenna/UHF amplifiers manufactured by Radio Solutions, Inc. as needed to encompass the Local Fire Department radio frequencies.
- B. The system shall be configured to maintain minimum radio signal strengths of -95 dBm uplink and -100dBm downlink available in 99% in critical areas (i.e. emergency command center, fire pump room, exit stairs, exit passageways, elevator lobbies, standpipe cabinets, sprinkler sectional valve locations and similar critical areas) and 95% in all other areas of each floor of the building transmitted and received by the Local Fire Department's Communications Division.
- C. Installation and location of roof-mounted or feed antenna shall be coordinated directly with the Local Fire Department and the Local Emergency Communications Division.
- D. Provisions shall be made for extension of in building (radiating) coverage antennas to be provided as required for the tenant improvements.
- E. The installation and testing of the system shall be in accordance with the Local Fire Department requirements.
- F. The system shall be capable of operating on an independent battery/secondary power source for a period of at least 12 hours without external power input.
- G. Each bi-directional amplifier shall be powered by its own twenty ampere circuit. Amplifier shall be installed in a 2-hour fire rated enclosure. Riser cable shall also be installed in a 2-hour fire rated enclosure.
- H. The cabinet shall be a NEMA 4 painted steel cabinet. The color will be red and bear the lettering as follows: "BROOKHAVEN FIRE DEPT. RADIO" in bright yellow lettering. The maintenance vendor and telephone number will be marked on the cabinet. The cabinet will have a locking mechanism to keep the unit(s) secure.
- I. Each amplifier unit will have a monitoring system that monitors amplifier operation and primary power. A failure will activate a Xenon strobe light and associated audible device. The audible signal may be silenced but the strobe light must remain illuminated until the fault condition has been corrected. The strobe light will be located in a public space authorized by the Local Fire Department Communications Officer. A sign will be located at the strobe light with the name and telephone number of the equipment maintenance contractor. The Fire Department is to be notified of any failures that extend past the two hour time limit. The Fire Alarm contractor shall be responsible for furnishing, installing, and coordinating the above mentioned equipment.
- J. The building's fire alarm system shall monitor the BDA system for malfunctions and shall include the following: Circuit Integrity, Antenna Malfunction and Signal Booster Failure, Low Battery Capacity (alarming at 70% of battery capacity), Loss of Normal AC Power, and Failure of Battery Charger.
- K. A dedicated remote monitoring panel shall be provided within the fire command center to annunciate the status of all signal booster locations. The monitoring panel shall provide visual and labeled indication of the following for each signal booster:
  1. Normal AC power
  2. Signal Booster trouble
  3. Loss of normal AC power
  4. Battery Charger failure
  5. Low Battery capacity
- L. A donor antenna must maintain isolation from the distributed antenna system and shall be a minimum of 15db above the signal booster gain under all operating conditions.

## 2.11 REMOTE ANNUNCIATOR

- A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.

1. Mounting: Semi-Flush cabinet, NEMA 250, Type 1.
- B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

## 2.12 ADDRESSABLE INTERFACE DEVICE

- A. General:
  1. Include address-setting means on the module.
  2. Store an internal identifying code for control panel use to identify the module type.
  3. Listed for controlling HVAC fan motor controllers.
- B. Monitor Module: Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts.
- C. Integral Relay: Capable of providing a direct signal to elevator controller to initiate elevator recall or to circuit-breaker shunt trip for power shutdown.
  1. Allow the control panel to switch the relay contacts on command.
  2. Have a minimum of two normally open and two normally closed contacts available for field wiring.
- D. Control Module:
  1. Operate notification devices.
  2. Operate solenoids for use in sprinkler service.

## 2.13 DIGITAL ALARM COMMUNICATOR TRANSMITTER

- A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632.
- B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically dial via cellular transmission or VOIP line. DACT shall dial a preset number for a designated remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.
- C. Local functions and display at the digital alarm communicator transmitter shall include the following:
  1. Verification that both telephone lines are available.
  2. Programming device.
  3. LED display.
  4. Manual test report function and manual transmission clear indication.
  5. Communications failure with the central station or fire-alarm control unit.
- D. Digital data transmission shall include the following:
  1. Address of the alarm-initiating device.
  2. Address of the supervisory signal.
  3. Address of the trouble-initiating device.
  4. Loss of ac supply.
  5. Loss of power.
  6. Low battery.
  7. Abnormal test signal.
  8. Communication bus failure.
- E. Secondary Power: Integral rechargeable battery and automatic charger.
- F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

## 2.14 NETWORK COMMUNICATIONS

- A. Provide network communications for fire-alarm system according to fire-alarm manufacturer's written requirements.

- B. Provide network communications pathway per manufacturer's written requirements and requirements in NFPA 72 and NFPA 70.
- C. Provide integration gateway using BACnet or Modbus for connection to building automation system.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.
  - 1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.
- B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."
  - 1. Devices placed in service before all other trades have completed cleanup shall be replaced.
  - 2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.
- B. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.
  - 1. Connect new equipment to existing control panel in existing part of the building.
  - 2. Connect new equipment to existing monitoring equipment at the supervising station.
  - 3. Expand, modify, and supplement existing monitoring equipment as necessary to extend existing functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.
- C. Install wall-mounted equipment, with tops of cabinets not more than 78 inches (1980 mm) above the finished floor.
- D. Manual Fire-Alarm Boxes:
  - 1. Install manual fire-alarm box in the normal path of egress within 60 inches (1520 mm) of the exit doorway.
  - 2. Mount manual fire-alarm box on a background of a contrasting color.
  - 3. The operable part of manual fire-alarm box shall be between 42 inches (1060 mm) and 48 inches (1220 mm) above floor level. All devices shall be mounted at the same height unless otherwise indicated.
- E. Smoke- or Heat-Detector Spacing:
  - 1. Comply with the "Smoke-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
  - 2. Comply with the "Heat-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.
  - 3. Smooth ceiling spacing shall not exceed 30 feet (9 m).
  - 4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Annex A or Annex B in NFPA 72.
  - 5. HVAC: Locate detectors not closer than 36 inches (910 mm) from air-supply diffuser or return-air opening.
  - 6. Lighting Fixtures: Locate detectors not closer than 12 inches (300 mm) from any part of a lighting fixture and not directly above pendant mounted or indirect lighting.
- F. Install a cover on each smoke detector that is not placed in service during construction. Cover shall remain in place except during system testing. Remove cover prior to system turnover.

- G. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct. Tubes more than 36 inches (9100 mm) long shall be supported at both ends.
  - 1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.
- H. Air-Sampling Smoke Detectors: If using multiple pipe runs, the runs shall be pneumatically balanced.
- I. Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location. Do not install smoke detectors in sprinklered elevator shafts.
- J. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within a dwelling or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.
- K. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.
- L. Audible Alarm-Indicating Devices: Install not less than 6 inches (150 mm) below the ceiling. Install audible devices on semi flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Install all devices at the same height unless otherwise indicated. Devices indicated as ceiling-mount shall be recessed in ceiling.
- M. Visible Alarm-Indicating Devices: Install integral or adjacent to each alarm audible device when indicated as combination devices. Individual devices shall be installed at least 6 inches (150 mm) below the ceiling and as prescribed by NFPA 72. Install all devices at the same height unless otherwise indicated.
- N. Device Location-Indicating Lights: Locate visibly on wall or ceiling in public space near the device they monitor. Label with designation of associated device or equipment.
- O. Antenna for Emergency Responder Radio Repeater system: Mount on building roof structure where required. Use mounting arrangement and substrate connection that resists local wind load with a gust factor of 1.3 without damage.

### 3.3 PATHWAYS

- A. Pathways above recessed ceilings and in non-accessible locations may be routed exposed.
  - 1. Exposed pathways located less than 96 inches (2440 mm) above the floor shall be installed in EMT. Pathways subject to severe physical damage shall be installed in GRC.
- B. Pathways shall be installed in EMT where exposed to view in public areas.
- C. Exposed EMT shall be painted red enamel unless otherwise directed by the Architect.

### 3.4 CONNECTIONS

- A. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches (910 mm) from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
  - 1. Alarm-initiating connection to smoke-control system (smoke management) at firefighters' smoke-control system panel.
  - 2. Alarm-initiating connection to stairwell and elevator-shaft pressurization systems.
  - 3. Smoke dampers in air ducts of designated HVAC duct systems.
  - 4. Magnetically held-open doors.
  - 5. Electronically locked doors and access gates.
  - 6. Alarm-initiating connection to elevator recall system and components.
  - 7. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
  - 8. Supervisory connections at valve supervisory switches.
  - 9. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
  - 10. Supervisory connections at elevator shunt-trip breaker.
  - 11. Data communication circuits for connection to building management system.
  - 12. Supervisory connections at fire-extinguisher locations.
  - 13. Supervisory connections at fire-pump power failure including a dead-phase or phase-reversal condition.
  - 14. Supervisory connections at fire-pump engine control panel.

### 3.5 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Install framed instructions in a location visible from fire-alarm control unit.

### 3.6 GROUNDING

- A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.
- B. Ground shielded cables at the control panel location only. Insulate shield at device location.

### 3.7 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 tests and inspections.
- C. Perform the following tests and inspections
  - 1. Visual Inspection: Conduct visual inspection prior to testing.
    - a. Inspection shall be based on completed record Drawings and system documentation that is required by the "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
    - b. Comply with the "Visual Inspection Frequencies" table in the "Inspection" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
  - 2. System Testing: Comply with the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
  - 3. Test audible and visible appliances for the private operating mode according to manufacturer's written instructions.
  - 4. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
- D. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
- E. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

### 3.8 SOFTWARE SERVICE AGREEMENT

- A. Comply with UL 864.
- B. Technical Support: Beginning at Substantial Completion, service agreement shall include firmware support for two years.
- C. Upgrade Service: At Substantial Completion, update firmware to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.

### 3.9 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

## END OF SECTION 28 46 21.11



**SECTION 32 1200 - FLEXIBLE PAVING****PART 1 GENERAL****1.01 SCOPE OF WORK**

- A. Provide labor, material and equipment for construction of asphalt concrete paving surfaces and pavement markings.
- B. The work includes providing paving subbase, base, and final subgrade preparation and fine grading normally incidental to paving operations.

**1.02 QUALITY ASSURANCE**

- A. Use a soils testing laboratory retained by the Owner, to perform pavement tests. Correct any deficiencies in material makeup, strength, or quantities revealed by testing.
- B. Conform to the requirements of the Georgia D.O.T., "Standard Specifications for Construction of Roads and Bridges,". Where particular sections of the reference specifications are called out, comply with sections of the specification related to the work.
- C. Work performed on the Georgia Department of Transportation (D.O.T.) rights-of-way must be approved and accepted by the Georgia D.O.T. prior to final payment for the work.
- D. Visual Inspection: Conduce a visual inspection. The opinion of the Owner is final. Ravelling, loose aggregate, insufficient liquid asphalt coverage, unsightly and rough seams, poor craftsmanship, and indications of poor quality control on the part of the Contractor are causes for rejection of the work and remedial action.

**PART 2 PRODUCTS****2.01 MATERIAL**

- A. Paving Base Course: Crushed stone base, primed as specified in Georgia D.O.T. Section 310, unless otherwise specified on the plans.
- B. Use materials for hot mix asphalt concrete construction as specified in Georgia D.O.T. Section 400.
- C. Use paving subbase of select soils from stockpiles and site grading operations.
- D. Thermoplastic traffic stripe: Georgia DOT Section 653.
- E. Use materials for shoulder paving that conform to those used in existing shoulders approved by Georgia D.O.T.

**PART 3 - EXECUTION****3.01 SUBGRADE PREPARATION**

- A. After the subgrade has been thoroughly compacted, proofroll the entire subgrade area. Proofroll as specified in the Section EARTHWORK of these specifications. Remove and satisfactorily repair defective areas which pump, or shove, or are found to be soft and test roll again as specified. In defective areas, plow, harrow and mix to a depth of 6 inches minimum the entire defective subgrade as required to achieve compaction. If stabilization stone is required, mix into the subgrade at 150 LB./SQ. YD. minimum. After the material has been thoroughly mixed, bring to line and grade the subgrade and compact to the densities for paving area fill contained in the Section EARTHWORK. Blade the surface of the finished subgrade to a smooth and uniform texture.
- B. The cost of stabilization stone is additional to the Contract except where defective conditions arise due to the Contractor's methods or earthwork is unclassified.

- C. Protect the subgrade from damage and maintain it in a smooth, compact, and rut-free condition until the base course has been placed.

### **3.02 PAVING SUBBASE COURSE**

- A. Construct paving subbase course of select surface soils previously stripped and stockpiled. Place paving subbase on prepared subgrade. Thoroughly mix and blend subbase and remove materials that will interfere with fine grading. Compact subbase for its full depth to the minimum standard proctor densities shown on the plans and specified in the Section EARTHWORK. Conform to the established elevations with an acceptable tolerance of one-half inch above or below. Free-drain paving areas without local depressions.

### **3.03 PAVING BASE COURSE**

- A. Construct paving base course of crushed stone or other materials as shown on the drawings and in accordance with Sections 310.01, 310.02, 310.03, and 310.04 of the Reference Specifications. Determine maximum dry density by ASTM D1557. Compaction 100%.

### **3.04 BITUMINOUS PAVING**

- A. Use bituminous paving, hot mix asphaltic concrete construction conforming to Sections 400.01, 400.02, 400.03, 400.04, 400.05, 400.07, and 400.08 of the Reference Specifications, modified as follows:
- B. When requested by the Owner, submit the job mix formula to the Owner for his approval. Approval does not relieve the Contractor of the responsibility for adequacy and warranty of the paving.

### **3.05 BITUMINOUS PRIME**

- A. Use bituminous prime conforming to Sections 412.01, 412.02, 412.03, and 412.04 of the Reference Specifications.

### **3.06 BITUMINOUS TACK COAT**

- A. Use bituminous tack coat conforming to Sections 413.01, 413.02, 413.03, and 413.04 of the Reference Specifications. Apply between asphaltic concrete layers and as otherwise directed by the Owner.

### **3.07 PAVEMENT MARKINGS**

- A. Apply pavement markings as detailed on the plans. Apply paint and markings in accordance with manufacturer's instructions regarding air temperature, wind, mixing, and transport. Protect new work till cured. Remove over spray, spills, and deformities.
- B. Install thermoplastic traffic striping per Georgia DOT Section 653.03.

### **3.08 TESTING THICKNESS**

- A. The Owner, at his option and at his expense, may take as many tests as necessary to determine the average thickness of the base course prior to the placing of the surface course. Calculate the average thickness of specimens. Meet the specified thickness of the base course minimum with the average. In areas where there is a deficiency in the thickness of the course, increase in thickness the surface course to the amount of the average deficiency of the tests. The surface course may also be tested. If tests show a deficiency of 1/4" or more in the surface course, place additional surface course up to one inch in thickness at no cost to the Owner and pay for the failing test.

### **3.09 VISUAL INSPECTION**

- A. The Owner may conduct a visual inspection of the finish work and surface course appearances.
- B. The Owner will annotate areas of rough, gravelly, or raveling asphalt, poor quality, rough or uneven seams, gouging, evidence of cold application, and other defects.
- C. The Contractor and Owner will agree upon the required remedial actions needed to address the deficiencies.

- D. Perform remedial work in a timely manner prior to final acceptance.

**3.10 CLEAN-UP**

- A. At the completion of the work, clean up scraps, rubbish and surplus materials caused by the work and haul them away from the site. Remove asphaltic materials from adjacent surfaces and leave in neat, clean and orderly condition. Hose and wash down asphalt and related concrete paving to remove mud, debris and other extraneous materials, just prior to final inspection.

**END OF SECTION**

**SECTION 32 1313 - CONCRETE PAVING****PART 1 GENERAL****1.01 SCOPE**

- A. Provide labor, material and equipment necessary for Portland Cement Concrete Paving.

**1.02 REFERENCE STANDARDS**

- A. Georgia Department of Transportation, "Standard Specifications for Road and Bridge Construction," Section 430. Where specific sections are cited, comply with applicable sections of the reference specification.
- B. ACI Standards:
  - 304 -Recommended Practice for Measuring, Mixing and Placing Concrete
  - 305 -Recommended Practice for Hot Weather, Concreting
  - 306 -Recommended Practice for Reinforced Concrete
  - 318 -Building Code Requirements.
- C. ASTM Standards:
  - C33 - Standard Specification for Concrete Aggregates
  - C94 - Standard Specification for Ready Mix Concrete
  - C-150 - Standard Specification for Portland Cement
  - C-172 - Standard Method of Sampling Fresh Concrete

**1.03 SUBMITTALS**

- A. Submit a shop drawing for review by the Owner, which contains as a minimum:
  - 1. Joint plan, showing type and location, no smaller than the scale of the construction documents.
  - 2. Joint details, including dowels where appropriate.
  - 3. Sealer manufacturer's information.

**PART 2 - PRODUCTS****2.01 MATERIALS**

- A. Use Portland Cement Type I or Type III High Early Strength Cement, minimum 3000 psi strength at 28 days, 4" maximum slump unless otherwise shown on the drawings.
- B. Use course aggregate Class A crushed stone, size 467, 67 or 57.
- C. Use dowels conforming to AASHTO: M31.
- D. Joint Fillers and Sealers - Georgia Department of Transportation, Section 833.

**PART 3 - EXECUTION****3.01 SUBGRADE PREPARATION**

- A. After the subgrade has been thoroughly compacted, proofroll the entire subgrade area as specified in the Section EARTHWORK. Remove and satisfactorily repair defective areas which pump, or shove, or are found to be soft and test roll again as specified. In the defective area plow, harrow and mix the entire subgrade to a depth of 6 inches minimum as required to achieve compaction. If stabilization stone is required, mix into the subgrade at 150LB./SQ. YD. minimum. After the material has been thoroughly mixed, bring to line and grade the subgrade and compact to the densities for paving area fill contained in the section EARTHWORK. Blade the surface of the finished subgrade to a smooth and uniform texture.
- B. The cost of stabilization stone is additional to the Contract except where defective conditions arise due to the Contractor's methods or earthwork is unclassified.

**3.02 FINAL PREPARATION OF SUBGRADES****CONCRETE PAVING**

- A. Base (where required):
  - 1. Spread the specified coarse aggregate to a thickness providing the compacted thickness shown on the Drawings.
  - 2. Compact to densities specified in the Section EARTHWORK.
- B. Thickness tolerance: Provide the compacted thicknesses shown on the Drawings within a tolerance of minus 0.0" to plus 0.5".
- C. Smoothness tolerance: Provide the lines and grades shown on the Drawings within a tolerance of 0.05 feet vertically and 1" in alignment at any point.
- D. Correct deviations by removing materials, replacing with new materials, and reworking or re-compacting as required.
- E. Use only the amount of moisture needed to achieve the specified compaction.

### 3.03 INSTALLATION

- A. Upon completion of base course and formwork, place reinforcement as shown on the Drawings.
  - 1. Clean reinforcement to remove loose rust and mill scale, earth, and other material which reduce bond or destroy bond with concrete.
  - 2. Position, support, and secure reinforcement against displacement by formwork, construction, and concrete placement operations.
  - 3. Place reinforcement to obtain the required coverages for concrete protection.
- B. Transit mix the concrete in accordance with the provisions of ASTM C94.
  - 1. With each load, provide tickets certifying to the materials and quantities and to compliance with the approved mix design.
  - 2. On the transit-mix ticket, state the time water was first added to the mix.
  - 3. Unless otherwise directed, provide 15 minutes total mixing time per batch after first addition of water.
- C. Do not use concrete that has stood over 30 minutes after leaving the mixer, or concrete that is not placed within 60 minutes after water is introduced to the mix.
- D. Conveying:
  - 1. Place concrete in accordance with the following and pertinent recommendations contained in ACI 304.
  - 2. Deposit concrete continuously in layers of thickness that no concrete will be placed on concrete which has hardened sufficiently to cause formation of seams or planes of weakness within the section.
  - 3. If a section cannot be placed continuously, provide construction joints as specified.
  - 4. Perform concrete placing at a rate that concrete which is being integrated with fresh concrete is still plastic.
  - 5. Deposit concrete as nearly as practicable in its final location so as to avoid segregation due to rehandling and flowing.
  - 6. Do not subject concrete to any procedure which will cause segregation.
  - 7. Do not use concrete which becomes non-plastic and unworkable, or does not meet required quality control limits, or has been contaminated by foreign materials.
  - 8. Remove rejected concrete from the site.
- E. Deposit and consolidate concrete in a continuous operation within the limits of construction joints until the placing of a panel or section is completed.
  - 1. Bring surfaces to the correct level with a straightedge, and then strike off.
  - 2. Use bull floats or darbies to smooth the surface, leaving it free from bumps and hollows.
  - 3. Do not sprinkle water on the plastic surface. Do not disturb the surfaces prior to start of finishing operations.
- F. Joints - Place joints as required to meet performance criteria:

1. Expansion/isolation joints at walls, buildings, and structures.
2. Contraction joints at maximum spacing of 15'-0" on center each way. Where widths are less than 30' -0", divide the overall length equally between joints.
3. Construction joints as required.
4. Saw cut or otherwise form contraction joints as soon as the concrete has hardened sufficiently to allow it to be worked without raveling. Complete cut within twelve hours of placement of concrete.
5. Use saw cut contraction joints one-quarter depth of slab minimum.
6. Size and place dowels and tie bars as recommended by ACI and Georgia DOT.

G. Finishing:

1. Begin floating when the water sheen has disappeared and when the surface has stiffened sufficiently to permit the operation.
2. During or after the first floating, check the plane of surface with a ten (10) foot straightedge applied at not less than two (2) different angles.
3. Cut down high spots and fill low spots and produce a surface level within 1/4" in ten (10) feet as determined by a ten (10) foot straightedge placed anywhere on the surface in any direction.
4. Re-float the surface immediately to a uniform sandy texture.
5. While the surface is still plastic, provide a textured finish by drawing a fiber bristle broom uniformly over the surface.
  - a. Unless otherwise directed by the Owner, provide the texturing in one direction only.
  - b. Provide "light", "medium", or "course" finish as shown on the drawings or as directed by the Owner.

#### 3.04 CURING AND PROTECTION

- A. Beginning immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

#### END OF SECTION

**SECTION 32 1600 - CURBS, GUTTERS, SIDEWALKS, AND DRIVEWAYS****PART 1 GENERAL****1.01 SCOPE OF WORK**

- A. Provide labor, material and equipment required to complete curb and gutter, sidewalks, and other miscellaneous site improvements, including preparation of subgrade for areas and backfilling and shaping of finished grade.

**1.02 QUALITY ASSURANCE**

- A. Submit design mixes when requested for each type of concrete. Use an independent testing facility acceptable to the Owner for preparing and reporting proposed mix designs.
- B. Provide drawings, schedules and details for the fabrication of the reinforced steel. Complete drawings and details so that when used with the contract drawings, the reinforcing steel can be placed.
- C. Store materials and equipment only in designated areas.
- D. Do not begin concrete operations until underground work of other trades has been completed.
- E. Verify grades and elevations before proceeding with the work. While grades and elevations will, in general, conform to those shown on drawings, the Owner reserves the right to make minor modifications by reasonable field adjustments prior to completion of subgrade work.

**PART 2 PRODUCTS****2.01 MATERIALS**

- A. Concrete:
  - 1. Use 3,000 psi concrete, 4" maximum slump unless otherwise shown on drawings, for aprons, curbs and gutters, and walks and steps.
- B. Filler and Sealer for Expansion Joints: preformed strips of cellular fiber impregnated with suitable bituminous binder. Filler to conform to section area and extend through section to within one-half inch (½") of top surface and to meet Federal Specifications HH-F-341(A) Type I.
- C. Reinforced Bars: ASTM A615-04 with Supplement S1, Grade 60.
- D. Formwork: Square-edged, finished one side lumber, plywood, metal or other material acceptable to the Owner. Comply with ACI Standard Recommended Practice for Concrete Formwork.
- E. Curing compounds: Meeting ASTM C309-03, Type 1.

**PART 3 EXECUTION****3.01 GENERAL**

- A. Provide formed concrete as detailed on the plans. Accurately form cast-in-place concrete to a true, clean, straight, even profile.
- B. Form curb and gutter to line grades indicated. Lay out radii with curved formwork. Place walk expansion joints at 50'-0" maximum and contraction joints at every 10'-0" on center. Provide expansion joints at curve intersections.
- C. Place concrete walks, aprons and pavement to the grades and dimensions shown on the drawings. Place walk expansion joints at a maximum 50'-0" spacing. Space contraction joints at dimensions equal to the walk width. Slope surfaces a minimum 1/8" per foot to prevent puddling or ponding of water.
- D. Form cast-in-place retaining walls to the details shown on the drawings, able to hold the weight of wet concrete without deflection.

**3.02 CONCRETE MIXING**

- A. Ready-mix Concrete: Comply with the requirements of ASTM C94-03.
- B. During hot weather or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C94-03 may be required.
- C. When the air temperature is between 85F and 90F, reduce the mixing and delivery time from 1 ½ hours to 75 minutes, and when the air temperature is above 90F, reduce the mixing and delivery time to 60 minutes.

### 3.03 PLACING OF CONCRETE

- A. Do not place concrete until embedded items and reinforcement have been placed in forms and the approval of the Owner has been obtained. Give ample notice to the Owner of an impending pour so that he may inspect work prior to placing.
- B. Convey concrete from mixer to place of final deposit by methods that will prevent segregation or loss of material.
- C. Deposit concrete as nearly as practicable to its final position. Carry on pouring at a rate that concrete is plastic and flows readily into spaces between reinforcement. Once started, continue placing as a continuous operation until placement of the section is completed.
- D. Work concrete into forms, around bars and embedded items with spades, rods, trowels and vibration, so as to procure a solid homogeneous mass, free of pockets, voids and honeycombs.
- E. Use construction joints made and located so as to least impair the strength of the structure. Where a joint is made, clean surface of the concrete and remove laitance. Mechanically roughen vertical joints, wet and slush with a coat of neat cement grout immediately before placement of new concrete.
- F. When hot weather conditions exist that would seriously impair the quality and strength of concrete, place concrete in compliance with ACI 305-99. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90F. Mixing water or used chopped ice to control the concrete temperature provided. Calculate the water equivalent of the ice into the total amount of mixing water. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that the steel temperature will not exceed the ambient air temperature immediately before embedment in concrete. Do not use retarding admixtures without the written approval of the Owner.

### 3.04 FINISHING OF CONCRETE

- A. Broom finish surfaces of aprons, curb and gutters, and drainage flumes in accordance with ACI 303-97.
- B. Smooth rub finish exposed surfaces of cast-in-place retaining walls in accordance with ACI 301-99.3.05

### 3.05 CURING OF CONCRETE

- A. Spray surfaces with a curing compound as soon as forms are removed and finishing is completed.

### 3.06 TESTING OF CONCRETE

- A. Perform one slump test, ASTM C143-03 for each concrete load at point of discharge and prepare one set of three standard compressive strength cylinders, ASTM C31-03 for each 100 cubic yards or fraction of concrete placed in any one day. Store compressive strength cylinders in damped protective material for pick up and use by the Testing Lab. The expense of transportation and testing of cylinders is included in the work.

### 3.07 REPLACING DAMAGED CONCRETE

- A. Do not spot patch concrete walks, curb and gutters, and site improvements damaged during construction. If a portion of a panel or section is damaged between tooled or expansion joints, replace the entire section.

END OF SECTION

CURBS, GUTTERS, SIDEWALKS,  
AND DRIVEWAYS

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## SECTION 323113 - CHAIN LINK FENCES AND GATES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Chain-link fences.
2. Swing gates.

#### 1.2 PREINSTALLATION MEETINGS

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

#### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For each type of fence and gate assembly.

1. Include plans, elevations, sections, details, and attachments to other work.

#### 1.4 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Product test reports.

C. Sample warranty.

#### 1.5 WARRANTY

A. Special Warranty: **Installer agrees** to repair or replace components of chain-link fences and gates that fail in materials or workmanship within specified warranty period.

1. Warranty Period: One year from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Chain-link fence and gate frameworks shall withstand the design wind loads and stresses for fence height(s) and under exposure conditions indicated according to **ASCE/SEI 7**:
1. Design Wind Load: **As indicated on Structural Drawings.**
    - a. Minimum Post Size: Determine according to ASTM F1043 for post spacing not to exceed **10 feet (3 m)** for Material **Group IA, ASTM F1043, Schedule 40 steel pipe.**
    - b. Minimum Post Size and Maximum Spacing: Determine according to CLFMI WLG 2445, based on mesh size and pattern specified.

### 2.2 CHAIN-LINK FENCE FABRIC

- A. General: Provide fabric in one-piece heights measured between top and bottom of outer edge of selvage knuckle or twist according to "CLFMI Product Manual" and requirements indicated below:
1. Fabric Height: match existing chain link fence height.
  2. Steel Wire for Fabric: Wire diameter of **0.148 inch (3.76 mm)] [0.120 inch (3.05 mm) .**
    - a. Mesh Size: **2-1/8 inches (54 mm).**
    - b. Zinc-Coated Fabric: ASTM A392, Type II, **Class 1, 1.2 oz./sq. ft. (366 g/sq. m) after** weaving.
    - c. Coat selvage ends of metallic-coated fabric before the weaving process with manufacturer's standard clear protective coating.
  3. Selvage: **Knuckled at both selvages.**
  4. Fit fence fabric with Solitube Slats, [solitubeslats.com](http://solitubeslats.com)
    - a. Slat color as selected by Architect from manufacturers full range.

### 2.3 FENCE FRAMEWORK

- A. Posts and Rails: ASTM F1043 for framework, including rails, braces, and line; terminal; and corner posts. Provide members with minimum dimensions and wall thickness according to ASTM F1043 or ASTM F1083 based on the following:
1. Fence Height: match existing.
  2. Heavy-Industrial-Strength Material: **Group IA, round steel pipe, Schedule 40 -steel C-section shapes.**
    - a. Line Post: **2.375 inches (60 mm) in diameter.**

- b. End, Corner, and Pull Posts: **2.375 inches (60 mm) in diameter.**
3. Horizontal Framework Members: **Intermediate top and bottom** rails according to ASTM F1043.
4. Metallic Coating for Steel Framework:
  - a. Type A zinc coating.

## 2.4 TENSION WIRE

- A. Metallic-Coated Steel Wire: **0.177-inch- (4.5-mm-)** diameter, marcelled tension wire according to ASTM A817 or ASTM A824, with the following metallic coating:
  1. Type II: Zinc coated (galvanized) with minimum coating weight matching chain-link fabric coating weight.

## 2.5 SWING GATES

- A. General: ASTM F900 for gate posts and [**single and double** swing gate types].
  1. Gate Leaf Width: **As indicated.**
  2. Framework Member Sizes and Strength: Based on gate fabric height [**of 72 inches (1830 mm) or less.**]
- B. Pipe and Tubing:
  1. Zinc-Coated Steel: ASTM F1043 and ASTM F1083; [**protective coating and finish to match fence framework**] [**manufacturer's standard protective coating and finish**] **<Insert finish>**.
  2. Gate Posts: **Round tubular steel.**
  3. Gate Frames and Bracing: [**Round tubular steel.**]
- C. Frame Corner Construction: **Welded.**
- D. Extended Gate Posts and Frame Members: Fabricate gate posts and frame end members to extend **12 inches (300 mm)** above top of chain-link fabric at both ends of gate frame to attach barbed wire assemblies.
- E. Hardware:
  1. Hinges: **180-degree outward**swing.
- F. Latch: Permitting operation from both sides of gate **with provision for padlocking accessible from both sides of gate.**

## 2.6 SWING GATES

- A. General: ASTM F900 for gate posts and **single and double** swing gate types.

1. Gate Leaf Width: **36 inches (914 mm)** for personnel and **As indicated** for vehicular traffic.
2. Framework Member Sizes and Strength: Based on gate fabric height of match existing perimeter fencing height. Forty-Eight inches at mechanical courtyard.

B. Pipe and Tubing:

1. Zinc-Coated Steel: ASTM F1043 and ASTM F1083; **manufacturer's standard protective coating and finish.**
2. Gate Posts: **Round tubular steel.**
3. Gate Frames and Bracing: **Round tubular steel.**

C. Frame Corner Construction: **Welded.**

D. Extended Gate Posts and Frame Members: Fabricate gate posts and frame end members to extend **12 inches (300 mm)** above top of chain-link fabric at both ends of gate frame to attach barbed **wire** assemblies.

E. Hardware:

1. Hinges: **180-degree outward** swing.
2. Latch: Permitting operation from both sides of gate **with provision for padlocking accessible from both sides of gate.**

## 2.7 FITTINGS

A. Provide fittings according to ASTM F626.

B. Finish:

1. Metallic Coating for Pressed Steel or Cast Iron: Not less than **1.2 oz./sq. ft. (366 g/sq. m)** of zinc.

## 2.8 GROUT AND ANCHORING CEMENT

A. Non-shrink, Nonmetallic Grout: Factory-packaged, non-staining, non-corrosive, non-gaseous grout complying with ASTM C1107/C1107M. Provide grout, recommended in writing by manufacturer, for exterior applications.

B. Anchoring Cement: Factory-packaged, non-shrink, non-staining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating, and that is recommended in writing by manufacturer for exterior applications.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Do not begin installation before final grading is completed unless otherwise permitted by Architect.

### 3.2 PREPARATION

- A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of **500 feet (152 m)** or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

### 3.3 CHAIN-LINK FENCE INSTALLATION

- A. Install chain-link fencing according to ASTM F567 and more stringent requirements specified.
- B. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed soil.
- C. Post Setting: Set posts **in concrete** at indicated spacing into firm, undisturbed soil. Set to depth determined by delegated engineer to resist specified wind loads minimum 36" deep
  - 1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
  - 2. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.
    - a. Concealed Concrete: Place top of concrete **2 inches (50 mm)** below grade to allow covering with surface material.
- D. Terminal Posts: Install terminal end, corner, and gate posts according to ASTM F567 and terminal pull posts at changes in horizontal or vertical alignment of **15 degrees or more**]. For runs exceeding **500 feet (152 m)**, space pull posts an equal distance between corner or end posts.
- E. Line Posts: Space line posts uniformly at **96 inches (2440 mm)** o.c.
- F. Chain-Link Fabric: Apply fabric to **outside** of enclosing framework. Leave **1-inch (25-mm)** bottom clearance between finish grade or surface and bottom selvage unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.

### 3.4 ADJUSTING

- A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

- B. Lubricate hardware and other moving parts.

END OF SECTION 323113

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## SECTION 323120 – WOOD FENCE AND GATES

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section Includes:
1. Gate kit
  2. Fence posts
  3. Preservative treated lumber.
  4. For installation at Generator and Patio.

## 1.2 PREINSTALLATION MEETINGS

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

## 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For each type of fence and gate assembly.
1. Include plans, elevations, sections, project specific details, and attachments to other work.

## 1.4 INFORMATIONAL SUBMITTALS

- A. Product certificates.
- B. Product test reports.
- C. Sample warranty.

## 1.5 WARRANTY

- A. Special Warranty: **Installer agrees** to repair or replace components of fences and gates that fail in materials or workmanship within specified warranty period.
1. Warranty Period: One year from date of Substantial Completion.P



## PART 2 -PRODUCTS

### 2.1 FENCE FRAMEWORK

- A. HOFT Products , [www.holtsolutions.com](http://www.holtsolutions.com) - No substitutions. Refer to details on the drawings.
- 1.. Provide Line Post kits - 6 feet high – C6 – 3” x 3” post with 1.125” wide groove. Including 6” line post, anchor plate post cap railblock , ½” spacers, section brackets.
  2. Provide Gate Kit.
  - 3.. Furnish 3/8” anchor screws fasteners in accordance with manufacturer’s requirements.

### 2.2 FENCE BOARDS

- A. General: Provide Preservative Treated Lumber
- B. Lumber Standards: Furnish lumber manufactured to comply with PS 20 "American Softwood Lumber Standard" and with applicable grading rules of inspection agencies certified by American Lumber Standards Committee's (ALSC) Board of Review.
- C. Inspection Agencies: Inspection agencies and the abbreviations used to reference them with lumber grades and species include the following:
1. SPIB - Southern Pine Inspection Bureau.
  2. WWPA - Western Wood Products Association.
- D. Grade Stamps: Provide lumber with each piece factory-marked with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content at time of surfacing, and mill.
- E. Provide 5/4” Lumber for slats. Nominal sizes are indicated, except as shown by detail dimensions. Provide actual sizes as required by PS 20, for moisture content specified for each use.
1. Provide dressed lumber, S4S, unless otherwise indicated.
  2. Provide seasoned lumber with 19 percent maximum moisture content at time of dressing and shipment for sizes 2 inches or less in nominal thickness, unless otherwise indicated.

### 2.2 PRESERVATIVE WOOD TREATMENT BY PRESSURE PROCESS

- A. General: Where lumber or plywood is indicated as preservative-treated wood or is specified herein to be treated, comply with applicable requirements of AWPB Standards C2 (Lumber) and C9 (Plywood). Mark each treated item with the AWPB or SPIB Quality Mark Requirements.
- B. Pressure-treat above-ground items with water-borne preservatives to a minimum retention of 0.25 pcf. For interior uses, after treatment, kiln-dry lumber and plywood to a maximum moisture content, respectively, of 19 percent and 15 percent. Treat indicated items and the following:
1. Wood fence Slats.
- C. Pressure-treat wood members in contact with the ground or fresh water with water-borne preservatives to a minimum retention of 0.40 pcf.
- D. Complete fabrication of treated items prior to treatment, where possible. If cut after treatment, coat cut surfaces to comply with AWPB M4. Inspect each piece of lumber or plywood after drying and discard damaged or defective pieces.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Stake locations of fence lines, gates, and terminal posts.

### 3.2 FENCE INSTALLATION

- A. Install fencing according to manufacturer's instructions..
- B. Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed soil.
- C. Anchor posts **to concrete** footings with Hilti Epoxy anchors
  - 1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.

### 3.3 ADJUSTING

- A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.
- B. Lubricate hardware and other moving parts.

END OF SECTION 323113

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**SECTION 32 1313 - CONCRETE PAVING****PART 1 GENERAL****1.01 SCOPE**

- A. Provide labor, material and equipment necessary for Portland Cement Concrete Paving.

**1.02 REFERENCE STANDARDS**

- A. Georgia Department of Transportation, "Standard Specifications for Road and Bridge Construction," Section 430. Where specific sections are cited, comply with applicable sections of the reference specification.
- B. ACI Standards:
  - 304 -Recommended Practice for Measuring, Mixing and Placing Concrete
  - 305 -Recommended Practice for Hot Weather, Concreting
  - 306 -Recommended Practice for Reinforced Concrete
  - 318 -Building Code Requirements.
- C. ASTM Standards:
  - C33 - Standard Specification for Concrete Aggregates
  - C94 - Standard Specification for Ready Mix Concrete
  - C-150 - Standard Specification for Portland Cement
  - C-172 - Standard Method of Sampling Fresh Concrete

**1.03 SUBMITTALS**

- A. Submit a shop drawing for review by the Owner, which contains as a minimum:
  - 1. Joint plan, showing type and location, no smaller than the scale of the construction documents.
  - 2. Joint details, including dowels where appropriate.
  - 3. Sealer manufacturer's information.

**PART 2 - PRODUCTS****2.01 MATERIALS**

- A. Use Portland Cement Type I or Type III High Early Strength Cement, minimum 3000 psi strength at 28 days, 4" maximum slump unless otherwise shown on the drawings.
- B. Use course aggregate Class A crushed stone, size 467, 67 or 57.
- C. Use dowels conforming to AASHTO: M31.
- D. Joint Fillers and Sealers - Georgia Department of Transportation, Section 833.

**PART 3 - EXECUTION****3.01 SUBGRADE PREPARATION**

- A. After the subgrade has been thoroughly compacted, proofroll the entire subgrade area as specified in the Section EARTHWORK. Remove and satisfactorily repair defective areas which pump, or shove, or are found to be soft and test roll again as specified. In the defective area plow, harrow and mix the entire subgrade to a depth of 6 inches minimum as required to achieve compaction. If stabilization stone is required, mix into the subgrade at 150LB./SQ. YD. minimum. After the material has been thoroughly mixed, bring to line and grade the subgrade and compact to the densities for paving area fill contained in the section EARTHWORK. Blade the surface of the finished subgrade to a smooth and uniform texture.
- B. The cost of stabilization stone is additional to the Contract except where defective conditions arise due to the Contractor's methods or earthwork is unclassified.

**3.02 FINAL PREPARATION OF SUBGRADES****CONCRETE PAVING**

- A. Base (where required):
  - 1. Spread the specified coarse aggregate to a thickness providing the compacted thickness shown on the Drawings.
  - 2. Compact to densities specified in the Section EARTHWORK.
- B. Thickness tolerance: Provide the compacted thicknesses shown on the Drawings within a tolerance of minus 0.0" to plus 0.5".
- C. Smoothness tolerance: Provide the lines and grades shown on the Drawings within a tolerance of 0.05 feet vertically and 1" in alignment at any point.
- D. Correct deviations by removing materials, replacing with new materials, and reworking or re-compacting as required.
- E. Use only the amount of moisture needed to achieve the specified compaction.

### 3.03 INSTALLATION

- A. Upon completion of base course and formwork, place reinforcement as shown on the Drawings.
  - 1. Clean reinforcement to remove loose rust and mill scale, earth, and other material which reduce bond or destroy bond with concrete.
  - 2. Position, support, and secure reinforcement against displacement by formwork, construction, and concrete placement operations.
  - 3. Place reinforcement to obtain the required coverages for concrete protection.
- B. Transit mix the concrete in accordance with the provisions of ASTM C94.
  - 1. With each load, provide tickets certifying to the materials and quantities and to compliance with the approved mix design.
  - 2. On the transit-mix ticket, state the time water was first added to the mix.
  - 3. Unless otherwise directed, provide 15 minutes total mixing time per batch after first addition of water.
- C. Do not use concrete that has stood over 30 minutes after leaving the mixer, or concrete that is not placed within 60 minutes after water is introduced to the mix.
- D. Conveying:
  - 1. Place concrete in accordance with the following and pertinent recommendations contained in ACI 304.
  - 2. Deposit concrete continuously in layers of thickness that no concrete will be placed on concrete which has hardened sufficiently to cause formation of seams or planes of weakness within the section.
  - 3. If a section cannot be placed continuously, provide construction joints as specified.
  - 4. Perform concrete placing at a rate that concrete which is being integrated with fresh concrete is still plastic.
  - 5. Deposit concrete as nearly as practicable in its final location so as to avoid segregation due to rehandling and flowing.
  - 6. Do not subject concrete to any procedure which will cause segregation.
  - 7. Do not use concrete which becomes non-plastic and unworkable, or does not meet required quality control limits, or has been contaminated by foreign materials.
  - 8. Remove rejected concrete from the site.
- E. Deposit and consolidate concrete in a continuous operation within the limits of construction joints until the placing of a panel or section is completed.
  - 1. Bring surfaces to the correct level with a straightedge, and then strike off.
  - 2. Use bull floats or darbies to smooth the surface, leaving it free from bumps and hollows.
  - 3. Do not sprinkle water on the plastic surface. Do not disturb the surfaces prior to start of finishing operations.
- F. Joints - Place joints as required to meet performance criteria:

1. Expansion/isolation joints at walls, buildings, and structures.
2. Contraction joints at maximum spacing of 15'-0" on center each way. Where widths are less than 30' -0", divide the overall length equally between joints.
3. Construction joints as required.
4. Saw cut or otherwise form contraction joints as soon as the concrete has hardened sufficiently to allow it to be worked without raveling. Complete cut within twelve hours of placement of concrete.
5. Use saw cut contraction joints one-quarter depth of slab minimum.
6. Size and place dowels and tie bars as recommended by ACI and Georgia DOT.

G. Finishing:

1. Begin floating when the water sheen has disappeared and when the surface has stiffened sufficiently to permit the operation.
2. During or after the first floating, check the plane of surface with a ten (10) foot straightedge applied at not less than two (2) different angles.
3. Cut down high spots and fill low spots and produce a surface level within 1/4" in ten (10) feet as determined by a ten (10) foot straightedge placed anywhere on the surface in any direction.
4. Re-float the surface immediately to a uniform sandy texture.
5. While the surface is still plastic, provide a textured finish by drawing a fiber bristle broom uniformly over the surface.
  - a. Unless otherwise directed by the Owner, provide the texturing in one direction only.
  - b. Provide "light", "medium", or "course" finish as shown on the drawings or as directed by the Owner.

#### 3.04 CURING AND PROTECTION

- A. Beginning immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

#### END OF SECTION