

PROJECT MANUAL  
FOR

**Biological Science Building**  
**2<sup>nd</sup> Floor Lab 2168**  
**Fire Damage RESTORATION**

WAYNE STATE UNIVERSITY

DETROIT, MICHIGAN

WSU PROJECT NO. 089-409131

Design & Construction Services  
Facilities Planning & Management  
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iD Project No. 1217-1

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100% CD/BID ISSUE

SECTION 00 01 07

SEALS PAGE

PART 1 GENERAL

**ARCHITECTURAL**

I hereby certify this plan, specification, or report was prepared by myself or under my direct supervision and I am a duly Registered Architect under the laws of the State of Michigan.

Laura A. Clary, AIA, ALA, NCARB, LEEP-AP 

Date: 01-17-2025 Registration No.: 1301049628

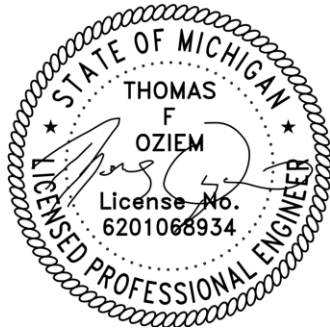


**MECHANICAL**

I hereby certify this plan, specification, or report was prepared by myself or under my direct supervision and I am a duly Registered Mechanical Engineer under the laws of the State of Michigan.

Thomas Oziem, PE, CEM 

Date: 12-20-2024 Registration No.: 6201068934



**ELECTRICAL**

I hereby certify this plan, specification, or report was prepared by myself or under my direct supervision and I am a duly Registered Electrical Engineer under the laws of the State of Michigan.

\_\_\_\_\_ Matt Williams, PE  \_\_\_\_\_

Date: 12-20-2024 Registration No.: 6201311034



PART 2 PRODUCTS - Not Applicable To This Section

PART 3 EXECUTION - Not Applicable To This Section

END OF SECTION

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SECTION 01 40 00

QUALITY CONTROL

PART 1 GENERAL

1.1 SUMMARY

- A. Quality Monitoring: Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality. Perform quality control procedures and inspections during installation.
- B. Standards: Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- C. Tolerances: Monitor fabrication and installation tolerance control of products to produce acceptable high quality Work. Do not permit tolerances to accumulate. Comply with manufacturers' tolerances and installation requirements.
- D. Reference Standards:
  - 1. Wayne State University, Construction Design Standards, Second Revision, November 2018.
  - 3. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- E. Manufacturer's Field Services: When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to perform the following as applicable, and to initiate instructions when necessary.
  - 1. Observe site conditions.
  - 2. Conditions of surfaces, surface preparation and installation.
  - 3. Quality of workmanship.
  - 4. Start-up of equipment.
  - 5. Test, adjust and balance of equipment.

PART 2 PRODUCTS - Not Applicable To This Section

PART 3 EXECUTION - Not Applicable To This Section

END OF SECTION

SECTION 01 50 00

TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.1 SUMMARY

- A. Security and Protection: Coordinate with the Owner to provide security and protection requirements including the following:
  - 1. Fire extinguishers.
  - 2. Site enclosure, barricades, warning signs, and lights.
  - 3. Environmental protection and dust control.

PART 2 PRODUCTS - Not Applicable To This Section

PART 3 EXECUTION - Not Applicable To This Section

END OF SECTION

SECTION 01 60 00

PRODUCT REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

- A. Manufactures: Provide products from one manufacturer for each type or kind as applicable. Provide secondary materials as required by manufacturers of primary materials.
- B. Product Selection: Provide products selected by Architect.
- C. Substitutions: Request for substitution must be in writing and requires approval by Owner and Architect. Products submitted for substitution shall be submitted with complete documentation, and include construction costs of substitution including related work. Conditions for substitution include:
  - 1. Specified material cannot be coordinated with other work.
  - 2. Specified material is not acceptable to authorities having jurisdiction.
  - 3. Substantial advantage is offered to the Owner in terms of cost, time, or other valuable consideration.
- D. Substitution Requests: Substitutions shall be submitted prior to award of contract, unless otherwise acceptable as per Wayne State University general and supplemental conditions. Approval of shop drawings, product data, or samples containing substitutions is not an approval of a substitution unless an item is clearly presented as a substitution at the time of submittal.

PART 2 PRODUCTS - Not Applicable To This Section

PART 3 EXECUTION - Not Applicable To This Section

END OF SECTION

SECTION 01 63 10

SUBSTITUTION REQUEST FORM

PART 1 GENERAL

1.1 IDENTIFICATION

- A. Request Number: \_\_\_\_\_
- B. Contractor: \_\_\_\_\_
- C. Subcontractor: \_\_\_\_\_

1.2 REQUEST

A. We hereby submit for consideration the following product in place of the specified product for this project:

1. Specified Product Specification Section / Reference Drawing(s):

\_\_\_\_\_

2. Proposed Substitution:

\_\_\_\_\_

3. Manufacturer:

\_\_\_\_\_

4. Location:

\_\_\_\_\_

5. Product Website URL:

\_\_\_\_\_

6. Phone:

\_\_\_\_\_

7. Time Used:

\_\_\_\_\_

8. Identify the Difference between Proposed Substitution and Specified Product: (All substitutions and exceptions must be listed, omission of this information and acceptance of materials otherwise submitted will not relieve the obligation for the contractor to meet design as drawn and specified.)

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1.3 INFORMATION

A. Attach complete information for changes to Drawings and/or Specifications which the proposed substitution will require for its proper installation.

1.4 SUBMISSION

A. Submit with request all necessary samples and substantiating data to establish equivalent quality and performance to the specified product. Clearly mark manufacturer's literature to indicate equivalent performance.

1.5 AFFIRMATION

A. Does the substitution affect dimensions shown on the drawings? \_\_\_Yes \_\_\_No  
If yes, clearly indicate how:

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B. Does the substitution request result in a (credit\_\_\_) (add\_\_\_) (no charge\_\_\_) to the base contract amount?

1. If Credit/Add, How Much: (-/+)

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C. Will the Undersigned pay for all additional costs resulting from the proposed substitution including the Architect's and Consultant's additional services? \_\_\_Yes \_\_\_No

If no, fully explain: 

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D. What effect does the substitution have on the other subcontracts or trades?

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E. What effect does the substitution request have on the construction schedule?

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F. Are manufacturer's warranties for the proposed and specified product the same? \_\_\_Yes \_\_\_No  
If no, explain or provide attachment\_\_\_\_\_

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G. Reason for substitution request:\_\_\_\_\_

---

H. Itemized comparison of specified product(s) and proposed substitution:

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I. Accurate cost data comparing proposed substitution with specified product:

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J. Differences of maintenance services and sources:

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1.6 AFFIRMATION DOCUMENTATION

- A. Submit executed affidavit from Product Manufacturer.
- B. Additionally, submit Testing Laboratory Certificate.
- C. Contractor is specifically bound by the General Conditions in addition to those of this Section.

1.7 ARCHITECT'S ACTION

A. Refer to Applied Review Stamp with Annotations for Approved, Approved as Noted (conditional approval), Not approved, Revise and Resubmit.

END OF SECTION

SECTION 01 70 00

EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

- A. Substantial Completion: The following are prerequisites to substantial completion. Provide the following.
  - 1. Punch list prepared by Contractor and subcontractors as applicable.
  - 2. Supporting documentation.
  - 3. Warranties.
  - 4. Certifications.
  - 5. Occupancy permit.
  - 6. Start-up and testing of building systems.
  - 7. Change over of locks.
  - 8. Commissioning documentation.
- B. Final Acceptance: Provide the following prerequisites to final acceptance.
  - 1. Final payment request with supporting affidavits.
  - 2. Completed punch list.
- C. As-Built Drawings: Provide a marked-up set of drawings including changes, which occurred during construction.
- D. Project Closeout: Provide the following during project closeout.
  - 1. Submission of record documents.
  - 2. Submission of maintenance manuals.
  - 3. Training and turnover to Owner's personnel.
  - 4. Final cleaning and touch-up.
  - 5. Removal of temporary facilities.

PART 2 PRODUCTS - Not Applicable To This Section

PART 3 EXECUTION

3.1 CUTTING AND PATCHING

- A. Cutting and Patching: Provide cutting and patching work to properly complete the work of the project, complying with project requirements for:
  - 1. Mechanical/electrical systems.
  - 2. Visual requirements, including detailing and tolerances.
  - 3. Operational and safety limitations.
  - 4. Fire resistance ratings.
  - 5. Inspection, preparation, and performance.
  - 6. Cleaning.
- B. Means and Methods: Do not cut and patch in a manner that would result in a failure of the work to perform as intended, decrease energy performance,



increase maintenance, decrease operational life, or decrease safety performance.

- C. Inspection: Inspect conditions prior to work to identify scope and type of work required. Protect adjacent work. Notify Owner of work requiring interruption to building services or Owner's operations.
- D. Performance of Operations: Perform work with workmen skilled in the trades involved. Prepare sample area of each type of work for approval.
- E. Cutting: Use cutting tools, not chopping tools. Make neat holes. Minimize damage to adjacent work. Inspect for concealed utilities and structure before cutting.
- F. Patching: Make patches, seams, and joints durable and inconspicuous. Comply with tolerances for new work.
- G. Cleaning: Clean work area and areas affected by cutting and patching operations.

END OF SECTION

## SECTION 02 41 19.16

### SELECTIVE INTERIOR DEMOLITION

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Provide demolition activities. Demolition shall not impact the building structure, building enclosure, building core functions or building egress. Demolition shall be limited to select interior elements, utilities and finishes.

##### 1.2 SUBMITTALS

- A. Schedule: Submit for approval selective interior demolition schedule, including schedule and methods for capping utilities to be abandoned and maintaining existing utility service.

##### 1.3 QUALITY ASSURANCE

- A. Codes and Regulations: Comply with governing codes and regulations. Use experienced workers.

##### 1.4 PROJECT CONDITIONS

- A. Occupancy: Immediate areas of work will not be occupied during selective interior demolition. Personnel and students may occupy adjacent areas. Adjacent areas to remain operational during demolition.
- B. Existing Conditions: No responsibility for buildings and structures to be demolished will be assumed by the Owner.

#### PART 2 PRODUCTS

##### 2.1 DEMOLITION APPLICATIONS

- A. Demolition:
  1. Application: Salvage of designated items identified in drawings and by WSU project manager.
  2. Application: Protection of existing structure and adjacent assemblies, finishes and materials. Include walk off mats at entrances to work areas to minimize dirt in building areas not in project scope.
  3. Application: Disconnection, capping, and removal of utilities.
  4. Application: Pollution control during building demolition, including noise control.
  5. Application: Removal and legal disposal of materials.
  6. Salvage: Designated items.

7. Utilities: Interruption, capping or removal as applicable.
8. Hazardous Materials: Not known to be present.

### PART 3 EXECUTION

#### 3.1 SELECTIVE DEMOLITION

- A. Demolition Operations: Do not damage building elements and improvements indicated to remain. Items of salvage value, not included on schedule of salvage items to be returned to Owner, shall be removed to a storage facility as identified by the Owner. Storage or sale of items at project site is prohibited.
- B. Utilities: Locate, identify, disconnect, and seal or cap off utilities in buildings to be demolished.
- C. Occupied Spaces: Do not close or obstruct streets, walks, drives or other occupied or used spaces or facilities without the written permission of the Owner and the authorities having jurisdiction. Do not interrupt utilities serving occupied or used facilities without the written permission of the Owner and authorities having jurisdiction. If necessary, provide temporary utilities.
- D. Operations: Cease operations if public safety or remaining structures are endangered. Perform temporary corrective measures until operations can be continued properly.
- E. Security: Provide adequate protection against accidental trespassing. Secure project after work hours.
- F. Restoration: Restore finishes of patched areas to match existing material and finish.

END OF SECTION

SECTION 03 54 00

CEMENTITIOUS UNDERLAYMENT

PART 1 GENERAL

1.1 SUMMARY

- A. Provide cementitious underlayment.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.

1.3 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Cementitious Self-Leveling Underlayment:
  1. Basis of Design Manufacturer: Allied Custom Gypsum; LATICRETE SUPERCAP, LLC; Maxxon Corp.; Ardex
  2. Type: Low-alkali, cement-based, self-leveling underlayment.
  3. Compressive Strength: 4200 psi or higher.
  4. Pour Depth: Average 1/4 inch to 1-1/2 inches.
  5. Primer: As recommended by manufacturer based on project conditions.
  6. Moisture Vapor Control coating: As recommended by manufacturer based on project conditions.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install materials in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections.
- B. Restore damaged finishes. Clean and protect work from damage.

END OF SECTION

SECTION 07 21 00

MINERAL WOOL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Mineral wool insulation for the following applications.
  - 1. Perimeter fire-containment systems.
  - 2. Fire-resistant joint systems in between rated assemblies.
  - 3. Firestopping of through penetrations in rated assemblies.

1.2 A. Related Sections

- 1. Division 7, Section "Building Insulation"

1.3 SUBMITTALS

- A. Submit product characteristics, performance criteria, and limitations, including installation instructions.

1.4 QUALITY ASSURANCE

- A. Preconstruction Meeting: Convene a minimum of two weeks prior to commencing work of this section. Agenda shall include materials proposed for use, sequence of construction and coordination with installation of adjacent and covering materials.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to the job site in original packages, containers, or bundles bearing the brand name and manufacturer's identification.
- B. Storage: Store materials in dry locations with adequate ventilation, free from water, and in such a manner to permit easy access for inspection and handling.
- C. Handling: Handle using procedures recommended by the manufacturer for materials and personnel.

1.6 LIMITED WARRANTY

- A. Warranty: Provide manufacturer's standard limited warranty against manufacturing defects.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Basis-of-Design Manufacturer: Thermafiber, Inc. (an Owens Corning company), One Owens Corning Parkway, Toledo, OH 43659. Toll free 888-834-2371, Fax 260-563-8979, or [www.owenscorning.com](http://www.owenscorning.com).

2.2 PERIMETER FIRE CONTAINMENT SYSTEMS

- A. General: Provide where indicated for joints between the perimeter edge of fire-resistance-rated floor assemblies and non-fire-resistance-rated exterior curtain walls.

1. Provide a perimeter fire-containment system with the fire test response characteristics indicated, as determined by testing identical systems per the Underwriters Laboratories (UL®) or Intertek® Laboratories, per ASTM E 2307. If no tested system exists, an engineering judgment provided by the manufacturer, third-party testing lab, or fire protection engineering firm that follows guidelines established by the International Firestop Council must accompany the design.
  2. For non-fire-resistance-rated floor assemblies, add an approved material or assembly for retarding the passage of flames and hot gasses.
- B. Curtain Wall Insulation:
1. Product: Thermafiber® FireSpan® 90 insulation; density of 8 pcf (nominal).
    - a. Formaldehyde-Free (FF) Option.
      - GREENGUARD Gold Certified.
      - UL Validated Formaldehyde-Free.
      - Declare Label is Living Building Challenge Red-list Approved.
  2. Product: Thermafiber® FireSpan® 40 insulation; density of 4.0 pcf (nominal).
    - a. Formaldehyde-Free (FF) Option.
      - GREENGUARD Gold Certified.
      - UL Validated Formaldehyde-Free.
      - Declare Label is Living Building Challenge Red-list Approved.
  3. Product: Thermafiber® FireSpan® 120 insulation; density of 12.0 pcf (nominal).
    - a. Formaldehyde-Free (FF) Option.
      - GREENGUARD Gold Certified.
      - UL Validated Formaldehyde-Free.
      - Declare Label is Living Building Challenge Red-list Approved.
  4. Product: Thermafiber® FireLedge® Fabrication Board insulation; density of 8 pcf (nominal).
  5. Minimum Thickness and Density as noted in tested and listed design.
  6. R-Value: 4.3 per inch for FireSpan® 40 and 90 and FireLedge®. FireSpan® 120 is 4.1 per inch.
  7. Facing: Unfaced.
  8. Facing: Foil-Faced.
  9. Surface Burning Characteristics: Tested in accordance with ASTM E84. Unfaced, maximum Flame Spread 0 and Smoke Developed 0; Foil-Faced, maximum Flame Spread 25 and Smoke Developed 0.
  10. Corrosivity: Non-corrosive, when tested in accordance with ASTM C665.
  11. Fiber Type: EPA Choice Fiber; minimum 75% pre-consumer recycled content; complies with EPA Preference Program.
  12. Fiber Type: Standard fiber; 70% pre-consumer recycled content.
  13. Post-Consumer Recycled Content: 0%.
  14. UL® Certified Environmental Product Declaration (EPD) in accordance with ISO 14025.
  15. Published Health Product Declaration (HPD).
- C. Safing Insulation:
1. Product: Thermafiber® Safing insulation. Designated Type SAF in UL® Fire-Resistance Directory.

- a. Formaldehyde-Free (FF) Option.
    - GREENGUARD Gold Certified.
    - UL Validated Formaldehyde-Free.
    - Declare Label is Living Building Challenge Red-list Approved.
  2. R-Value: 4.3 per inch.
  3. Facing: Unfaced.
  4. Facing: Foil-Faced.
  5. Density: 4.0 pcf (actual).
  6. Density: 6.0 pcf (actual).
  7. Minimum Thickness and Density as noted in tested and listed design.
  8. Surface Burning Characteristics: Tested in accordance with ASTM E84. Unfaced, maximum Flame Spread 0 and Smoke Developed 0; Foil-Faced, maximum Flame Spread 25 and Smoke Developed 0.
  9. Corrosivity: Non-corrosive, when tested in accordance with ASTM C665.
  10. Fiber Type: EPA Choice Fiber; minimum 75% pre-consumer recycled content; complies with EPA Preference Program.
  11. Fiber Type: Standard fiber; 70% pre-consumer recycled content.
  12. Post-Consumer Recycled Content: 0%.
  13. UL® Certified Environmental Product Declaration (EPD) in accordance with ISO 14025.
  14. Published Health Product Declaration (HPD).
  15. This product qualifies under the Department of Homeland Security SAFETY Act designation, which provides commercial building professions and building owners liability protection in the event of a domestic act of terrorism.
- D. Safing Clips: Z-shaped galvanized steel clips formed from 1-inch-wide strips of 20-gauge galvanized steel; 3 inches high with 2-inch and 3-inch upper and lower horizontal legs. Use where required by specific UL® or Intertek® design listings.
- E. Hardware: Thermafiber® Impasse® hardware for attaching curtain wall insulation or other mechanical fasteners as approved by the tested and listed system per ASTM E2307.
- F. Mullion Covers: Thermafiber® FireSpan® 90 insulation for protection of vertical mullions. Refer to specific UL® or Intertek® designs for size of mullion covers.
- G. Hardware: Thermafiber® Spiral Anchors are used to secure mullion covers.
- H. Hardware: Thermafiber® Mullion Cover Brackets are an alternative method for securing mullion covers.
- I. Backer/Reinforcement Member: Thermafiber® Impasse® T-bar or galvanized steel channel or angle (see specific listing for appropriate gauge of steel) approved by the perimeter fire-containment system manufacturer. Place horizontally at the safe-off line to support the curtain wall insulation to prevent bowing of curtain wall insulation caused by compression fitting of the Safing insulation. See specific listed design for system requirements.
- J. Smoke Barrier: When required apply approved smoke sealant as listed in the appropriate tested and listed assembly per ASTM E2307.
- K. Vapor Retarder Tape: Compatible with specified facer and comparable perm rating. For taping insulation joints and repairing tears.

2.7 FIRE-RESISTANT JOINT SYSTEMS IN BETWEEN RATED ASSEMBLIES

A. Insulation for Joint Forming Material:

1. Product for Fire-Rated Construction Joints: Thermafiber® Safing insulation – Type SAF Forming Material.
2. Formaldehyde-Free (FF) Option.
  - a. GREENGUARD Gold Certified.
  - b. UL Validated Formaldehyde-Free.
  - c. Declare Label is Living Building Challenge Red-list Approved.
3. Product for Head-of-Wall Applications: Thermafiber® TopStop® insulation.
4. Facing: Unfaced.
5. Surface Burning Characteristics: Flame Spread 0 and Smoke Developed 0; tested in accordance with ASTM E84.
6. Tested in accordance with UL 2079.
7. Corrosivity: Non-corrosive, when tested in accordance with ASTM C665.
8. Fiber Type: Standard fiber; minimum 75% pre-consumer recycled content; complies with EPA Preference Program.
9. Post-Consumer Recycled Content: 0%.
10. UL® Certified Environmental Product Declaration (EPD) in accordance with ISO 14025.
11. Published Health Product Declaration (HPD).
12. This product qualifies under the Department of Homeland Security SAFETY Act designation, which provides commercial building professions and building owners liability protection in the event of a domestic act of terrorism.

B. Smoke Barrier Sealant: Smoke sealant as listed in the appropriate fire-tested assembly.

2.8 FIRESTOPPING OF THROUGH PENETRATIONS IN RATED ASSEMBLIES

A. Safing Insulation – Type SAF Forming Material:

1. Product: Thermafiber® Safing insulation; unfaced.
2. Formaldehyde-Free (FF) Option.
  - a. GREENGUARD Gold Certified.
  - b. UL Validated Formaldehyde-Free.
  - c. Declare Label is Living Building Challenge Red-list Approved.
3. Density: 4.0 pcf (actual).
4. Density: 6.0 pcf (actual).
5. Minimum Thickness and Density as noted in tested and listed design, per ASTM E814 or UL 1479.
6. Surface Burning Characteristics: Flame Spread 0 and Smoke Developed 0; tested in accordance with ASTM E84.
7. Tested in accordance with ASTM E814 or UL 1479.
8. Corrosivity: Non-corrosive, when tested in accordance with ASTM C665.
9. Fiber Type: Standard fiber; minimum 75% pre-consumer recycled content; complies with EPA Preference Program.
10. Post-Consumer Recycled Content: 0%.



11. UL® Certified Environmental Product Declaration (EPD) in accordance with ISO 14025.
  12. Published Health Product Declaration (HPD).
  13. This product qualifies under the Department of Homeland Security SAFETY Act designation, which provides commercial building professions and building owners liability protection in the event of a domestic act of terrorism.
- B. Smoke Barrier Sealant: Smoke sealant as listed in the appropriate fire-tested assembly.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine the areas and conditions under which work of this section will be installed. Do not proceed with installation until unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install insulation in accordance with approved submittals, manufacturer's written recommendations and guidelines.
- B. Install insulation to maintain continuity of thermal protection to building elements and spaces.
- C. Comply with tested and listed systems.
- D. Install products in proper relationship with each other and adjacent construction, and as follows:
1. Backer Reinforcement Members for Perimeter Fire Containment System:
    - a. Where required, install backer reinforcement member in accordance with the UL® or Intertek® listed and tested system, per ASTM E2307.
    - b. Install Thermafiber® Impasse® T-bar or an approved light steel angle or channels (see specific listing for appropriate gauge of steel), placed horizontally at the safing line, attached to the vertical mullions, either within the insulation at a horizontal splice, or behind the insulation and mechanically attached to vertical mullions.
    - c. Install to prevent the bowing of the curtain wall insulation due to the compression fit of the safing insulation.
  2. Curtain Wall Insulation:
    - a. Install curtain wall insulation in accordance with the UL® or Intertek® listed system and manufacturer's instructions.
    - b. Install backer reinforcement assembly in accordance with the UL® or Intertek® listed and tested design. Not applicable when the Thermafiber® No Backer Bar™ system is specified.
    - c. Fasten insulation in place with mechanical fasteners within the mullions and transoms (spandrel area), spaced at intervals recommended by the UL® or Intertek® listed and tested assembly to hold insulation securely in place without touching the exterior wall. One-inch air space must be maintained.
    - d. Provide Thermafiber® Impasse® Hangers or mechanical fasteners as approved by architect and manufacturer.
    - e. Comply with specific listed and tested assemblies per ASTM E2307 for mechanical fastener requirements.
  3. Safing Insulation – Type SAF Forming Material:
    - a. Install safing insulation of proper size in safe-off area between curtain wall insulation and floor slab as prescribed by the UL® or Intertek® listed and tested assembly per ASTM E2307. Safing insulation direction and compression, as well as the absence of safing Z-clips, are prescribed by the UL® or Intertek® listed and tested assembly.
    - b. Install safing insulation of proper density, thickness, depth, compression, and orientation

- c. into perimeter joint, construction joints (head-of-wall, floor-to-floor, floor-to-wall, etc.) as prescribed by the UL® or Intertek® or other third-party testing laboratory listed and tested assembly.
  - d. Install safing insulation of proper density, thickness, and compression into poke-throughs and penetrations as prescribed by the UL® or Intertek® listed and tested assembly.
4. Smoke Barrier System:
- a. Utilize foil-faced Thermafiber® FireSpan® curtain wall Insulation with Thermafiber® Safing insulation.
  - b. Apply approved smoke sealant in accordance with the third-party laboratory tested and listed assembly.
  - c. Install safing insulation of proper density, thickness, compression, and orientation as prescribed by the third-party laboratory listed and tested assembly.
  - d. Install safing insulation of proper density, thickness, and compression into poke-throughs and penetrations as prescribed by the tested assembly.
5. Vapor Retarders:
- a. Seal all seams in curtain wall insulation or exterior wall insulation with vapor retarder tape.
  - b. Application of vapor retarder must be directed by the architect or engineer of record.
  - c. For continuous vapor barrier, repair all tears in insulation foil-facing with vapor retarder tape.

### 3.3 PROTECTION

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

End of Section

## SECTION 07 21 01

### SOUND ATTENUATION INSULATION

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. This Section includes the following:
  - 1. Sound attenuation insulation.
- B. Related Sections include the following:
  - 1. Division 9, Section "Gypsum Board Assemblies".
  - 2. Division 9, Section "Non-structural Metal Framing".
  - 3. Division 7, Section "Mineral Wool Insulation"

##### 1.2 PERFORMANCE REQUIREMENTS

- A. Plenum Rating: Provide glass-fiber insulation where indicated in ceiling plenums whose test performance is rated as follows for use in plenums as determined by testing identical products per "Erosion Test" and "Mold Growth and Humidity Test" described in UL 181, or on comparable tests from another standard acceptable to authorities having jurisdiction.
  - 1. Erosion Test Results: Insulation shows no visible evidence of cracking, flaking, peeling, or delamination of interior surface of duct assembly, after testing for 4 hours at 2500-fpm (13-m/s) air velocity.
  - 2. Mold Growth and Humidity Test Results: Insulation shows no evidence of mold growth, delamination, or other deterioration due to the effects of high humidity, after inoculation with *Chaetomium globosum* on all surfaces and storing for 60 days at 100 percent relative humidity in the dark.

##### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: Full-size units for each type of exposed insulation indicated.
- C. Product test reports.
- D. Research/Evaluation Reports: For foam-plastic insulation.

#### 1.4 QUALITY ASSURANCE

- A. Retain ASTM test method below based on product and kind of fire-resistance characteristic specified for each product in Part 2. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84 for surface-burning characteristics, by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
- 2. Products: Subject to compliance with requirements, provide one of the products specified.
- 3. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

#### 2.2 GLASS-FIBER BLANKET INSULATION

- A. Manufacturers:
  - 1. CertainTeed Corporation.
  - 2. Johns-Manville Corp.
  - 3. Owens-Corning Fiberglas Corp.
- B. Unfaced, Glass-Fiber Blanket Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
- C. Where glass-fiber blanket insulation is indicated by the following thicknesses, provide blankets in batt or roll form:
  - 1. 3-inch- (76-mm-) thick, unfaced glass-fiber blanket insulation.
  - 2. 1-1/2-inch- (38-mm-) thick, unfaced glass-fiber blanket.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and application indicated. Provide all materials for a complete installation including manufacturer's recommended fasteners for specified application.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice, rain, and snow.
- C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Water-Piping Coordination: If water piping is located within insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.
- E. For preformed insulating units, provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

### 3.2 INSTALLATION OF INSULATION IN CEILINGS FOR SOUND ATTENUATION

- A. Install 3-inch- (76-mm-) thick, unfaced glass-fiber blanket insulation over suspended ceilings at partitions in a width that extends insulation 24 inches (610 mm) on either side of partition.

END OF SECTION

## SECTION 07 84 00

### FIRESTOPPING

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Provide firestopping of all penetrations through fire rated wall construction as well as floor penetrations both above and below the area to be renovated. This includes all new work as well as filling in any missing firestopping at existing penetrations to remain.
- B. Related Sections include the following:
  - 1. Division 9: Section "Gypsum Board Assemblies"
  - 2. Division 22: Plumbing
  - 3. Division 23: Heating, Ventilating and Air Conditioning
  - 4. Division 24: Electrical

##### 1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Submit for approval test reports and product certificates.

##### 1.3 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Fire Performance: UL 2079, ASTM E 814, and local regulations.

#### PART 2 PRODUCTS

##### 2.1 MATERIALS

- A. Firestopping Systems:
  - 1. Manufacturers: 3M Fire Protection Products; A/D Fire Protection Systems Inc., e.z. barrier; Henkel Corporation; Specified Technologies Inc.
  - 2. Applications as Applicable to Assembly: Through-penetrations, fire-resistive joints, perimeter fire containment, smoke seals.
  - 3. Types as Applicable to Assembly: Endothermic and intumescent

- sealants, pillows, putty and wrap strips.
4. Provide firestop systems and accessories that are compatible with one another.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

- A. Review extent of work with authorities having jurisdiction and obtain approval of installation thicknesses and methods.
- B. Sequence work to avoid need for removal of firestopping by work of other trades.
- C. Comply with manufacturers' instructions and recommendations. Securely anchor insulation with safing clips. Install firestopping without gaps or voids.
- D. Protect, inspect and repair work until final acceptance.

END OF SECTION

## SECTION 07 92 00

### JOINT SEALERS

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Provide joint sealers and fillers.

##### 1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Samples: Submit two representative samples of each material specified indicating visual characteristics and finish. Include range samples if variation of finish is anticipated.
  - 1. Include manufacturers full range of color and finish options if additional selection is required.

##### 1.3 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

#### PART 2 PRODUCTS

##### 2.1 MATERIALS

- A. Interior Joints, Limited Movement, Acrylic:
  - 1. Manufacturers: 3M, Dupont, Dow Corning, Lexon and GE.
  - 2. Materials: Acrylic-emulsion, ASTM C 834.
- B. Interior Joints, Moisture and Mildew Resistant Silicone:
  - 1. Manufacturers: 3M, Dupont, Dow Corning, Lexon and GE.
  - 2. Materials: One-part mildew-resistant silicone sealant, ASTM C 920.

#### PART 3 EXECUTION

##### 3.1 INSTALLATION

- A. Examine substrate; report unsatisfactory conditions in writing. Beginning work means acceptance of substrates.
- B. Provide sealants in colors as selected from manufacturer's standards.



- C. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections. Clean and prime joints, and install bond breakers, backer rods and sealant as recommended by manufacturers.
- D. Depth shall equal width up to 1/2 inch wide; depth shall equal 1/2 width for joints over 1/2 inch wide.
- E. Cure and protect sealants as directed by manufacturers. Replace or restore damaged sealants. Clean adjacent surfaces to remove spillage.

END OF SECTION

## SECTION 08 11 13

### HOLLOW METAL DOORS AND FRAMES

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Provide steel doors and frames.

##### 1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.

##### 1.3 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Standards: ANSI/SDI-100, Recommended Specifications for Standard Steel Doors and Frames.
- C. Performance Standards:
  - 1. Fire-Rated Assemblies: NFPA 80, and acceptable testing agency listing.
  - 2. Thermal-Rated Assemblies at Exterior: ASTM C 236 or ASTM C 976.
  - 3. Sound-Rated Assemblies at Mechanical Rooms: ASTM E 1408, and ASTM E 413.

#### PART 2 PRODUCTS

##### 2.1 MATERIALS

- A. Interior Steel Doors:
  - 1. Material: Minimum 18 gauge steel sheet.
  - 2. Thickness: 1-3/4 inches.
  - 3. Finish: Factory primed and field painted.
  - 4. Finish: Factory finished.
  - 5. Accessories:
    - a. Sightproof stationary louvers.
    - b. Glazing stops.
    - c. Silencers.
- B. Interior Steel Frames:

1. Material: Minimum 16 gauge steel sheet.
2. Corners: Mitered or coped.
3. Type: Knockdown.
4. Finish: Factory primed and field painted.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Fabricate work to be rigid, neat and free from seams, defects, dents, warp, buckle, and exposed fasteners. Install doors and frames in compliance with SDI-100, NFPA 80, and requirements of authorities having jurisdiction.
- B. Provide thermally improved doors with maximum U-value of 0.24 BTU/hr./sq. ft. degree F (ASTM C 236) for all exterior doors and elsewhere as noted.
- C. Provide acoustically improved doors with minimum STC of 33 (ASTM E 90 and ASTM E 413) where indicated.
- D. Hardware: Prepare doors and frames to receive hardware on final schedule. Provide for 3 silencers on single doorframes; 2 on double doorframes.
- E. Shop Finish: Clean, treat and prime paint all work with rust-inhibiting primer comparable with finish paint specified in Division 9 section. Provide asphalt emulsion sound deadening coating on concealed frame interiors.
- F. Touch-up damaged coatings ready to receive finish painting.

END OF SECTION

## SECTION 08 71 00

### DOOR HARDWARE

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Provide door hardware.
- B. Related Sections include the following:
  - 1. Division 8, Section "Hollow Metal Door and Door Frames".

##### 1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Samples: Submit two representative samples of each material specified indicating visual characteristics and finish. Include range samples if variation of finish is anticipated.
- C. Submit for approval hardware schedule proposed for use based on Owner's requirements.

##### 1.3 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Hardware for Fire-Rated Openings: NFPA 80, and local requirements.
- C. Materials and Application: ANSI A156 series standards.
- D. Hardware shall comply with ADA requirements for handle and pull force.

#### PART 2 PRODUCTS

##### 2.1 MATERIALS

- A. Door Hardware: Provide door hardware as per building standard.
  - 1. Manufacturers:
    - a. Hinges: Hager Hinge, McKinney/Parker and Stanley Hardware.
    - b. Cylinder Locksets and Latchsets: Corbin/Ruswin (2000 Series), Best 7-K.
    - c. Closers: Corbin Ruswin Architectural Hardware, LCN and Norton Door Control.

- d. Cylinder Locks and Deadbolts: Best (7A/9A Series) and Corbin/Ruswin Architectural Hardware.
  - e. Manual Flush Bolts: Glynn-Johnson.
  - f. Offline Electronic Lock: Schlage AD-250.
  - g. Accessories (Stops, coordinators, kick plates, etc.): Baldwin Hardware, Glynn-Johnson, Hager, Hiawatha, Ives, Rockwood Architectural.
2. Quality Level: Commercial.
  3. Locksets and Latchsets: Mortise type.
  4. Lock Cylinders: Interchangeable.
  5. Keying: Owner's requirements 7-pin (SFIC) small format interchangeable core.
  6. Hinges and Butts: Provide 3 steel hinges, full-mortise type at interior.
  7. Closer: Provide hydraulic door closer with hold open.
  8. Hardware Finishes: Satin stainless finish on exposed surfaces.
  9. Auxiliary Materials:
    - a. Stops and overhead door holders.
    - b. Soundstripping.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Follow guidelines of DHI 'Recommended Locations for Builder's Hardware and hardware manufacturers' instructions.
- B. Contractor to provide construction cores at all lockable locations prior to substantial completion. Wayne State University shall provide a core combination schedule and key quantity requirement to the contractor. The contractor shall provide and install permanent cores at the time of substantial completion.
- C. Adjust operation, clean and protect.

END OF SECTION

## SECTION 09 22 16

### NON-STRUCTURAL METAL FRAMING

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Provide non-structural metal framing for gypsum board assemblies.
- B. Related Sections include the following:
  - 1. Division 12, Section "Painted Metal Laboratory Casework".
  - 2. Division 8, Section "Hollow Metal Door and Door Frames".
  - 3. Division 9, Section "Gypsum Board Assemblies" for wall reinforcing.
  - 4. Division 10, Section "Fire Protection Specialties".
  - 5. Division 11, Section "Lab Accessories".

##### 1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.

##### 1.3 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Tolerances: Not more than 1/8 inch in 10 feet deviation from true plane, plumb, level and proper relation to adjacent surfaces in finished work.
- C. Fire Resistance for Fire-Rated Assemblies: ASTM E 119.
- D. Performance: Fire, structural, and seismic performance meeting requirements of building code and local authorities.

#### PART 2 PRODUCTS

##### 2.1 MATERIALS

- A. Steel Framing for Walls and Partitions:
  - 1. Manufacturers: Brady Construction Corp., Chicago Metallic Corp., Clark Dietrich, MBA Metal Framing, Ruskin Corp.
  - 2. Material Standard: ASTM C645.

3. Stud Thickness: 20 gauge (.0329 inch).
4. Stud Depth, Typical: 3-5/8 inches.
5. Auxiliary Framing Components: Furring brackets, resilient furring channels, Z-furring members, and non-corrosive fasteners.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

- A. Provide fire-rated systems where indicated and where required by authorities having jurisdiction.
- B. Where new partitions meet existing construction, remove existing cornerbeads to provide a smooth transition.
- C. Provide acoustical sealant at both faces at top and bottom runner tracks, wall perimeters, openings, expansion and control joints.

END OF SECTION

SECTION 09 51 00

ACOUSTICAL CEILINGS

PART 1 GENERAL

1.1 SUMMARY

- A. Provide acoustical ceilings and suspension systems:
  - 1. (ACT-2) Acoustical ceiling panels.
  - 2. Wire hangers, fasteners, main runners, cross tees, and wall angle moldings.
- B. Related Sections:
  - 1. Division 9, Section "Gypsum Board Assemblies".
  - 2. Division 23 - Mechanical Work
  - 3. Division 26 - Electrical Work

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Samples: Submit two representative samples of each material specified indicating visual characteristics and finish. Include range samples if variation of finish is anticipated.
- C. Shop Drawings: Layout and details of acoustical ceilings. Show locations of items which are to be coordinated with, or supported by the ceilings.
- D. Certifications: Manufacturer's certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards. For acoustical performance, each carton of material must carry an approved independent laboratory classification of NRC, CAC, and AC.
- E. Extra Stock: Submit extra stock equal to 2 percent of amount installed.

1.3 QUALITY ASSURANCE

- A. Single-Source Responsibility: Provide acoustical panel units and grid components by a single manufacturer.
- B. Comply with governing codes and regulations. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.



- C. Performance: Fire, structural, and seismic performance meeting requirements of building code and local authorities. Acoustical performance based on project requirements.
  - D. Fire Performance Characteristics: Identify acoustical ceiling components with appropriate markings of applicable testing and inspecting organization.
1. Surface Burning Characteristics: As follows, tested per ASTM E 84 and complying with ASTM E 1264 for Class A products.
- a. Flame Spread: 25 or less
  - b. Smoke Developed: 50 or less
2. Fire Resistance Ratings: As indicated by reference to design designations in UL Fire Resistance Directory, for types of assemblies in which acoustical ceilings function as a fire protective membrane and tested per ASTM E 119.
- a. Protect lighting fixtures and air ducts to comply with requirements indicated for rated assembly.
- E. Handle acoustical ceiling units carefully to avoid chipping edges or damaged units in any way.

### 1.3 REFERENCES

- A. American Society for Testing and Materials (ASTM):
  - 1. ASTM A 1008 Standard Specification for Steel, Sheet, Cold Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
  - 2. ASTM A 641 Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
  - 3. ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.
  - 4. ASTM C 423 Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
  - 5. ASTM C 635 Standard Specification for Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
  - 6. ASTM C 636 Recommended Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels.
  - 7. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials.
  - 8. ASTM E 1414 Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum.

9. ASTM E 1111 Standard Test Method for Measuring the Interzone Attenuation of Ceilings Systems.
10. ASTM E 1264 Classification for Acoustical Ceiling Products.
11. ASTM E 1477 Standard Test Method for Luminous Reflectance Factor of Acoustical Materials by Use of Integrating-Sphere Reflectometers.
12. ASTM D 3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
13. ASTM E 119 Standard Test Methods for Fire Tests of Building Construction and Material.

B. ASHRAE Standard 62.1-2004, "Ventilation for Acceptable Indoor Air Quality"

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical ceiling units to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical ceiling units, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical ceiling units carefully to avoid chipping edges or damaged units in any way.

#### 1.7 PROJECT CONDITIONS

- A. Space Enclosure:

All ceiling products and suspension systems must be installed and maintained in accordance with Manufacturer's written installation instructions for that product in effect at the time of installation and best industry practice. Prior to installation, the ceiling product must be kept clean and dry, in an environment that is between 32°F (0°C) and 120°F (49°C) and not subject to Abnormal Conditions. Abnormal conditions include exposure to chemical fumes, vibrations, moisture from conditions such as building leaks or condensation, excessive humidity, or excessive dirt or dust buildup.

The ceilings must be maintained to avoid excessive dirt or dust buildup that would provide a medium for microbial growth on ceiling panels. Microbial protection does not extend beyond the treated surface as received from the factory, and does not protect other materials that contact the treated surface such as supported insulation materials.

#### 1.8 WARRANTY

- A. Acoustical Panel: Submit a written warranty executed by the manufacturer, agreeing to repair or replace acoustical panels that fail within the warranty period. Failures include, but are not limited to:

1. Acoustical Panels: Sagging and warping as a result of defects in materials or factory workmanship.
2. Grid System: Rusting and manufacturer's defects
3. Acoustical Panels with BioBlock Plus or designated as inherently resistive to the growth of micro-organisms installed with Armstrong suspension systems: Visible sag and will resist the growth of mold/mildew and gram positive and gram negative odor and stain causing bacteria.

B. Warranty Period:

1. Acoustical panels: Ten (10) years from date of substantial completion.
2. Grid: Ten (10) years from date of substantial completion.
3. Acoustical panels and grid systems with HumiGuard Plus or HumiGuard Max performance supplied by one source manufacturer is thirty (30) years from date of substantial completion.

C. The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

## 1.9 MAINTENANCE

A. Extra Materials: Deliver extra materials to Owner. Furnish extra materials described below that match products installed. Packaged with protective covering for storage and identified with appropriate labels.

1. Acoustical Ceiling Units: Furnish quality of full-size units equal to 5.0 percent of amount installed.
2. Exposed Suspension System Components: Furnish quantity of each exposed suspension component equal to 2.0 percent of amount installed.

## PART 2 PRODUCTS

### 2.1 MATERIALS

- A. Mineral Fiber Acoustical Ceilings:
1. Manufacturers:
    - a. Armstrong World Industries.
    - b. USG.
    - c. Celotex.
  2. Design standard is Armstrong:
    - a. (ACT-2) BSL-2 Biology Lab, Microscopy and Equipment: Ultima Health Zone NRC item #1448.

## 2.2 ACOUSTICAL CEILING UNITS

### A. Acoustical Panels:

1. ULTIMA Health Zone High NRC:
  - a. Sound Absorption (NRC) 0.80
  - b. Sound Blocking (CAC) 35
  - c. Light Reflectance 86%
  - d. Sag/Humidity Resistance HumiGuard Plus
  - f. Fire Performance Class A (UL)
3. Surface Texture: Fine.
4. Composition: Mineral Fiber.
5. Color: White.
6. Size: 24-in X 48-in X 1-in.
  7. Edge Profile: Square Lay-In. Painted.
  8. Noise Reduction Coefficient (NRC): ASTM C 423; Classified with UL label on product carton.
  9. Ceiling Attenuation Class (CAC): ASTM C 1414; Classified with UL label on product carton.
  10. Emissions Testing: Section 01350 Protocol, < 13.5 ppb of formaldehyde when used under typical conditions required by ASHRAE Standard 62.1-2004, "Ventilation for Acceptable Indoor Air Quality".
  11. Flame Spread: ASTM E 1264; Fire Resistive.
  12. Light Reflectance (LR): ASTM E 1477; White Panel: Light Reflectance.
  13. Dimensional Stability: - Temperature is between 32°F (0° C) and 120°F (49° C). It is not necessary for the area to be enclosed or for HVAC systems to be functioning.
  14. Antimicrobial Protection: Inherent - Resists the growth of mold/mildew and bacterial growth.

## 2.3 SUSPENSION SYSTEMS

- A. Components: All main beams and cross tees shall be commercial quality hot-dipped galvanized (galvanized steel, aluminum, or stainless steel) as per ASTM A 653. Main beams and cross tees are double-web steel construction with

15/16 IN type exposed flange design. Exposed surfaces chemically cleansed, capping pre-finished galvanized steel (aluminum or stainless steel) in baked polyester paint. Main beams and cross tees shall have rotary stitching (exception: extruded aluminum or stainless steel).

1. Structural Classification: ASTM C 635 HD.
  2. Color: White and match the actual color of the selected ceiling tile, unless noted otherwise.
  3. Design standard is Prelude 15/16" Exposed Tee as manufactured by Armstrong World Industries, Inc.
- B. Attachment Devices: Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.
- C. Wire for Hangers and Ties: ASTM A 641, Class 1 zinc coating, soft temper, pre-stretched, with a yield stress load of at least three design load, but not less than 12 gauge.
- D. Edge Moldings and Trim: Metal or extruded aluminum of types and profiles indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations, including light fixtures, that fit type of edge detail and suspension system indicated. Provide moldings with exposed flange of the same width as exposed runner.
- E. Accessories  
1" Flush "T" Act. to Drywall Transition Molding

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Do not proceed with installation until all wet work such as concrete, plastering and painting has been completed and thoroughly dried out, unless expressly permitted by manufacturer's printed recommendations.

### 3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less than half width units at borders, and comply with reflected ceiling plans. Coordinate panel layout with mechanical and electrical fixtures.
- B. Coordination: Furnish layouts for preset inserts, clips, and other ceiling anchors whose installation is specified in other sections.
  1. Furnish concrete inserts and similar devices to other trades for installation well in advance of time needed for coordination of other work.

### 3.3 INSTALLATION

- A. Install suspension system and panels in accordance with the manufacturer's instructions, and in compliance with ASTM C 636 and with the authorities having jurisdiction.
- B. Suspend main beam from overhead construction with hanger wires spaced 4-0 on center along the length of the main runner. Install hanger wires plumb and straight.
- C. Install wall moldings at intersection of suspended ceiling and vertical surfaces. Miter corners where wall moldings intersect or install corner caps.
- D. For reveal edge panels: Cut and reveal or rabbet edges of ceiling panels at border areas and vertical surfaces.
- E. Install acoustical panels in coordination with suspended system, with edges resting on flanges of main runner and cross tees. Cut and fit panels neatly against abutting surfaces. Support edges by wall moldings.

### 3.4 ADJUSTING AND CLEANING

- A. Replace damaged and broken panels.
- B. Clean exposed surfaces of acoustical ceilings, including trim, edge moldings, and suspension members. Comply with manufacturer's instructions for cleaning and touch up of minor finish damage.
  - 1. Ceiling Touch-Up Paint, (Item #5760, 8oz. bottles) (Item #5761, quart size cans), "global white" latex paint should be used to hide minor scratches and nicks in the surface.
- C. Remove and replace work that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

## SECTION 09 65 13

### RESILIENT BASE AND ACCESSORIES

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Provide resilient wall base and accessories.
- B. Related Sections include the following:
  - 1. Division 9, Section "Gypsum Board Assemblies".
  - 2. Division 9, Section "High Performance Coatings".
  - 4. Division 12, Section "Painted Metal Lab Casework".

##### 1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Samples: Submit two representative samples of each material specified indicating visual characteristics and finish. Include range samples if variation of finish is anticipated.
- C. Submit extra stock equal to 2% of total used.

##### 1.3 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Performance: Fire performance meeting requirements of building code and local authorities.

#### PART 2 PRODUCTS

##### 2.1 MATERIALS

- A. Resilient Wall Base:
  - 1. Manufacturers:
    - a. Armstrong World Industries.
    - b. Nora Rubber.
    - c. Flexco.
    - d. Roppe.
    - e. Johnsonite.

- f. Mannington.
  - g. Commercial Resilient.
  - h. Mercer Products.
  - i. NAFCO.
  - j. VPI Floor Products.
- 2. Color: See schedule on architectural plans.
  - 3. Standard: ASTM F 1861.
  - 4. Type: TS (rubber, vulcanized thermoset).
  - 5. Style: Straight.
  - 6. Thickness: 0.125 inch
  - 7. Height: 4 inches.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

- A. Comply with manufacturer's instructions and recommendations. Install in proper relation to adjacent work.
- B. Install base and accessories to minimize joints. Install base with joints as far from corners as practical.
- C. Clean, polish, and protect.

END OF SECTION



SECTION 09 65 16  
VINYL SHEET FLOORING

PART 1 GENERAL

1.1 THIS SECTION INCLUDES

- A. Flooring and accessories as shown on the drawings and schedules and as indicated by the requirements of this section.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Submit shop drawings, seaming plan, coving details, and manufacturer's technical data, installation and maintenance instructions for flooring and accessories.
- C. Submit the manufacturer's standard samples showing the required colors for flooring, welding rods, and applicable accessories.
- D. Submit the manufacturer's certification that the flooring has been tested by an independent laboratory and complies with the required fire tests.

1.3 QUALITY ASSURANCE

- A. Select an installer who is competent in the installation of resilient sheet flooring using heat-welded seam using manufacturers installation and welding method.
- B. Provide types of flooring and accessories supplied by one manufacturer, including leveling and patching compounds, and adhesives.
- C. If required, provide flooring material to meet the following fire test performance criteria as tested by a recognized independent testing laboratory:
  - a. ASTM E 648 Critical Radiant Flux of 0.45 watts per sq. cm. or greater, Class I.
  - b. ASTM E 662 (Smoke Generation) Maximum Specific Optical Density of 450 or less.

1.4 PERFORMANCE REQUIREMENTS

- A. General Performance:

|                               |                      |                                   |
|-------------------------------|----------------------|-----------------------------------|
| General Performance           | ISO 10581 (EN 649)   | Conforms                          |
|                               | ASTM F1913           | Conforms                          |
|                               | ASTM F1700           | Conforms                          |
| Use Area                      | ISO 10874 (EN 685)   | 23, 34, 43                        |
| Slip Resistance               | EN 13893             | Class DS                          |
|                               | DIN 51130            | R10                               |
|                               | ASTM D2047           | SCOF <sub>≥</sub> 0.6             |
| Binder Content                | ISO 10581            | Type I                            |
| Abrasion Resistance           | EN 660-2             | Group T                           |
| Reaction to Fire              | EN 13501-1           | Class Bfl-S1                      |
|                               | ASTM E662            | <450                              |
|                               | ASTM E648            | Class 1                           |
|                               | CAN/ULC S102.2       | FSV < 300; SDV                    |
|                               | AS ISO 9239-1        | < 500<br>Class B                  |
| Static Electrical Propensity  | EN 1815              | ≤2.0kV Classified as 'antistatic' |
| Residual Indentation          | ASTM F970 (Modified) | ≤0.125mm (750psi)                 |
|                               | ISO 24343-1 (EN 433) | ≤0.10mm                           |
| Castor Chair (continuous use) | ISO 4918 (EN 425)    | Suitable                          |

### Acoustic Performance

|                        |             |     |
|------------------------|-------------|-----|
| Impact Sound Reduction | ISO 10140-3 | 2dB |
|------------------------|-------------|-----|

### Maintenance Performance

|                         |   |                 |
|-------------------------|---|-----------------|
| Resistance to Chemicals | ISO 26987 (EN 423)  | Good resistance |
| Alco Hand Gels          | Compatible for use with most commonly used alco-based hand gels |                 |
| Steam Cleaning          | Suitable for steam cleaning on a periodic basis                 |                 |

All Polyflor commercial sheet vinyl ranges provide a continuous, impervious and hygienic flooring solution which can be confidently cleaned in accordance with recommended maintenance procedures and approved maintenance products. The implementation of an effective cleaning regime is the most important defense against infection.

### Hygiene

|                                     |                |                        |
|-------------------------------------|----------------|------------------------|
| Bacterial Resistance                | ISO 846 Part C | Does not favour growth |
| Clean Rooms                         | ISO 14644-1    | Class 4                |
| Ease of Radioactive Decontamination | ISO 8690       | Excellent              |

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Flooring material and adhesive shall be acclimated to the installation area for a minimum of 48 hours prior to installation.

#### 1.5 PROJECT CONDITIONS

- A. Install flooring and accessories after the other finishing operations, including painting, have been completed. Close spaces to traffic during the installation of the flooring.

#### 1.2 WARRANTY

- A. Warranty Period: Manufacturer's standard warranty against manufacturing defects and wearing.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
  - a. Armstrong.
  - b. Johnsonite.
  - c. LG Flooring.
  - d. Polyflor.
  - e. Shaw Commercial Hard Surface.
- B. Substitutions: Subject to review and approval of the architect.

#### 2.2 MATERIALS: RESILIENT SHEET FLOORING

- A. Basis of Design: Palettone PUR sheet vinyl flooring has a 2mm gauge and features a high quality, cross-linked, UV cured polyurethane reinforcement that protects the floor covering by resisting soiling and scuffing and features polish-free maintenance.
  - 1. Color: As per finish schedule.
  - 2. Size: 2.187yd x 21.872 yd.
  - 3. Thickness: nominal total thickness of 0.080 in. (2.0 mm).
  - 4. Auxiliary Materials: Provide matching vinyl weld rod by same manufacturer and intended for heat welding of seams. Color shall be compatible with field color of flooring.

#### 2.3 ADHESIVES

- A. Provide Commercial Sheet Flooring Adhesive, as recommended by the flooring

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SPECIFICATIONS

VINYL SHEET FLOORING

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manufacturer.

- B. Provide Seam Adhesive at seams as recommended by the flooring manufacturer.

### 2.3 ACCESSORIES

- A. Provide Palettone PUR welding rods #8637 to match flooring color.
- B. Provide transition/reducing strips tapered to meet abutting materials.
- C. Provide threshold of thickness and width as shown on the drawings.

## PART 3 EXECUTION

### 3.1 INSPECTION

- A. Examine subfloors prior to installation to determine that surfaces are smooth and free from cracks, holes, ridges, and other defects that might prevent adhesive bond or impair durability or appearance of the flooring material.
- B. Inspect subfloors prior to installation to determine that surfaces are free from curing, sealing, parting and hardening compounds; residual adhesives; adhesive removers; and other foreign materials that might prevent adhesive bond. Visually inspect for evidence of moisture, alkaline salts, carbonation, dusting, mold, or mildew.
- C. Report conditions contrary to contract requirements that would prevent a proper installation. Do not proceed with the installation until unsatisfactory conditions have been corrected.
- D. Failure to call attention to defects or imperfections will be construed as acceptance and approval of the subfloor. Installation indicates acceptance of substrates with regard to conditions existing at the time of installation.

### 3.2 PREPARATION

- A. Smooth concrete surfaces, removing rough areas, projections, ridges, and bumps, and filling low spots, control or construction joints, and other defects with Armstrong [S-183 Fast-Setting Cement-Based Underlayment][S-184 Fast-Setting Cement-Based Patch and Skim Coat][S-194 Fast-Setting Cement-Based Patch and Underlayment] as recommended by the flooring manufacturer.
- B. Remove paint, varnish, oils, release agents, sealers, and waxes. Remove residual adhesives as recommended by the flooring manufacturer. Remove curing and hardening compounds not compatible with the adhesives used, as indicated by a bond test or by the compound manufacturer's recommendations for flooring. Avoid organic solvents.
- C. Perform pH tests on concrete floors regardless of their age or grade level. All test results shall be documented and retained.
- D. Vacuum or broom-clean surfaces to be covered immediately before the application of flooring. Make subfloor free from dust, dirt, grease, and all foreign materials.

### 3.3 INSTALLATION OF SHEET FLOORING

- A. Install flooring in strict accordance with the latest edition of manufacturers' installation manual.

- B. Install flooring wall to wall and extend flooring into toe spaces.
- C. Scribe, cut, and fit or flash cove to permanent fixtures, columns, walls, partitions, pipes, outlets, and built-in furniture and cabinets.
- D. Adhere flooring to the subfloor without cracks, voids, raising and puckering at the seams. Roll with a 100-pound (45.36 kilogram) roller in the field areas. Hand-roll flooring at the perimeter and the seams to assure adhesion. Refer to specific rolling instructions of the flooring manufacturer.
- E. Lay flooring to provide a minimum number of seams. Avoid cross seams, filler pieces, and strips. Match edges for color shading and pattern at the seams in compliance with the manufacturer's recommendations.
- F. Install flooring with adhesives, tools, and procedures in strict accordance with the manufacturer's written instructions. Observe the recommended adhesive trowel notching, open times, and working times.
- G. Prepare heat-welded seams with special routing tool supplied for this purpose and heat weld with vinyl welding rod in seams. Use methods and sequence of work in conformance with written instructions of the flooring manufacturer. Finish all seams flush and free from voids, recesses, and raised areas.
- H. Provide integral flash cove wall base where shown on the drawings, including cove fillet support strip and top edge cap trim. Construct flash cove base in accordance with the flooring manufacturer's instructions.

#### 3.4 INSTALLATION OF ACCESSORIES

- A. Place resilient edge strips tightly butted to flooring, and secure with adhesive recommended by the edge strip manufacturer. Install edge strips at edges of flooring that would otherwise be exposed.

#### 3.5 PROTECTION

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

#### 3.6 MAINTENANCE

- A. Comply with manufacturer's instructions for proper cleaning and maintenance of the products.

END OF SECTION

## SECTION 09 91 00

### PAINTS

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. (PNT-1) and (PNT-5) Provide painting and surface preparation.
- B. Related Sections include the following:
  - 1. Division 8, Section "Hollow Metal Door and Door Frames".
  - 2. Division 9, Section "Gypsum Board Assemblies".

##### 1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Samples: Submit two representative samples of each material specified indicating visual characteristics and finish. Include range samples if variation of finish is anticipated.
  - 1. Include manufacturers full range of color and finish options if additional selection is required.
- C. Extra Stock: Submit 1 unopened gallons of each paint and color used in the project.

##### 1.3 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Regulations: Compliance with VOC and environmental regulations.

#### PART 2 PRODUCTS

##### 2.1 MATERIALS

- A. (PNT-1) Painting – Walls and Ceiling: interior wall and ceiling surfaces.
  - 1. Manufacturers:
    - a. Sherwin Williams.
    - b. Pratt & Lambert.
    - c. Benjamin Moore.
    - d. ICI Paint Stores.
    - e. PPG Architectural Finishes.
  - 2. Primary Coating Type: Low VOC water-based epoxy paints.
  - 3. Gypsum Board Walls in Rooms and Corridors:

- a. Paint Systems: Primer plus two finish coats.
  - b. Finish: Water-based epoxy paint with a eggshell finish, except toilet rooms, laboratories and storage rooms to be satin finish.
  - c. Color: Refer to architectural plans and finish schedule for locations.
4. Masonry Walls:
- a. Paint Systems: Primer with void filler plus two finish coats.
  - b. Finish: Latex enamel paint with an eggshell finish.
  - c. Color: Refer to architectural plans and finish schedule for locations.
- B. (PNT-5) Painting – Interior Hollow Metal Doors and Door Frames:
- 1. Manufacturers:
    - a. Sherwin Williams.
    - b. Pratt & Lambert.
    - c. Benjamin Moore.
    - d. ICI Paint Stores.
    - e. PPG Architectural Finishes.
  - 2. Primary Paint Systems: Rust-inhibiting primer plus two finish coats, sprayed application.
  - 3. Finish: Alkyd based enamel paints with a satin finish.
    - a. Color: Refer to architectural plans and finish schedule for locations.
- C. Fire Rated Assemblies: New and Existing.
- 1. Paint "ONE HOUR RATED in stencil form with letters not less than 1.5" in height and the color red on a white or existing light contrasting background 12" below ceiling/floor deck every 10 feet of continuous wall surface and not less than once in each room adjoining the wall.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Inspect surfaces, report unsatisfactory conditions in writing; beginning work means acceptance of substrate.
- B. Comply with manufacturer's instructions and recommendations for preparation, priming and coating work. Coordinate with work of other sections.
- C. At existing areas to be repainted, remove blistered or peeling paint to sound substrates. Remove chalk deposits and mildew and wash all surfaces with mild detergent. Perform related minor preparation including caulk and glazing compounds. Spot prime bare areas before priming and painting as specified.
- D. Re-coat or remove and replace work which does not match or shows loss of adhesion. Clean up, touch up and protect work.

END OF SECTION

SECTION 10522

FIRE EXTINGUISHERS, CABINETS, AND ACCESSORIES

PART 1 GENERAL

1.01 SUMMARY

- A. This Section includes the following:
  - 1. Portable fire extinguishers
- B. Related Sections include the following
  - 1. Section 09 21 16 - Gypsum Board Assemblies
  - 2. Section 09 22 16 - Non-structural Metal Framing
  - 3. Section 09 91 00 - Paints

1.02 REFERENCES

- A. American Disability Act (ADA), ANSI A 117.1 – Accessible and Usable Buildings and Facilities
- B. American Society for Testing and Materials (ASTM)
  - A1008/A1008M Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
  - C1036 Standard Specification for Flat Glass
  - E814 Standard Test Method for Fire Tests of Through-Penetration Fire Stops
- C. Federal Standard (FED-STD)
  - FED-STD-795 Uniform Federal Accessibility Standards (UFAS)
- D. National Fire Protection Association (NFPA)
  - NFPA 10 Portable Fire Extinguishers
- E. International Building Code (IBC)
- F. International Fire Code (IFC)



1.03 SUBMITTALS

- A. Submit brochure and product data.
- B. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.

1.04 QUALITY ASSURANCE

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10.
- B. Fire Extinguishers: Listed and labeled by Underwriter's Laboratory (UL) or Factory Mutual (FM) for type, rating, and classification.
- C. Accessibility Requirements: Comply with requirements applicable in the jurisdiction of the project, including but not limited to ADA and ICC/ANSI A117.1 requirement as applicable.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
  - 1. J.L. Industries, Inc. a division of Activar Construction Products Group
  - 2. Larsen's Manufacturing Co.
  - 3. Potter Roemer LLC
  - 4. Kidde Residential and Commercial Division, subsidiary of Kidde plc.

2.02 MATERIALS

- A. Cold-Rolled Steel Sheet: Carbon steel, complying with ASTM A1008/A1008M, commercial quality, stretcher leveled, temper rolled.

2.03 PORTABLE FIRE EXTINGUISHERS

- A. General: Provide fire extinguishers of type, size, and capacity for each cabinet and other locations indicated.
  - 1. Product: A 10-lb, multi-purpose, UL listed, dry chemical fire extinguisher with a minimum rating of Class A-B-C.
- B. Mounting Brackets: Manufacturer's standard steel bracket, designed to secure extinguisher, of sizes required for types and capacities of fire extinguisher indicated, with plated or baked-enamel finish.
- C. Fire extinguishers installed outside shall be located in approved weather-tight fire extinguisher cabinets.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Examine walls and partitions for suitable framing depth and blocking where recessed and semirecessed cabinets are to be installed. Verify that rough openings for cabinets are correctly sized and located.
- B. Examine fire extinguishers for proper charging and tagging. Remove and replace damaged, defective, or undercharged units.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02 INSTALLATION OF FIRE EXTINGUISHERS

- A. Comply with manufacturer's written instructions for installing fire extinguishers and mounting brackets.
- B. Mounting Height: Install extinguishers at heights indicated below.
  - 1. Install fire extinguishers mounted on hangers or brackets attached to a wall so that the top of the fire extinguisher is not more than 3½ ft. above the floor.
  - 2. In no case shall the clearance between the bottom of the fire extinguisher and the floor be less than 4 inches.
- C. Locations: Install extinguishers at locations indicated below.
  - 1. Install fire extinguishers at locations specified on the drawings or as directed by the authority having jurisdiction.
  - 2. Fire extinguishers shall be conspicuously located, along normal paths of travel, including exits from areas. Extinguishers shall not be obstructed or obscured from view.
- D. Install portable fire extinguishers on the hanger or in the bracket supplied, or place in the fire extinguisher cabinets provided. Verify that the extinguisher operating instructions face outward.

### 3.03 INSTALLATION OF FIRE EXTINGUISHER CABINETS

- A. Comply with manufacturer's written instructions for installing fire extinguisher cabinets.
- B. Mounting Height: Install fire extinguisher cabinets at the height required so that the top of the fire extinguisher is not more than 54 inches above the floor.
- C. Install fire extinguisher cabinets at locations specified on the drawings.

- D. Fire extinguisher cabinets shall protrude no more than 4 inches into corridors, passageways, or aisles.
- E. Repair/paint wall surfaces surrounding fire extinguisher cabinet damaged during installation to match existing wall surface.

3.04 SIGNAGE

- A. Identify bracket-mounted extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to wall surface.
- B. Identify fire extinguisher in cabinet with the words "FIRE EXTINGUISHER" applied to door.
  - 1. Application Process: Decals
  - 2. Lettering Color: Red
  - 3. Orientation: Vertical

3.05 ADJUSTING, CLEANING, AND PROTECTION

- A. Adjust cabinet doors that do not swing or operate freely.
- B. Refinish or replace cabinets and doors damaged during installation.
- C. Provide protection and maintain conditions that ensure that cabinets and doors are without damage or deterioration at the time of Construction Completion.

END OF SECTION

SECTION 11 53 13.11

HIGH PERFORMANCE FUME HOODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Work includes providing laboratory fume hoods complete with factory installed wired and piped service fixtures as indicated on Drawings and coordinated with laboratory casework specified in Division 12 and Alternate No. 5 (Phase 3): Replace Fume Hoods - Replace 27 fume hoods, associated base cabinets, and ceiling closure panels. (Note this alternate is broken out for funding/budgeting purposes only.)
- B. Coordinate installation of fume hood controls with control system specified by Mechanical.
- C. Section Includes: High Performance Laboratory Fume Hoods Typical, except specialty hoods as noted on drawings.
- D. Related Sections:
  - 1. Section 11 53 43, "Service Fittings and Fixtures".
  - 2. Section 11 53 43.10, "Laboratory Accessories".
  - 3. Section 12 35 53.13, "Painted Metal Laboratory Casework".
  - 4. Division 22, "Plumbing".
  - 5. Division 23, "Heating Ventilation and Air Conditioning".
  - 6. Section 23 09 01, "Laboratory Controls".
  - 7. Division 26, "Electrical".

1.3 Related Work to Be Performed by Skilled Mechanical, Electrical and Plumbing Trades:

- A. Final installation of all plumbing, services and electrical fixtures attached to fume hood or benchtop (excluding piping and wiring within fume hoods).
- B. Final connection to service lines of all plumbing, services and electrical fixtures attached to fume hoods. Pressure testing of all plumbing after final connection.

#### 1.4 REFERENCES

- A. SEFA 1-Latest Edition: Laboratory Fume Hoods – Design, Materials, Use and Testing Guidelines; Science Equipment and Furniture Association (SEFA)
- B. ISO 9001:2008 – Quality Management, International Standards Organization (ISO)
- C. Architectural Barriers Act (ABAAS) Accessibility Guidelines for Buildings and Facilities.
- D. ANSI/ASHRAE 110, 2016 Methods of Testing Performance of Laboratory Fume Hoods.
- E. UL1805 Standard for Laboratory Hoods and Cabinets.
- F. American National Standards Institute (ANSI)
  - 1. ANSI/ASHRAE Standard 110-2016 – Method of Testing Performance of Laboratory Fume Hoods
  - 2. ANSI/ISO/ASQC Q9001-2015 – Quality Systems
- G. National Fire Protection Association (NFPA)
  - 1. NFPA 45 – Fire Protection for Laboratories Using Chemicals
- H. National Electrical Code
- I. CPSC Standard 16 CF R1201 – Safety Glazing Materials Building Materials

#### 1.5 DESCRIPTION

All benchtop typical high-performance fume hoods for variable air volume (VAV) shall be furnished, installed, and demonstrated to properly perform in accordance with the specifications set forth herein.

#### 1.6 PERFORMANCE REQUIREMENTS

- A. Fume Hoods, shall be designed to meet or exceed the American Standard for Laboratory Ventilation and the American Industrial Hygiene Association standard as described in ANSI/AIHA Z9.5. This standard of performance shall be verified through factory testing in accordance with the established protocol as set out by the ANSI/ASHRAE 110 standard.
- B. Fume hoods shall function as ventilated, enclosed workspaces, designed to capture, confine and exhaust fumes, vapors and particulate matter produced or generated within the enclosure. Design fume hoods so that, when connected to exhaust system that provides proper exhaust volume under normal laboratory conditions, fume hoods will operate in a safe, efficient manner, within acceptable tolerances for face velocities specified. Dead air pockets and reverse air currents will not be permitted along surface of hood interiors.

- C. Structural Performance: Provide fume hood components capable of withstanding the following loads without permanent deformation, excessive deflection, or binding of cabinet drawers and doors:
  - 1. Fume Hood Base Cabinets and Stands: refer to Division 12, Section "Painted Metal Laboratory Casework" for structural performance requirements.
- D. Fume hood shall be designed to minimize static pressure loss. Maximum average static pressure loss readings taken three diameters above the hood outlet from four points, 90 degrees apart, shall not exceed the following maximums with sash in safe design open operating position (80%):

| <u>Size</u> | <u>Face Velocity</u> | <u>Measured S.P.L. (W.G.)</u> |
|-------------|----------------------|-------------------------------|
| 4-foot      | 60 F.P.M.            | .08 inches                    |
| 5-foot      | 60 F.P.M.            | .08 inches                    |
| 6-foot      | 60 F.P.M.            | .12 inches                    |

- E. Average Illumination of Work Area: 100 foot-candles. Work area shall be defined as the area inside the superstructure from side to side and from face of baffle to the inside face of the sash, and from the working surface to a height of 28 inches.

#### 1.7 SUBMITTALS

- A. Product Data: Submit manufacturer's data for each component furnished. Include component dimensions, configurations, construction details, joint details, and attachments. Indicate location, size and service requirement for each utility connection.
- B. Shop Drawings:
  - 1. Provide scalable drawing(s) of each hood, illustrating front, side, and top views. Drawings shall include all options, special features, component dimensions, construction details, and tolerances. Particular attention shall be given to installation interfaces as required by other trades (plumbing fixtures, exhaust connections, electrical requirements, etc.). Drawings shall be available on electronic format for viewing.
  - 2. Indicate locations of blocking and other supports required for installing fume hoods.
  - 3. Indicate locations and types of service fittings, together with associated service connections required.
  - 4. Indicate plumbing connections, duct connections, electrical connections, and locations of access panels.
  - 5. Include roughing-in information for mechanical, plumbing, and electrical connections.

6. Show adjacent walls, doors, windows, other building components, laboratory casework, and other laboratory equipment. Indicate clearances from above items.
7. Coordinate shop drawings with other work involved.
8. Preparation instructions and recommendations.
9. Storage and handling requirements and recommendations.
10. Installation methods.

C. Selection Samples:

Submit the following:

1. One complete set of metal color chips representing the manufacturer's full range of available colors.
- D. Submit detailed seismic anchorage and attachment drawings and calculations complying with all Uniform Building Code requirements and regulations for seismic restraint (where applicable).
- E. Operation and Maintenance Manuals: Submit bound manual with operating and maintenance instructions, describe proper operating procedures, emergency instructions, maintenance and replacement schedules, components parts list, and nearest local factory representative for components and emergency repairs.
- F. Instructions to be inscribed on instruction plate to be attached to hood, as specified in Part 2 of this Section.
- G. Professional quality video - minimum 15 minutes in length on proper hood usage.
- H. Test Reports: Submit test reports on each size and type of hood verifying conformance to test performances specified. Test report must accompany each hood as part of installation and usage package. Submit independent test reports as required by specification.
1. Submit test reports on each size and type of hood verifying conformance to test performances specified. Test report must accompany each hood as part of installation and usage package. Submit independent test reports by both the manufacturer and field testing as required by specification – See attached Appendix B.
- I. Certifications: Submit certification stating that items in this section are installed per applicable referenced codes, standards, specifications and are complete and ready for intended function. Copies of all hood certification test reports shall be included. Certificates must be provided with the signature of a qualified individual of the supplier.

- J. Noise Criteria: Test data of octave band analysis verifying hood is capable of a 50 NC value when connected to a 50 NC HVAC source. Reading taken 3' in front of open sash at 110 fpm face velocity.
- K. Fume hoods under this section shall be classified to UL standard 1805 which covers, fire, electrical and mechanical hazards. Approval with scope limited to electrical hazards shall not be an acceptable substitute for UL1805.
- L. All products must be manufactured or substantially transformed in the United States or TAA designated country. Documentation to be provided with first submittal.
  - 1. USA Certificate of Origin: Manufacturer shall supply with first submittal, an example of their Certificate of Origin declaring products are wholly manufactured and assembled specifically in the United States, including city and state locations. A notarized Certificate of Origin shall be provided with closeout documents.

## 1.8 QUALITY ASSURANCE

- A. Single Source Responsibility: Fume Hoods and accessories included in this section shall be manufactured or furnished by the same manufacturer or laboratory furniture supplier for single responsibility.
- B. Manufacturer shall identify and designate a full-time factory representative for on-site supervision and coordination during the installation of fume hoods and all components.
- C. Provide and install service fixtures in laboratory fume hoods, manufactured or furnished by laboratory fume hood company for single responsibility.
- D. Fume hood construction and performance including all electrical and mechanical components shall be designed in accordance with all applicable IBC, OSHA, NFPA and NEC.
- E. Fume Hood Standard: Provide fume hoods complying with the requirements of SEFA 1.1, "Laboratory Fume Hoods - Recommended Practices".
- F. Installer's Qualifications: Factory certified by the manufacturer.
- G. Safety Glass: Products complying with ANSI Z97.1 and testing requirements of 16 CFR, part 1201 for Category II materials.
  - 1. Subject to compliance with requirements, permanently mark safety glass with certification label of SGCC or another certification agency acceptable to authorities having jurisdiction.
- H. Manufacturer's Qualifications: Modern plant with proper tools, dies, fixtures and skilled workmen to produce high quality laboratory casework and fume hoods, and shall meet the following minimum requirements:
  - 1. Five years or more experience in manufacture of laboratory casework and fume hoods of type specified.
  - 2. Ten installations of equal or larger size and requirements.



3. List of manufacturing facilities.
  4. Manufacturer of fume hoods shall have the capability within their facility of performing fume hood tests based on the latest ANSI/ASHRAE Specification 110.
- I. Demonstrate fume hood performance before shipment by testing according to ASHRAE 110. Provide testing facility, instruments, equipment, and materials needed for tests.
- J. Design Data Reports: Manufacturer shall submit test data and design criteria which are in compliance with the project specifications.
1. As Manufacturer Tests (AM): to be performed by the manufacturer. See Appendix A for the required Inspection Data Sheets.
    - a. Cross-Draft Velocity Test
    - b. Face Velocity Test
    - c. Hood Monitor and Alarms Test
    - d. Exhaust Flow Measurement
    - e. Hood Static Pressure Measurement
    - f. Dynamic VAV Response and Stability Test
    - g. Airflow Visualization Test (Smoke)
    - h. Sash Movement Effect Test
    - i. \*Tracer Gas Containment Test (Static Mannequin)
    - j. \*Perimeter Scan Test
  2. After Installation Test Reports (AI): to be performed by an independent 3rd party. See Appendix B for the Performance Test Data Sheet.
    - a. Cross-Draft Velocity Test
    - b. Face Velocity Test
    - c. Hood Monitor and Alarms Test
    - d. Exhaust Flow Measurement
    - e. Hood Static Pressure Measurement
    - f. Dynamic VAV Response and Stability Test
    - g. Airflow Visualization Test (Smoke)
    - h. Sash Movement Effect Test
    - i. \*Tracer Gas Containment Test (Static Mannequin)
    - j. \*Perimeter Scan Test
  3. \* All LFHs must be tracer gas tested during AM and AI testing. The gas shall be sulfur hexafluoride (SF<sub>6</sub>) or an alternate gas (with similar characteristics) that is approved by the latest version of ANSI Z9.5/ASHRAE 110 or the EPA authority having jurisdiction.
- K. Factory Testing: Prior to delivery to the job site, every hood shall be tested to manufacturer's specifications for performance and safety and a copy of the "Inspection Report" report shall accompany each hood. One representative sample hood of each type shall have been tested according to the test procedures outlined below to verify that subsequent production models meet the "Personnel Protection Factor" criteria. The test facility (emulating actual operating conditions), samples, apparatus and instruments to be supplied by the manufacturer.
1. ASHRAE 110-2016: Consists of the following individual tests, "as manufactured":

- a. Tracer Gas:
    - 1) A tracer gas is introduced 6 inches behind the sash at a rate of 4 liters per minute. A sensor located outside the work zone monitors for gas leakage from the hood face. The "Personnel Protection Factor" shall be less than 4.0 AM at less than 0.1 PPM, in the center, right and left sides of the work access opening.
  - b. Face Velocity: Measured velocity shall fall within design.
  - c. Smoke Patterns: A smoke source is passed around the periphery of the access opening. No reverse flow or refluxing shall occur.
  - d. Saturation Smoke Test: Release of a large volume of smoke shall result in total containment.
2. SEFA 1-2010: Consists of the following tests, usually conducted in the field to verify "as installed performance" performance:
- a. Face Velocity (sash fully open):
  - b. Using a suitable velocimeter, determine that face velocity meets the design requirements.
  - c. Airflow Smoke Patterns (sash fully open):
  - d. A source of smoke is passed around the exterior/interior of the work access-opening periphery along with an interior smoke candle. No reverse flow, refluxing, or escape shall be observed.
- L. Field Testing: Each cabinet shall be subjected to field certification per manufacturer's procedures and performance criteria, after the cabinets are completely installed and all exhaust/supply systems fully operational and balanced as intended. The field tests shall be conducted by an independent certifying agency, selected by the manufacturer, and approved by the Owner, at no expense to the Owner. The Owner or his representative may witness the tests. In the event that cabinets cannot be certified, a detailed report shall be prepared outlining deficiencies.
- M. Training: After the equipment has been accepted and is fully operational as intended, the manufacturer shall coordinate with the Owner for training on the proper operation, adjustment, and maintenance of the equipment at no expense to the Owner. A maximum of two, four-hour training sessions shall be required.

## 1.9 WARRANTY

- A. Furnish a written warranty that Work performed under this Section shall remain free from defects as to materials and workmanship for a period of two (2) years from date of shipment. Defects in materials and workmanship that may develop within this time are to be replaced without cost or expense to the Owner.

Defects include, but are not limited to:

1. Ruptured, cracked, or stained coating
2. Discoloration or lack of finish integrity
3. Cracking or peeling of finish
4. Slippage, shift, or failure of attachment to wall, floor, or ceiling

5. Weld or structural failure
6. Warping or unloaded deflection of components
7. Failure of hardware

#### 1.10 DELIVERY, STORAGE AND HANDLING

##### A. Packaging, Shipping, Handling and Unloading

1. Packaging: Products shall have packaging adequate enough to protect finished surfaces from soiling or damage during shipping, delivery and installation.
2. Delivery: Fume hood delivery shall only take place after painting, utility rough-ins and related activities are completed that could otherwise damage, soil or deteriorate fume hoods in installation areas.
3. Handling: Care, such as the use of proper moving equipment, experienced movers, etc., shall be used at all times to avoid damaging the fume hoods. Until installation takes place, any wrapping, insulation or other method of protection applied to products from the factory will be left in place to avoid accidental damage.

##### B. Acceptance at Site:

1. Fume hoods will not be delivered or installed until the conditions specified under Part 3, Installation section of this document have been met.

##### C. Storage:

1. Fume hoods shall be stored in the area of installation. If, prior to installation, it is necessary for the fume hoods to be temporarily stored in an area other than the installation area, the environmental conditions shall meet the environmental requirements specified under the Project Site Conditions article of this section.

##### D. Waste Management and Disposal:

1. The supplier of the laboratory fume hoods are responsible for removing any waste or refuse resulting from the installation of, or work pertaining to laboratory fume hoods; thereby leaving the project site clean and free of debris. Trash container(s) to be provided by others.

#### 1.11 PROJECT SITE CONDITIONS

- A. Building must be enclosed (windows and doors sealed and weather-tight).
- B. An operational HVAC system that maintains temperature and humidity at occupancy levels must be in place.
- C. Adjacent and related work shall be complete.

- D. Ceiling, overhead ductwork and lighting must be installed.
- E. Site must be free of any further construction such as "wet work".
- F. Required casework must be installed accurately (plumb and level) and the project must be ready for fume hood installation.

## PART 2 – PRODUCTS

### 2.1 MANUFACTURER

- A. Acceptable Manufacturers:
  - 1. Air Master Systems Corp.
  - 2. CiF Lab Solutions, c/o Stonecreek Interior Systems, LLC
  - 3. Esco Technologies, Inc.
  - 4. Hemco Corporation
  - 5. Kewaunee Scientific Corp. c/o Farnell Equipment Company
  - 6. Labconco Corporation
  - 7. Lab Crafters, Inc.
  - 8. Mott Manufacturing c/o Detroit Technical Company
- B. Requests for substitutions will be considered in accordance with provisions of Division 1 Section 01 25 00 Substitution Procedures.
- C. General Design Requirements:
  - 1. Fume hoods required under this specification will be referenced as: General Purpose, High Performance Variable Air Volume (VAV) Fume Hood.
  - 2. Fume Hood Configurations: Provide in sizes and configurations with fume hood bases as shown on the drawings.
  - 3. All cabinets of size and type as indicated on the hood schedule shall be a bench style single pass flow-through design in which all work access inflow air, is drawn through the cabinet's internal exhaust plenums to a single exit point at the top.

### 2.2 FUME HOOD MATERIALS

- A. Basic Materials: *A complete list of basic materials is provided below. Note not all models use all materials listed.*
  - 1. Exterior Panels, Framing Members, and Furring Panels: Cold rolled and leveled mild steel and shall conform to ASTM A366, finished as in Para. 2.3.
  - 2. Screws: Interior fastening devices; stainless steel screws complete with corrosion resistant plastic caps.

3. Upper front Panel: Minimum 20 Ga (0.9mm) mild steel, finished same as exterior panels.
4. Lower Foil / Flush sill: Design to minimize turbulence, produce smooth airflow over the work surface and prevent reverse flow within 6 inches of the sash plane. Type 316-4 stainless steel powder coated.
5. Safety Glass: Clear laminated safety glass, type 6mm (1/4") thick.
6. Sash Frame (if present): 18-gauge metal (minimum) and shall have no metal-to-metal contact the LFH jamb during operation. The sash frame-to-glass junction to be sealed to prevent vapor leakage and prevent items being trapped or caught between the glass/glazing and the frame.
7. Sash guides: Track to be corrosion resistant polyvinyl chloride (PVC) and provide smooth movement and positioning of the sash.
8. Sash Chain: #35 hardened carbon steel roller chain.
9. Sprocket system for Sash Chain: Hardened sprockets with one full width shaft per sash running in ball bearings. The sash shall be weight-balanced at any height to maintain position without movement. The force to move the will not exceed five pounds (22.2 Newton).
10. Sash Pull: Type 316, 18 Ga (1.2mm) thick stainless steel with an AISI #4 satin finish.
11. Baffle: Designed to provide effective capture and containment at all sash opening heights.
12. Baffle support brackets: Fiberglass reinforced polyester thermoset resin of 3/16" (5mm) thickness for standard fume hoods or as compatible with specialty fume hood types.
13. Duct Stubs and Duct Transition: Type 316, 18 Ga (1.2mm) stainless steel and to be leak-free. The duct stub to have a monitoring port installed to measure hood static pressure above the outlet collar. Fume hood vendor to provide duct transition for connection to ductwork, installation to be by mechanical trades.
14. Light Switches: Light switches to be black in color, commercial spec grade or higher, rated 120V, 20A and 208V shall be UL and CSA approved.
15. Electrical receptacles: Electrical receptacles to be GFCI type, be black in color, commercial spec grade or higher and shall be UL and CSA approved. Electrical services shall be three wire grounding type GFCI receptacles rated for 120 volt supply per the fume hood details.
16. Cover Plates: Electrical cover plates to be black, nylon and UL and CSA approved.

- B. Fume Hood Liner: The interface between the work surface and the hood liner must be sealed to prevent leakage. The liner is to be constructed of a durable material with a finish that shall be resistant to heat, solvents and corrosives.
1. FRP: for Standard Hoods
    - a) Hood linings and baffles shall be fiberglass reinforced polyester thermoset resin of 3/16" (5mm) thickness.
    - b) The fiberglass reinforced polyester panel shall have a minimum flexural strength of 15,000 psi (103,400 kPa), with a flame spread of 25 or less as per ASTM #E84.
    - c) Final appearance shall be smooth and white in color.
  2. PVC type: As noted on drawings.
    - a) Hood linings and baffles shall be Poly Vinyl Chloride of 1/4" (6mm) thickness. Final appearance shall be smooth and white in colour.
    - b) Hood linings and baffles shall be Poly Vinyl Chloride of 1/4" (6mm) thickness with square corners. Final appearance shall be smooth and white in colour.
  3. Stainless steel: As noted on drawings.
    - a) 316 stainless steel.
- C. Fume Hood Furring Panels: for closure between the ceiling and/or sidewalls.
1. Where called for, provide matching furring panels to enclose the space between top edge of fume hoods and the finished ceiling.
  2. Panels shall be flanged, notched and reinforced where required to form a well-fitted enclosure, free from oil canning. Secure panels using cadmium-plated, self-tapping screws; panels shall be removable for maintenance purposes.
  3. Front of furring panel shall match fume hood to which it is connected.
  4. Panels to provide access for servicing the light fixture.

## 2.3 SAFETY MONITORS AND ALARMS

- A. Fume Hood Face Velocity Sensors and Safety Monitor Alarms: Refer to specification Division 23, "Heating Ventilation and Air Conditioning" for airflow monitor and alarms. Install digital air flow monitor box on the face of the fume hood as shown on drawings.
1. General VAV Fume Hood Control System Features
    - 1) Airflow sensors and quick response (three seconds or less) pressure independent valves shall be installed in each exhaust duct, desirably at roof level, to maintain face velocity and to prevent backflow or air volume fluctuations.

2. Safety Monitor: UL listed, tamper proof, with all alarm circuits, electric components, external tubing, and manifolds furnished complete and factory installed. The monitor shall have light emitting diode and digital LCD display which provides clear indication of airflow conditions.
3. Calibration shall not accrue until the hood is stationed and the hood exhaust and room supply systems are balanced. A secondary calibration has been factory set into the alarm's memory only to determine that the alarm is functional and ready for shipment. The primary calibration must be completed in the field.
4. Airflow Sensor: Thermally compensated glass-beaded thermistor, factory connected to a side-wall port on the interior of the fume hood.
5. Alarm Signal: Audible signal and a visual digital LCD display.
  - a. Mute pushbutton, which disables the audible alarm, shall be accessible on the front of the safety monitor.
  - b. Provide alternate mode in which audible alarm is silenced indefinitely but visual alarm remains activated until the alarm condition is corrected.
  - c. When alarm condition is corrected and face velocity and volume return to specified levels, then the Safety Monitor will automatically reset and begin routine monitoring.
6. Provide test circuit to verify proper Safety Monitor operation.
7. Electrical Rating: Maximum 12 VDC, and maximum current rating of 200MA.

## 2.5 BENCH FUME HOOD CONSTRUCTION

- A. Fume hood superstructure shall of the restricted bypass, high performance type and be double wall construction consisting of an outer shell of sheet steel and an inner hood liner. Double wall shall house and conceal steel framing members, attaching brackets and remote operating service fixture mechanisms.
  - a. Overall double wall thickness; 4-3/4" (121mm) maximum.
  - b. Hood exterior not to exceed 65 inches in height and 36 inches in depth.
  - c. Hood width to be 8, 60, 72, or 96 inches as indicated on drawings.
- B. Front double-wall posts to accept up to five plumbing fittings per side, one electrical duplex per side, light switch, monitor alarm where indicated on drawings and pressure gauge where indicated on drawings. Posts are only punched for plumbing fittings as ordered. Electrical outlets and light switch shall be factory-wired and terminate at a junction box on roof of hood. All electrical components shall be UL listed/classified.
- C. Fume hood side walls shall be nominally 4.75" (121mm) thick and shall provide space for routing of plumbing supply lines and electrical cables. Access to the service piping should be readily available from the interior of the LFHs. It shall have access panels for access to the hood's services. Its face shall be of an aerodynamic design to reduce turbulence of the air entering the hood.

- a. Hood to be plumbed for pipeed connections above fume hood.
- D. Exterior panel members shall be fastened by means of concealed devices. Exposed screws are not acceptable.
- E. Provide access to remote-controlled fixture valves concealed between walls through removable panels on hood exterior and access panels on both inside liner walls. Assemble hood superstructure, fasten and connect inner and outer frame into a rigid self-supporting entity.
- F. Lighting shall be provided by LED module and driver located on the fume hood roof. Provide a 6mm (0.236") safety glass panel on hood "roof", sealed to isolate the lighting fixture from fume chamber. One nominal 22" (559mm) module shall be provided for each hood up to 6 foot in size with 8 foot models having two.
  - a. Average interior illumination levels within the fume chamber shall be 100 foot candles at the worksurface.
  - b. The LED module and driver combination to be rated at 5900 lumens with a color temperature 3500K and 85 CRI.
  - c. Where identified on Lab Equipment Drawings sheet Q-600 through Q-602, provide a sperate control for an Amber Light to filter UV light between 10 to 400 nm on the spectrum.
- G. Front Panel shall be contoured powder coated steel and shall cover the roof area of the fume hood and extend nominally 3" (75mm) below the fume hood roof line covering the top edge of the upper vision panel glass.
- H. Vision panel glass shall be clear laminated safety glass and shall cover the upper portion of the fume hood front opening between the top edge of the sash glass and the roofline of the fume hood.
- I. Fume hood sash shall be full view type providing a clear and unobstructed side to side view of fume hood interior. In combination with the stationary vision panel glass, vertical viewing area shall be a minimum of 44" (1397mm) above the work surface. Sash shall be laminated safety glass. Bottom and side sash rails shall be 18 Ga (1.2mm) powder coated stainless steel. Bottom rail shall be an integral, formed, full width, flush pull and shall be anchored on each side to sash chains at bottom. A chain, bearing and shaft counter balance system shall be used for vertical operation of sash and prevent jamming to permit one finger operation at any point along full width sash pull and to maintain sash at any position below working height without creep. Sash system shall be designed to prevent sash drop in the event of chain failure. Superstructure shall have a single sash and counter balance system. Sash shall open and close against rubber bumper stops.
- J. Hood sash shall rise into an enclosure box to assure a leak free chamber.
- K. Perimeter of sash opening shall have a lower flush sill containment trough and an angled side and top with angled edge toward hood interior. Air shall enter under the bottom flush sill through a nominal 1" (25mm) by-pass when the sash is in the closed position.



Bottom foil shall be removable without the use of special tools. Sash shall close on top of flush sill.

- L. One-piece baffle shall provide controlled air vectors into and through the fume hood and be fabricated of the same material as the liner. Provide exhaust slot on the bottom edge of baffle.
- M. Operating Type: Variable Air Volume: Provide fume hoods that maintain a constant face velocity as the sash height changes. It shall be capable of varying the exhaust air volume in proportion to the hood face opening by either changing the speed of the exhaust blower or by adjusting a damper in the exhaust duct for general laboratory fume hood operations.
- N. Design fume hoods to maintain a minimum exhaust airflow between 150 – 475 air changes per hour (ACH) at 100 PFM face velocity. The ACH shall be determined using the interior volume of the fume hood.
- O. Airflow Requirements: Airflow: Refer to Mechanical Schedules and Airflow Diagrams.
- P. Size and Configuration: Refer to drawings for fume hood type, size and service configuration.
  - 1. Utility Preparation: Fume hoods shall be completely prepiped and prewired with all vacuum breakers, valves and outlet fittings factory mounted. Prewiring of the hood shall terminate in junction boxes mounted on the top of the fume hood. Prepiping of the hood shall include extension of piping from the top of each side of the fume hood to the service valve and then to the service outlet and also include waste vent piping for cup sinks fitted in hoods.
  - 2. Electrical convenience duplex outlets shown mounted on the face of fume hoods shall be installed in front posts and pre-wired to a junction box mounted on top of fume hood superstructure. Electrical devices shall be UL classified/listed. Type and quantity shall be as shown on project drawings.
  - 3. Fume Hood Face Velocity Sensors and Safety Monitor Alarms:
    - a. The hoods shall be fabricated and equipped with all wiring, conduits, and electrical boxes required. Provide wiring in accordance with control unit manufacturer's instructions to a junction box at top of hood. The alarm units shall be flush mounted.
    - b. Vacuum Breakers: All required vacuum breakers shall be visible and be mounted outside of the working space on the front of fume hood above the level of the sash opening.
  - 4. Service Fittings: Provide in accordance with fitting schedule. No valve operator shall be located inside the fume hood working space. Valves shall align vertically and horizontally with outlets where possible.
    - a. The color of Service Fitting Outlets in the hood interior shall match the color of the valve handle on hood exterior.

5. Access Panels: Provide interior gasketed, access panels in fume hood side walls for access to concealed piping. Access panels area to be of same material as hood liner.

## 2.6 FUME HOOD EXTERIOR FINISH

- A. Finish and performance coating data as per Division 12 Section 56 53.13, Painted Metal Laboratory Casework".

## PART 3 – EXECUTION

### 3.1 INSTALLATION

- A. In addition to requirements of Section 11 53 23, install fume hoods in positions shown, align and set level with levelling devices.
- B. Work in close cooperation with allied trades installing ductwork, wiring and other services.
- C. Apply small bead of sealant to junction of fume hood counter top and adjacent hood liner.

### 3.1 FIELD QUALITY CONTROL

- A. Field Test: Field test 100% of installed units after completion of installation to verify proper operation of hoods in accordance with specified requirements. In addition, field test to be after balancing of building air handling system is completed.
  1. Notify Owner's Representative a minimum of one week prior to start of testing to make arrangements to have Owner's Representative present during testing.
  2. If any hood tested for performance fails to perform as specified, field test additional hoods as directed by Owner and Architect.
  3. Field adjust fume hoods, in conjunction with a tuned building exhaust and HVAC system, or replace hoods and make other corrections until tested hoods perform as specified.
  4. After making corrections, retest fume hoods that failed to perform as specified.

### 3.2 ADJUSTING AND CLEANING

- A. Adjust moving parts for smooth, near-silent, accurate sash operation with one hand. Adjust sashes for uniform contact of rubber bumpers. Verify that counterbalances operate without interference.

- B. Repair or remove and replace defective work as directed on completion of installation.
- C. Clean finished surfaces, including both sides of glass; touch up as required; and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.

END OF SECTION

## SECTION 11 53 33

### LABORATORY SAFETY EQUIPMENT

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.2 SUMMARY

This Section includes laboratory safety equipment including emergency eyewashes, showers and other related products.

- A. Extent and types of safety equipment as indicated on Laboratory Equipment drawings.
- B. Provide safety equipment as specified herein and as indicated on Laboratory Equipment drawings.
- C. Related Sections include the following:
  - 1. Division 11, Section 116622 "Laboratory Accessories".
  - 2. Division 12, Section 12352, "Painted Metal Laboratory Casework".
  - 3. Divisions 22 and 26, Sections for plumbing and electrical requirements.
  - 4. Divisions 22 and 26, Sections for final connections to building services and systems.

##### 1.3 PERFORMANCE REQUIREMENTS

- A. General Performance: Provide certification that fixtures and fittings have been tested in accordance to and meet the performance requirements as described in SEFA 7.
- B. Chemical Resistance: All coating materials shall meet the following tests for chemical resistance:
  - 1. Fume Test: Suspend coated samples in a container at least 6 cubic feet capacity, approximately 12" above open beakers, each containing 100 cc of 70% nitric acid, 94% sulfuric acid and 35% hydrochloric acid, respectively. After exposure to these reagent fumes for 150 hours, the finish on the samples shall show no discoloration, disintegration or other damage to the coating.
  - 2. Direct Application Test: The test of coated samples shall consist of the direct action of the reagents listed below. This test is to be conducted in such as manner that the test surface is kept wet throughout the entire test period and at a controlled temperature of 77 degrees F +/- 3 degrees F. The test must be conducted for a period of not less than one

hour. As a result of the test the coating on the samples shall not rupture or otherwise compromised exposing the base material through erosion, dissolution, cracking, splitting or other damage resulting from reagent exposure. Obvious and significant deterioration is not acceptable. However, slight discoloration or temporary softening of the coating is permissible.

|                            |  |
|----------------------------|--|
| Acetic Acid, 98%           | Lactic Acid, 10%                               |
| Acetone                    | Methanol                                       |
| Acid Dichromate, 5%        | Methyl Alcohol                                 |
| Ammonium Hydroxide, 28%    | Methyl Ethyl Ketone                            |
| Amyl Acetate               | Methylene Chloride                             |
| Amyl Alcohol               | Mineral Oil                                    |
| Benzene                    | Mono Chlorobenzene                             |
| Butyl Alcohol              | N-Hexane                                       |
| Calcium Hypochlorite       | Naphthalene                                    |
| Carbon Disulfide           | Nitric Acid, 70%                               |
| Carbon Tetrachloride       | Perchloric Acid, 70%                           |
| Chloroform                 | Phenol   |
| Chronic Trioxide Acid      | Phosphoric Acid, 85%                           |
| Cresol                     | Sea Water                                      |
| Crude Oil                  | Silver Nitrate, Saturated                      |
| Dichlor Acetic Acid        | Sodium Bichromate, Saturated                   |
| Dimethylformamide          | Sodium Carbonate, 10%                          |
| Dioxane                    | Sodium Chloride, 20%                           |
| Distilled Water            | Sodium Hydroxide, 50%                          |
| Ether                      | Sodium Hydroxide, Flake                        |
| Ethyl Acetate              | Sodium Hypochlorite                            |
| Ethyl Alcohol              | Sodium Sulfide, Saturated                      |
| Ethyl Ether                | Sulfuric Acid, 96%                             |
| Formaldehyde, 37%          | Sulfuric Acid 77% & Nitric Acid 70%, eq. parts |
| Formic Acid, 90%           | Toluene  |
| Furfural                   | Trichloroethylene                              |
| Gasoline                   | Turpentine                                     |
| Glacial Acetic Acid, 99.5% | Urea, Saturated                                |
| Glycerin                   | Xylene   |
| Hydrochloric Acid, 38%     | Xylem  |
| Hydrofluoric Acid, 48%     | Zinc Chloride, Saturated                       |
| Hydrogen Peroxide, 5%      |  |
| Iodine, Tincture of        |  |
| Isopropyl Alcohol          |  |
| Kerosene                   |  |

3. Adhesion Test: Corrosion resistant finishes shall meet the standards set forth in "Standard Test Methods for Measuring Adhesion by Tape Test", ASTM D3359-02, "Standard Test Method for Mandrel Bend Test of Attached Organic Coatings", ASTM D522-93a and "Standard Test Method for Chipping Resistance of Coatings", ASTM D3170-03.
4. Mar and Abrasion Resistance: Coating material shall have a pencil hardness of 2H-4H with adhesion substantial enough to withstand both direct and reverse impacts of 160 inch-pounds. Coating shall have excellent mar resistance and be capable of withstanding scuffing, marring and other ordinary wear.

5. **Reparability:** Coating material shall be capable of surface repair in the event that a fixture is scratched or a surface rupture occurs. The service fixture manufacturer shall have available an air-drying aerosol coating, specially formulated to match the existing epoxy coating color, which may be applied in the field to repair coated surfaces.

#### 1.4 SUBMITTALS

- A. **Product Data:** Submit manufacturer's data and installation instructions for each type of emergency fixture.
  1. Include independent laboratory certification that applied finish complies with specified chemical and physical resistance requirements.
  2. Submit samples when requested by Laboratory Architect, complete with fittings and accessories with specified finish.

#### 1.5 EXTRA MATERIALS

- A. Provide to Owner a complete touch-up kit for surface repair of emergency fixtures. Provide an air drying aerosol or liquid coating specially formulated to match the coating color which can be applied in the field to repair coated surfaces.

#### 1.6 QUALITY ASSURANCE

- A. **Single Source Responsibility:** All laboratory safety equipment, including those provided as an integral part of other laboratory equipment such as fume hoods, shall be the product of one service fixture manufacturer, unless specified otherwise.
- B. All fixtures shall be in accordance with IBC, NFPA and OSHA for the intended use.
- C. All emergency eye wash and shower equipment shall be certified to comply with ANSI Z358.1-2014.
- D. All fixtures shall comply with the ADA requirements of Section 309.4 of ANSI/ICC A117.1-2009, where a fixture is to be ADA compliant, the maximum force required to open or close a manually activated fitting shall not exceed 5 lbs.

### PART 2 - PRODUCTS

#### 2.1 APPROVED MANUFACTURERS

- A. All mechanical laboratory service fixtures shall be the product of one of the following:
  1. Chicago Faucet
  2. Guardian Equipment
  3. Water Saver Faucet Co.
  4. Far laboratory Faucets Ltd.

## 2.2 FABRICATION; GENERAL

- A. All laboratory service fixtures shall have the construction and shall meet the performance requirements set forth in this specification. Fixture types shall be as indicated in the fixture schedule on the Laboratory Equipment drawings and fixture details as an attachment to this specification.
- B. Emergency Fixtures: Provide all emergency fixtures factory assembled, including the assembly of all valves, flanges, and other mounting accessories. Individually factory test each fixture and provide all fixtures complete with washers, locknuts, unions, nipples and other accessories.
- C. Material and Finish: Fabricate service fixtures from cast brass containing a minimum of 85% copper or forged brass containing a minimum of 60% copper.
  - 1. Safety equipment as follows:
    - a. Satin Chrome Finish with Clear Epoxy Coating: All components shall be polished and electroplated with one layer of nickel. Exposed surfaces shall then be further polished to an AISI No. 6 brushed finish which is fine-grained and uniform. Components shall then be electroplated with one layer of chrome. Following chrome plating, surfaces to be coated shall be cleaned and degreased. Following plating and cleaning a clear epoxy coating shall be applied to all exposed surfaces and fully baked to permit curing. Surfaces shall have a minimum coating thickness of 2 mils.
- D. Safety Equipment:
  - 1. Finish: The exposed metal components of the safety equipment shall be:
    - a. Stainless steel.
  - 2. Provide emergency eye/face wash, drench hose and shower units with spray-type outlet heads to deliver a soft, wide, high volume spray of water. Safety equipment locations are indicated on the Laboratory Equipment drawings. Provide all piping and accessories for a complete installation.
  - 3. Dual Purpose Eye Wash/Drench Hose Units: Deck mounted eye wash/drench hose units shall be capable of use as a fixed eye wash with hands-free operation or as a drench hose. Units shall have two Gentle Spray outlet heads mounted parallel and angled forward, each with a self-regulating volume control, reticulated polyurethane filter and removable spray cover. Dust covers shall be hinged swing-away style and shall be permanently attached to the spray head with a stainless steel pin. Units shall be furnished with a deck flange with locator guide to hold the unit facing forward and an 8 ft. reinforced PVC hose.
  - 4. Emergency eyewash units shall have the following:
    - a. Controlled, low velocity flow completely rinses eyes and face and is not injurious to user.

- b. Hands free stay open ball valve activating within one second or less.
- c. Eyewash unit must be capable of delivering at least 0.4 gpm for 15 minutes.
- d. The nozzles must be protected from airborne contaminants.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION OF SERVICE FIXTURES

- A. Install in a precise manner in accordance with manufacturer's directions. Adjust moving parts to operate freely without excessive bind.
- B. Follow the manufacturer's recommended test and working pressures for fittings. Testing or using a fitting at pressure for which it is not designed can result in leakage or failure.
- C. Provide all interconnecting conduit, wiring, and devices to junction box for final connection to building systems by Electrical Trades Contractor.

#### 3.2 REPAIRING, CLEANING, AND PROTECTION

- A. Repairing: Repair or remove and replace defective work as directed upon completion of installation.
- B. Cleaning: Clean shop-finished surfaces, touch-up as required, and remove or refinish damaged or soiled areas, as acceptable to Laboratory Architect.
- C. Protection: Advise Contractor of procedures and precautions for protection of installed laboratory service fixtures from damage by work of other trades.

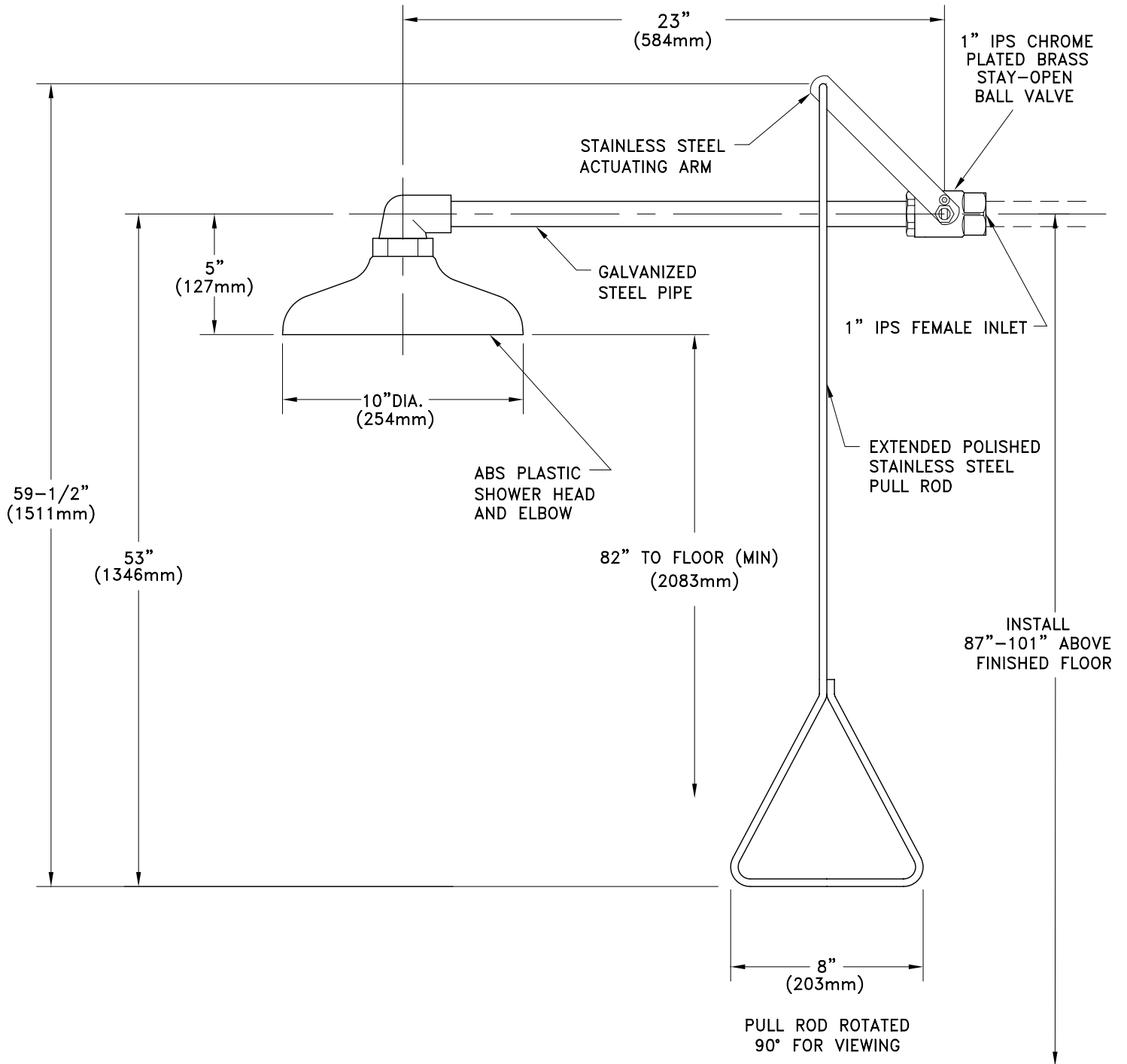
END OF SECTION

LAC  
iDesign Solutions, LLC



**ESBF643**

**BARRIER-FREE HORIZONTALLY MOUNTED EMERGENCY SHOWER WITH STAY-OPEN BALL VALVE AND PULL ROD**



MEASUREMENTS MAY VARY ±1/4".

Drawing Number: \_\_\_\_\_

Revision Number: 100703-DWC

- ~~○ EW1028 Eyewash/Drench Hose Unit, Deck Mounted, Ball Valve with Flag Handle~~
- EW1028VB Eyewash/Drench Hose Unit, Deck Mounted, Ball Valve with Flag Handle, Vacuum Breaker



**APPLICATION:** Dual purpose eyewash/drench hose unit for deck mounting. Unit meets the provisions of ANSI Z358.1 -2004 as both an eyewash and a drench hose. Unit may be left in the deck flange for use as a fixed eyewash, leaving user's hands free. Alternatively, unit may be removed for use as a drench hose to rinse any part of user's eyes, face or body.

**SPRAY HEAD ASSEMBLY:** Two GS-Plus™ spray heads mounted side-by-side. Each head has a "flip top" dust cover, internal flow control and filter to remove impurities from the water flow.

**VALVE:** 1/2" IPS brass stay-open ball valve. EW1028 has valve mounted above counter and activated by flag handle.

**HOSE:** 8' reinforced PVC hose. 300 PSI maximum working pressure.

**MOUNTING:** Eyewash assembly has deck flange for countertop mounting. Flange has handle locator guide to position spray heads facing forward at all times.

**SUPPLY:** 1/2" NPT male inlet.

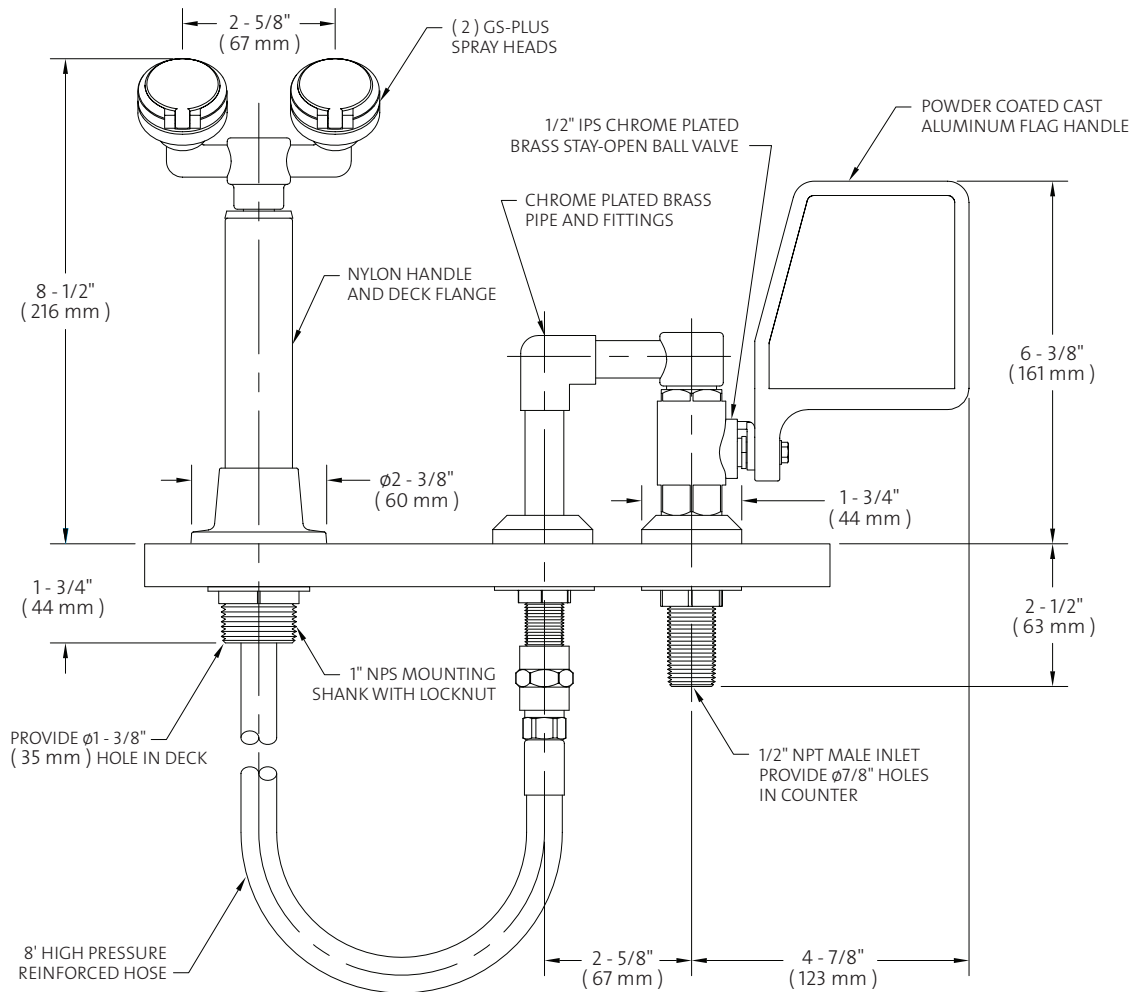
**SIGN:** ANSI-compliant identification sign.

**QUALITY ASSURANCE:** Unit is completely assembled and water tested prior to shipment.

### Available Options

- **DC** Stainless steel dust cover for each spray head.
- **FSH** 8 ft. flexible stainless steel hose in place of PVC hose.
- **HG** Undercounter hose guide bracket to prevent hose from tangling or binding.
- **BP** In-line dual check backflow preventer installed on inlet of hose. *Note: Check with code authority for compliance with local plumbing code.*
- **VB** Atmospheric vacuum breaker installed on outlet of ball valve (EW1028VB).
- **TMV** AP3600 thermostatic mixing valve precisely blends hot and cold water to deliver warm (tepid) water as provided by ANSI Z358.1 - 2004. Refer to "Tempering Units" section for complete technical and product selection information.

- **EW1028** Eyewash/Drench Hose Unit, Deck Mounted, Ball Valve with Flag Handle
- **EW1028VB** Eyewash/Drench Hose Unit, Deck Mounted, Ball Valve with Flag Handle, Vacuum Breaker



### NOTES:

1. EACH GS-PLUS SPRAY HEAD HAS A "FLIP-TOP" DUST COVER, INTERNAL FLOW CONTROL AND FILTER TO REMOVE IMPURITIES FROM THE WATER FLOW.
2. HOSE SHOULD NOT BE USED IN APPLICATIONS WHERE WATER PRESSURE EXCEEDS 90 PSI. HOSE SHOULD BE INSPECTED PERIODICALLY FOR DETERIORATION.
3. UNIT FURNISHED FOR MOUNTING ON COUNTERTOPS FROM  $1/8"$  UP TO  $1-1/2"$  THICK.

THIS SPACE FOR ARCHITECT/ENGINEER APPROVAL

Due to continuing product improvement, the information contained in this document is subject to change without notice. All dimensions are  $\pm 1/4"$  (6mm). rev. 0308

Sign Included



SECTION 11 53 43  
LABORATORY SERVICE FITTINGS AND FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes laboratory service fittings and fixtures, also known as valves, for water, vacuum and compressed gas.
- B. Extent and types of laboratory service fixtures and safety equipment as indicated on Laboratory Equipment drawings.
- C. Provide service fittings and fixtures as specified herein and as indicated on Laboratory Equipment drawings.
- D. Related Sections include the following:
  - 1. Division 11, "Laboratory Accessories".
  - 2. Division 12, "Painted Metal Laboratory Casework".
  - 3. Divisions 22 and 26, Sections for plumbing and electrical requirements.
  - 4. Divisions 22 and 26, Sections for final connections to building services and systems.

1.3 PERFORMANCE REQUIREMENTS

- A. General Performance: Provide certification that fixtures and fittings have been tested in accordance to and meet the performance requirements as described in SEFA 7.
- B. Chemical Resistance: All coating materials shall meet the following tests for chemical resistance:
  - 1. Fume Test: Suspend coated samples in a container at least 6 cubic feet capacity, approximately 12" above open beakers, each containing 100 cc of 70% nitric acid, 94% sulfuric acid and 35% hydrochloric acid, respectively. After exposure to these reagent fumes for 150 hours, the finish on the samples shall show no discoloration, disintegration or other damage to the coating.
  - 2. Direct Application Test: The test of coated samples shall consist of the direct action of the reagents listed below. This test is to be conducted in such as manner that the test surface

3. is kept wet throughout the entire test period and at a controlled temperature of 77 degrees F +/- 3 degrees F. The test must be conducted for a period of not less than one hour. As a result of the test the coating on the samples shall not rupture or otherwise compromised exposing the base material through erosion, dissolution, cracking, splitting or other damage resulting from reagent exposure. Obvious and significant deterioration is not acceptable. However, slight discoloration or temporary softening of the coating is permissible.

|                            |  |
|----------------------------|--|
| Acetic Acid, 98%           | Lactic Acid, 10%                               |
| Acetone                    | Methanol                                       |
| Acid Dichromate, 5%        | Methyl Alcohol                                 |
| Ammonium Hydroxide, 28%    | Methyl Ethyl Ketone                            |
| Amyl Acetate               | Methylene Chloride                             |
| Amyl Alcohol               | Mineral Oil                                    |
| Benzene                    | Mono Chlorobenzene                             |
| Butyl Alcohol              | N-Hexane                                       |
| Calcium Hypochlorite       | Naphthalene                                    |
| Carbon Disulfide           | Nitric Acid, 70%                               |
| Carbon Tetrachloride       | Perchloric Acid, 70%                           |
| Chloroform                 | Phenol   |
| Chronic Trioxide Acid      | Phosphoric Acid, 85%                           |
| Cresol                     | Sea Water                                      |
| Crude Oil                  | Silver Nitrate, Saturated                      |
| Dichlor Acetic Acid        | Sodium Bichromate, Saturated                   |
| Dimethylformamide          | Sodium Carbonate, 10%                          |
| Dioxane                    | Sodium Chloride, 20%                           |
| Distilled Water            | Sodium Hydroxide, 50%                          |
| Ether                      | Sodium Hydroxide, Flake                        |
| Ethyl Acetate              | Sodium Hypochlorite                            |
| Ethyl Alcohol              | Sodium Sulfide, Saturated                      |
| Ethyl Ether                | Sulfuric Acid, 96%                             |
| Formaldehyde, 37%          | Sulfuric Acid 77% & Nitric Acid 70%, eq. parts |
| Formic Acid, 90%           | Toluene  |
| Furfural                   | Trichloroethylene                              |
| Gasoline                   | Turpentine                                     |
| Glacial Acetic Acid, 99.5% | Urea, Saturated                                |
| Glycerin                   | Xylene   |
| Hydrochloric Acid, 38%     | Xylem  |
| Hydrofluoric Acid, 48%     | Zinc Chloride, Saturated                       |
| Hydrogen Peroxide, 5%      |  |
| Iodine, Tincture of        |  |
| Isopropyl Alcohol          |  |
| Kerosene                   |  |

4. Adhesion Test: Corrosion resistant finishes shall meet the standards set forth in "Standard Test Methods for Measuring Adhesion by Tape Test", ASTM D3359-02, "Standard Test Method for Mandrel Bend Test of Attached Organic Coatings", ASTM D522-93a and "Standard Test Method for Chipping Resistance of Coatings", ASTM D3170-03.
5. Mar and Abrasion Resistance: Coating material shall have a pencil hardness of 2H-4H with adhesion substantial enough to withstand both direct and reverse impacts of 160

inch-pounds. Coating shall have excellent mar resistance and be capable of withstanding scuffing, marring and other ordinary wear.

6. **Reparability:** Coating material shall be capable of surface repair in the event that a fixture is scratched or a surface rupture occurs. The service fixture manufacturer shall have available an air-drying aerosol coating, specially formulated to match the existing epoxy coating color, which may be applied in the field to repair coated surfaces.

#### 1.4 SUBMITTALS

- A. **Product Data:** Submit manufacturer's data and installation instructions for each type of service fixture.
  1. Include independent laboratory certification that applied finish complies with specified chemical and physical resistance requirements.
  2. Submit samples of plumbing and electrical service fixtures when requested by Laboratory Architect, complete with fittings and accessories with specified finish.
- B. **Service Color Code:** Submit samples of index disc with letter code in colors used to identify water, vacuum and compressed gas services listed.

#### 1.5 EXTRA MATERIALS

- A. Provide to Owner a complete touch-up kit for surface repair of service fittings and fixtures. Provide an air drying aerosol or liquid coating specially formulated to match the coating color which can be applied in the field to repair coated surfaces.

#### 1.1 QUALITY ASSURANCE

- A. **Single Source Responsibility:** All laboratory service fixtures and safety equipment, including those provided as an integral part of other laboratory equipment such as fume hoods, shall be the product of one service fixture manufacturer, unless specified otherwise.
- B. All fixtures shall be in accordance with IBC, NFPA and OSHA for the intended use.
- C. All fixtures for water service shall meet the requirements of ANSI/ASME A112.18.1M-2012 and be certified by the Canadian Standards Association (CSA) under Standard CAN/CSA B.125.M89.
- D. Atmospheric vacuum breakers shall be certified by the American Society of Sanitary Engineers (ASSE) under Standard 1001 and faucet fixture breakers shall be certified to comply with ANSI/ASSE Standard 1035.
- E. ADA fittings shall comply with the requirements of Section 309.4 of ANSI/ICC A117.1-2014, where a faucet or fitting will be used in an application that is intended to be ADA compliant, the maximum force required to open or close a manually activated fitting shall not exceed 5 lb. (22 N) at 80 PSI (550 kPa) static pressure.

- F. Natural gas service, ball valves shall be certified by the American Gas Association (AGA) under ANSI Z21.15-2009 and the Canadian Gas Association (CGA) 9.1 under CAN/CGA-3.16-M88 (CLIR 36).
- G. Electric pedestal boxes shall be listed by Underwriters Laboratories (UL) under Standard UL514A. Receptacles shall be UL labeled and commercial or specification grade.
- H. The entire installation shall be in accordance with the governing rules and regulations of the National Electric Code, and all local governing boards having jurisdiction and shall meet all the standards and requirements of the Owner.

## PART 2 - PRODUCTS

### 2.1 APPROVED MANUFACTURERS

- A. All mechanical laboratory service fixtures shall be the product of one of the following:
  - 1. Chicago Faucet
  - 2. Far laboratory Faucets Ltd.
  - 3. Water Saver Faucet Co.

### 2.2 FABRICATION; GENERAL

- A. All laboratory service fixtures shall have the construction and shall meet the performance requirements set forth in this specification. Fixture types shall be as indicated in the fixture schedule on the Laboratory Equipment drawings and fixture details as an attachment to this specification.
- B. Service Fixtures: Provide all service fixtures factory assembled, including the assembly of all valves and shanks to turrets, flanges, and other mounting accessories. Individually factory test each fixture and provide all fixtures complete with washers, locknuts, unions, nipples and other accessories.
- C. Material and Finish: Fabricate service fixtures from cast brass containing a minimum of 85% copper or forged brass containing a minimum of 60% copper.
  - 1. Finish service fixtures and safety equipment as follows:
    - a. Satin Chrome Finish with Clear Epoxy Coating: All components shall be polished and electroplated with one layer of nickel. Exposed surfaces shall then be further polished to an AISI No. 6 brushed finish which is fine-grained and uniform. Components shall then be electroplated with one layer of chrome. Following chrome plating, surfaces to be coated shall be cleaned and degreased. Following plating and cleaning a clear epoxy coating shall be applied to all exposed surfaces and fully baked to permit curing. Surfaces shall have a minimum coating thickness of 2 mils.

- b. Fittings Inside Fume Hoods: shall have an epoxy finish color-coded to match the fixture service index color. Following base preparation and cleaning, coating material shall be electrostatically applied to all exposed surfaces. After application, coating shall be fully baked to permit curing. Surfaces shall have a minimum coating thickness of 2 mils.
- D. Handles: Except as otherwise indicated, provide forged brass four-arm style handles on all fixtures with a color coded screw-on index disc.
1. Benchtop service fixtures at locations identified as accessible (ADA) and or for hand-washing (HW) and where otherwise indicated on lab equipment drawing shall be fitted with 4" wrist blade handles, color coded.
  2. Provide foot pedals as indicated on lab equipment drawings.
  3. Provide a combination fixture at locations indicating on lab equipment plan which indicates dual functions of both foot pedals and a mixing faucet with 4" wrist blade handles.
- E. Water Fixtures and Valves:
1. All fixtures and valves for water service shall have a renewable unit containing all working components subject to wear, including a stainless steel replaceable seat and an integral adjustable volume control. The renewable unit shall be interchangeable among all faucets and valves for water service. The renewable unit shall be broached for position locking in the valve body. The unit shall have a high durometer thermoplastic valve disc and a molded TFE stem packing. The unit shall be capable of being readily converted from compression to self-closing, and vice versa, without disturbing the faucet body.
    - a. Water Fixtures and valves shall be fully assembled and individually factory tested at 80 PSI water pressure.
  2. Goosenecks shall have a separate outlet coupling with a 3/8" IPS female thread securely brazed to the gooseneck for attachment of serrated hose ends, aspirators and other outlet fittings. Rigid goosenecks shall have a 3/8" IPS male inlet thread and be threaded directly into the faucet body so as to be absolutely rigid. Swing goosenecks shall utilize a TFE packing with an externally adjustable packing nut.
    - a. Gooseneck faucets at cup sinks (CS-#) and cold water gooseneck fixtures at lab sinks (LS-#) shall have a rigid/swing gooseneck.
    - b. Hot and cold water gooseneck fixtures at lab sinks (LS-#) shall have a rigid/swing gooseneck.
  3. Vacuum breakers, where required and indicated by the fixture number, shall be integral with the gooseneck. Vacuum breakers shall have a forged brass body, a renewable seat and an ultralight float cup with a silicone gasket for fine flow control. Vacuum breakers shall not spill over at low water volume.
- F. Valves for Gas, Air, Vacuum and Special Gas Service:



1. Needle Valves:

- a. Needle valves shall have a forged brass valve body with a 3/8" IPS female outlet for attachment of serrated hose ends, quick connects or other outlet fittings. Valves shall have a self-centering replaceable stainless steel floating cone and a replaceable stainless steel valve seat. The lateral movement of the cone shall not exceed .0.15". The valve shall have a molded TFE stem packing with an externally adjustable packing nut. The valve shall go from closed to fully open in two full revolutions of the handle.
- b. Needle valves shall be fully assembled and individually tested at 190 PSI air pressure under water. Maximum working pressure shall be 125 PSI air pressure.

G. Atmospheric Vacuum Breakers: shall be provided on Fume Hoods with potable water service and where otherwise indicated on the Laboratory Equipment drawings to prevent backflow or backsiphonage into the potable water system. Vacuum breakers shall be installed:

- 1. In accordance with the manufacturer's instructions and applicable plumbing codes.
- 2. In a location where they are accessible for maintenance.

H. Service Outlet Identification: The handle of each laboratory fitting, except pressure regulators, shall be marked to indicate the particular liquid or gas that is delivered by or through such fitting. The handle or the index button fastened to the handle shall be color coded, and the index button shall be embossed with identification letters to designate the service. Letters used to designate the service or symbol shall be legible and easy to read. Color code index discs as follows:

| <b>Basic Air &amp; Water Indexing</b> | <b>Index Color</b> | <b>Letter Color</b> | <b>Symbol</b> |
|---------------------------------------|--------------------|---------------------|---------------|
| Purified Air                          | Orange             | Black               | Pair          |
| Air                                   | Orange             | Black               | Air           |
| Compressed Air                        | Orange             | Black               | CA            |
| Lab Air                               | Orange             | Black               | LA            |
| Cold Water                            | Dk. Green          | White               | CW            |
| Chilled Water Supply                  | Dk. Green          | White               | CWS           |
| Chilled Water Return                  | Dk. Green          | White               | CWR           |
| Industrial Cold Water                 | Dk. Green          | White               | ICW           |
| Hot Water                             | Red                | White               | HW            |
| Industrial Hot Water                  | Red                | Red                 | IHW           |
| Steam                                 | Black              | White               | STM           |
| Tempered Water                        | Green              | White               | TW            |
| Glycol Supply                         | Lt. Green          | Black               | GYLS          |
| Glycol Return                         | Lt. Green          | Black               | GYLR          |
| Process Water Supply                  | Green              | White               | PCWS          |
| Process Water Return                  | Green              | White               | PCWR          |

|                 |          |       |      |
|-----------------|----------|-------|------|
| Deionized Water | White    | Black | DI   |
| Distilled Water | White    | Black | DW   |
| Purified Water  | White    | Black | PW   |
| Reverse Osmosis | White    | Black | RO   |
| High Vacuum     | Yellow   | Black | HVAC |
| Low Vacuum      | Yellow   | Black | LVAC |
| Vacuum          | Yellow   | Black | VAC  |
| Gas             | Dk. Blue | White | G    |
| Natural Gas     | Dk. Blue | White | NG   |
| Acetylene       | Violet   | White | C2H2 |
| Butane          | Lt. Blue | Black | BUT  |
| Isobutene       | Silver   | Black | ISO  |
| Methane         | Lt. Blue | Black | CH4  |
| Propane         | Pink     | Black | PRO  |

| <b>Gas Indexing</b> | <b>Index Color</b> | <b>Letter Color</b> | <b>Symbol</b> |
|---------------------|--------------------|---------------------|---------------|
| Ammonia             | Lt. Green          | Black               | NH3           |
| Argon               | Violet             | White               | Ar            |
| Carbon Monoxide     | Silver             | Black               | CO            |
| Carbon Dioxide      | Pink               | Black               | CO2           |
| Helium              | Black              | White               | He            |
| Hydrogen            | Pink               | Black               | H2            |
| Hydrogen Sulphite   | Black              | White               | H2S           |
| Nitrogen            | Brown              | White               | N2            |
| Nitrogen, Dewar     | Brown              | White               | N2d           |
| Nitrous Oxide       | Lt.Green           | Black               | N2O           |
| Oxygen              | Lt. Green          | Black               | O2            |
| Phosphorus          | Tan                | Black               | P             |
| Special Gas         | Lt. Blue           | Black               | SG            |
| Sulphur Dioxide     | Tan                | Black               | SO2           |

### 2.3 ELECTRICAL SERVICE FITTINGS

- A. Service Fittings, General: Provide UL-labeled units complying with Division 16 Sections, complete with metal housings, receptacles, terminals, switches, pilot lights, device plates, and accessories and gaskets required for mounting on casework.
1. Pedestal Type Fixtures: Cast aluminum box complete with cover plate(s) and receptacle(s) or other devices as indicated. Boxes shall be machined for both standard and ground fault receptacles. Fabricate units with sloped single face or double face, as indicated. Provide concealed mounting holes in base for attaching to casework and holes tapped for conduits and grounding screws.
  2. Line Type Fixtures: Cast aluminum box with threaded holes for mounting on rigid steel conduit, complete with cover plate(s) and receptacle(s) or other devices as indicated.

3. Recessed Type Fixtures: Galvanized steel outlet box (size as required) complete with cover plate(s) and receptacle(s) or other devices as indicated.
4. Cover Plates: Provide satin finish stainless steel Type 302 cover plates with formed and beveled edges for outlets and devices. Cover plates for receptacles or other devices on emergency circuits shall be finished red and engraved with the word "Emergency" in black filled letters.
5. Finishes for Service Fixture Components: Finish pedestal and line type fixtures and face plates as follows:
  - a. Exposed surfaces of electrical boxes shall have a satin (brushed) aluminum finish.
6. Receptacles: 20 Ampere Grounding Type Duplex Receptacles for 120 Volt, Single Phase Service: Straight blade, 2 pole, 3 wire, NEMA configuration 5-20R, rated 20 amperes, 125 volts, NEMA performance standard grade, for back and side wiring, color to match electrical devices in room.
  - a. Arrow-Hart 5352
  - b. Bryant 5352
  - c. Hubbell 5352
  - d. General Electric 5352
7. Ground Fault Interrupter Duplex Receptacle: 2 pole, 3 wire, grounding type, rated 20 ampere, 125 volt, NEMA configuration 5-20R, 5362 Series, color to match electrical devices in room.
  - a. Arrow Hart
  - b. Bryant
  - c. Hubbell
  - d. General Electric
8. Lighting Switches:
  - a. Switches for Controlling Lighting Directly on AC Systems in General: Toggle operated, specification grade, composition based, extra heavy duty, flush, quiet type, motor rated, with provision for back and side wiring, and rated 20 amperes, 120 volts A.C., color to match electrical devices in room.
    - 1) Arrow-Hart 1991 Series.
    - 2) Bryant, Hubbell, General Electric
9. Electrical Metallic Tubing: Zinc-coated steel per ANSI C80.3-1977 "Specification for Electrical Tubing, Zinc-Coated".
10. Flexible Steel Conduit: Per UL-1, "Flexible Steel Conduit".
11. Couplings and Connectors for EMT: Zinc-plated steel, compression type.
12. Fittings for Flexible Steel Conduit: Malleable iron or steel, zinc or cadmium plated, with insulated throats, securing the conduit by clamping action around the periphery of the conduit. Do not furnish fittings that anchor the conduit by means of set screws.

13. Junction Boxes:

- a. Sheet Metal Boxes: Code gage, full seam welded with bent-in flanges seam welded at corner joints, screw fastened cover of same gage as box. Fasten cover with brass machine screws. Galvanize box and cover after fabrication. Provide sizes conforming to NEC requirements for wiring space. Furnish gaskets when located in areas requiring gaskets.

2.4 WIRES AND CABLES

- A. Furnish wire and cable for standard specifications established for such material and construction by ASTM, ANSI, IPCEA and NEMA, where applicable. Furnish annealed copper conductors of 98% conductivity, not less than NO. 12 AWG. Furnish stranded conductors No. 12 AWG. NEC Type THW rated 75 deg C, 600 volts.
- B. Fume Hood Wiring: Each electrical device shall be wired separately with 2 #12 and 1 #12 ground wire in flexible ½" conduit to a junction box on top of fume hoods or on outside face of the casework back panel (cover accessible from inside casework). Furnish 18" of coiled slack wire pigtail in junction box for extension by Building Trades Contractor.

PART 3 - EXECUTION

3.1 INSTALLATION OF SERVICE FIXTURES

- A. Install in a precise manner in accordance with manufacturer's directions. Adjust moving parts to operate freely without excessive bind.
- B. Follow the manufacturer's recommended test and working pressures for fittings. Testing or using a fitting at pressure for which it is not designed can result in leakage or failure.
- C. Provide all interconnecting conduit, wiring, and devices to junction box for final connection to building systems by Electrical Trades Contractor.

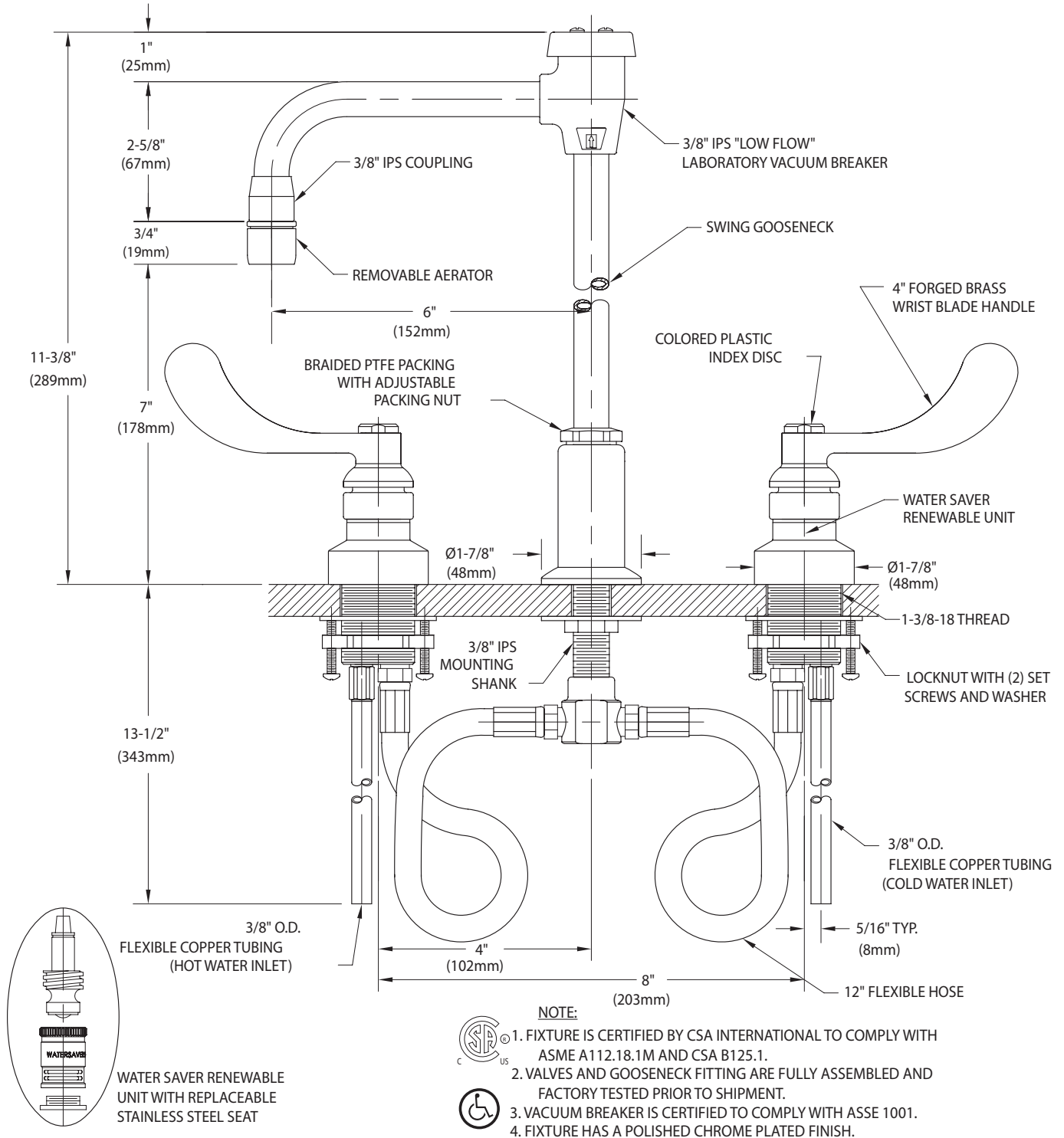
3.2 REPAIRING, CLEANING, AND PROTECTION

- A. Repairing: Repair or remove and replace defective work as directed upon completion of installation.
- B. Cleaning: Clean shop-finished surfaces, touch-up as required, and remove or refinish damaged or soiled areas, as acceptable to Laboratory Architect.
- C. Protection: Advise Contractor of procedures and precautions for protection of installed laboratory service fixtures from damage by work of other trades.

END OF SECTION



- ~~○ L2221VB Laboratory Mixing Faucet, Deck Mounted, 6" Rigid Vacuum Breaker Gooseneck, Aerator, Wrist Blade Handles~~
- ~~○ L2222VB Same as Above Except with 6" Swing Vacuum Breaker Gooseneck~~
- L2224VB Same as Above Except with 6" Rigid/Swing Vacuum Breaker Gooseneck



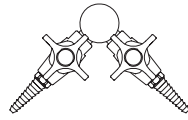
Measurements may vary ± 1/4".



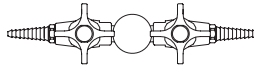
**L2880-131WSA** Needle Valve Assembly, Deck Mounted Single



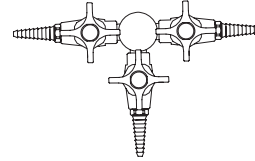
L2880-131WSA  
Single  
**(SF-11)**



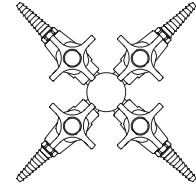
L2880-132AWSA  
90° Double  
**(SF-11-D)**



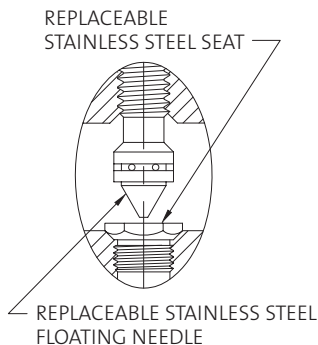
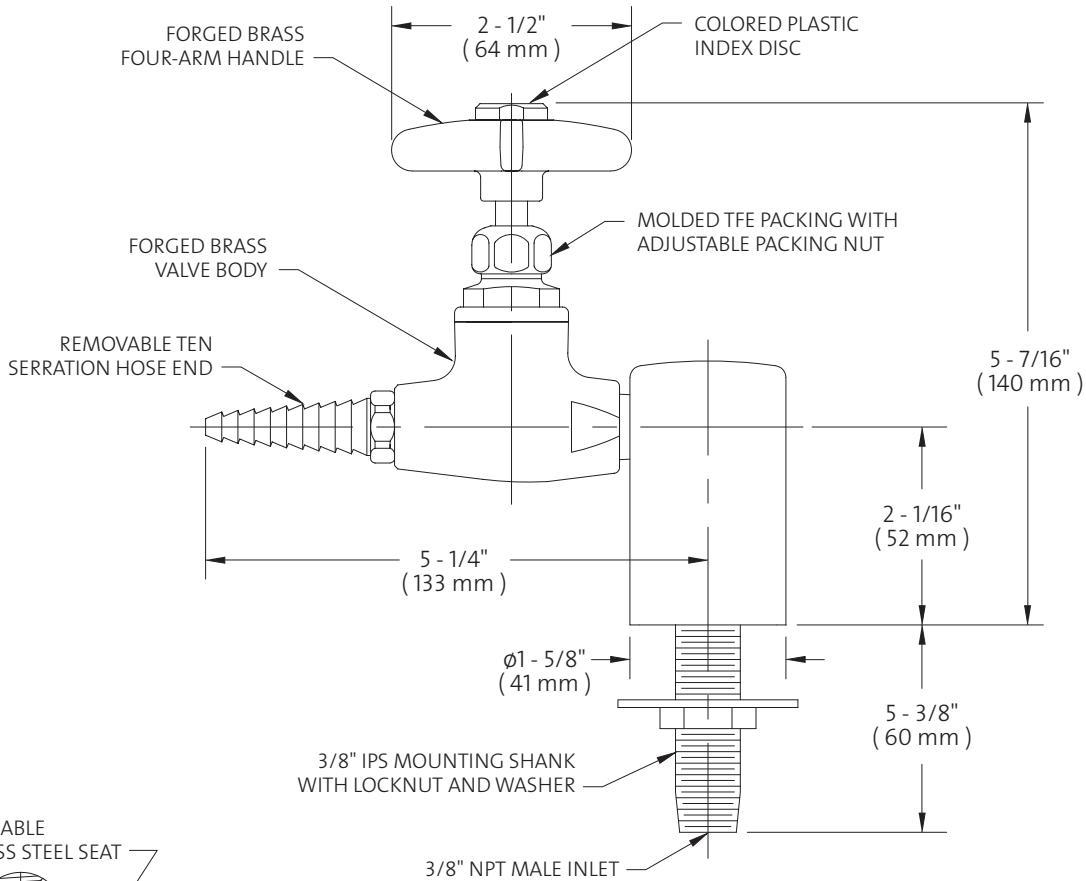
L2880-132SWSA  
180° Double  
**(SF-11-I)**



L2880-133WSA  
3-Way  
**(SF-11-T)**



L2880-134WSA  
4-Way  
**(SF-11-Q)**



NOTES:

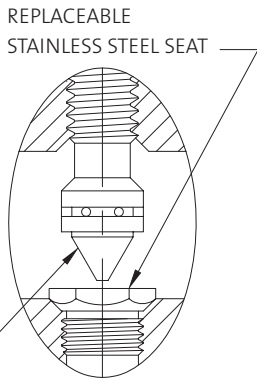
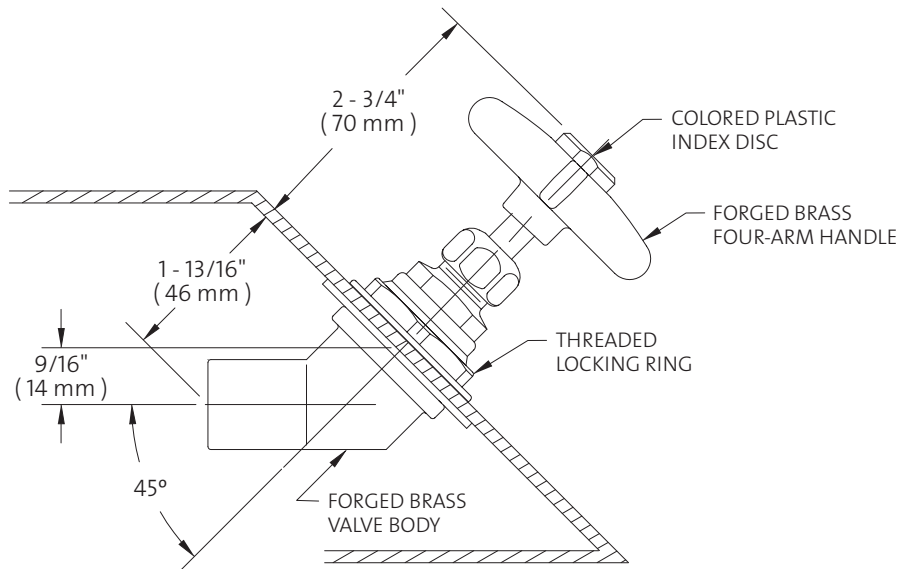
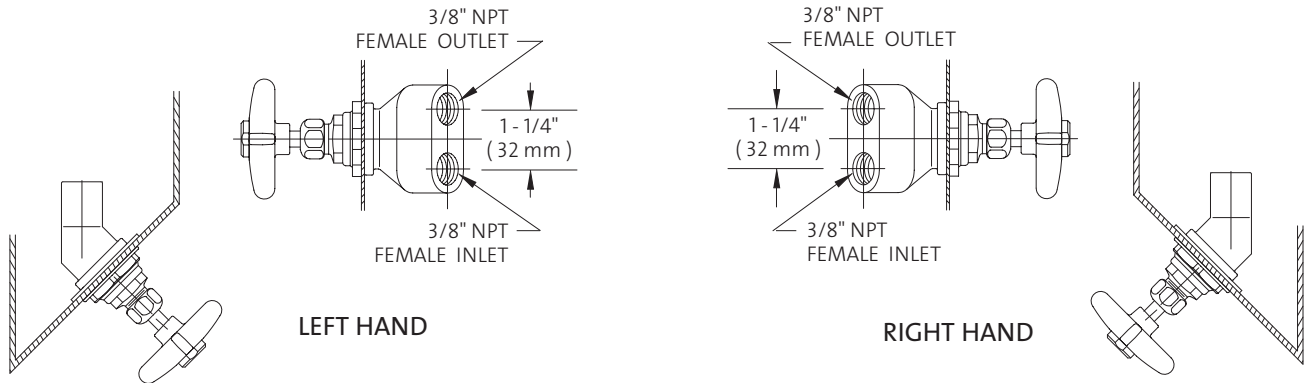
1. VALVE IS CERTIFIED BY CSA INTERNATIONAL TO COMPLY WITH ANSI 21.12 AND CGA 9.1.
2. FIXTURE IS FULLY ASSEMBLED AND FACTORY TESTED AT 225 PSI NITROGEN PRESSURE. MAXIMUM WORKING PRESSURE IS 150 PSI.
3. SPECIFY IF CLEANING FOR OXYGEN AND HIGH PURITY GASES IS REQUIRED.

Measurements may vary ± 1/4".

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- **L739RN** Remote Control Needle Valve, Panel Mounted, Angle Front Hood, Right Hand Mounting
- **L739LN** Same as Above Except Left Hand Mounting

### NEEDLE VALVE CONSTRUCTION



#### NOTES:

1. VALVE IS CLEANED, DEGREASED AND PACKED FOR HIGH PURITY GAS SERVICE.
2. VALVE IS FACTORY ASSEMBLED AND TESTED AT 225 PSI. MAXIMUM WORKING PRESSURE IS 150 PSI.
3. PROVIDE Ø1-14" MOUNTING HOLE FOR VALVE.
4. MAXIMUM PANEL THICKNESS IS 1/8".

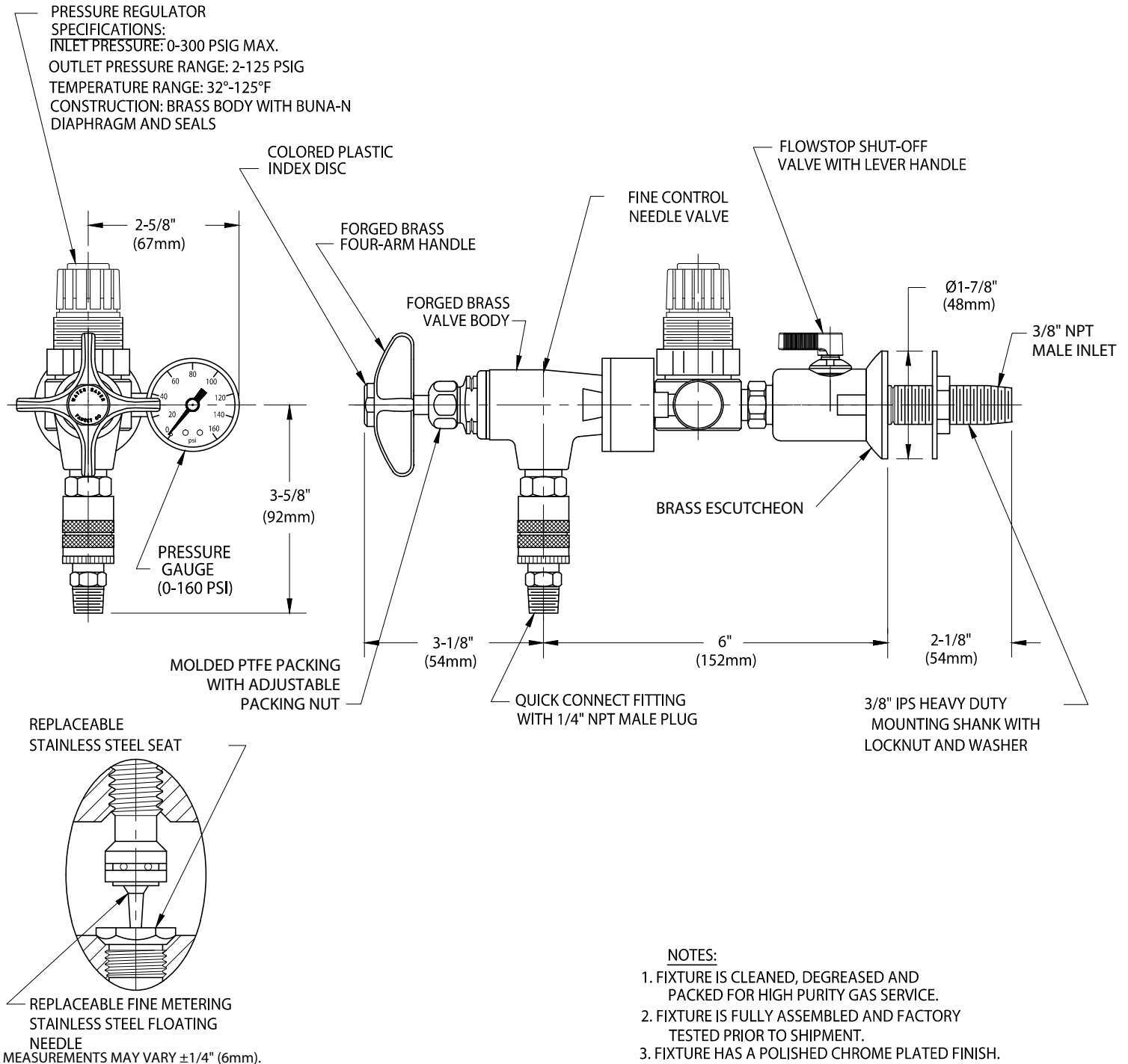
Measurements may vary ± 1/4".

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## L3173-366-758WSA

PRESSURE REGULATOR FIXTURE, HIGH PURITY GASES (0-125 PSIG), PANEL/WALL MOUNTED SINGLE

THIS FIXTURE IS FOR USE ON HIGH PURITY GAS SYSTEMS, INCLUDING OXYGEN. THE FOLLOWING GASES MAY BE USED WITH THIS FIXTURE: AIR, ARGON, CARBON DIOXIDE, HELIUM, NITROGEN, NITROUS OXIDE AND OXYGEN. DO NOT USE WHERE PRESSURE OR TEMPERATURE CAN EXCEED RATED OPERATING CONDITIONS.





## SECTION 11 53 43.10

### LABORATORY ACCESSORIES

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Division 1 Specification Sections for Guiding Principles for High Performance and Sustainable Buildings compliance requirements such as but not limited to Testing for Indoor Air Quality, Sustainable Design Requirements, Commissioning Requirements and Measurement & Verification, apply to this Section.

##### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Laboratory Benchtops.
  - 2. (LS-#) laboratory sinks.
  - 3. (PB-#) Pegboard glass drying racks.
  - 4. (SC-#) Service chases.
  - 5. (TL-#) task light.
  - 6. (CR-1) Gas cylinder restraint straps and racks.
  - 7. (US-#) Unistrut support framing.
  - 8. (LC-1) Lab coat racks.
  - 9. Concealed steel brackets.
- B. These accessories are part of Alternate No. 6 (Phase 3): Replace sanitary piping in Labs and lab casework to improve water quality in labs- Replace sinks, benchtops, plumbing fixtures, accessories, lab casework, fume hood side closure panels and paint walls. Flooring asbestos remediation.
- C. Related Sections include the following:
  - 1. Section 11 53 23 "High Performance Fume Hoods".
  - 2. Section 11 53 33, "Laboratory Safety Equipment".
  - 3. Section 11 53 43, " Laboratory Service Fittings and Fixtures".
  - 4. Section 12 35 53.13 "Painted Metal Laboratory Casework".

##### 1.3 PERFORMANCE REQUIREMENTS

- B. Seismic Performance: Provide assemblies and systems capable of withstanding the effects of earthquake motions determined according to the building code in effect for this Project or

ASCE 7, "Minimum Design Loads for Buildings and Other Structures", Section 9, "Earthquake Loads", whichever is more stringent.

#### 1.4 SUBMITTALS

- A. Product Data: Submit product data for manufactured items.
- B. Samples: Submit samples of the following:
  - 1. Benchtop materials.
  - 2. Painted metal finishes.
- C. Shop Drawings: Submit shop drawings for laboratory accessory assemblies that are factory and/or field assembled from manufactured components. Submit shop drawings showing locations, materials, connections and all details of construction and installation.
  - 1. Benchtops showing joint locations and fixture holes and cut outs.
  - 2. Glassware drying pegboard racks.
  - 3. Service drops.
  - 4. Fume extractors and supports.
- D. Product Test Reports: Based on tests performed by a qualified independent testing agency, indicate compliance with SEFA 3 and 8 for laboratory casework finishes and countertops with requirements specified for chemical and physical resistance.
- E. Qualification Data: Firms and/or persons specified shall demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of Architects and Owners, and other information specified.
- F. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.
- G. All products must be manufactured or substantially transformed in the United States or TAA designated country. Documentation to be provided with first submittal.
  - 1. USA Certificate of Origin: Manufacturer shall supply with first submittal, an example of their Certificate of Origin declaring products are wholly manufactured and assembled specifically in the United States, including city and state locations. A notarized Certificate of Origin shall be provided with closeout documents.

#### 1.5 QUALITY ASSURANCE

- A. Coordinate the interface of the laboratory accessories with the laboratory casework. Verify and coordinate all requirements for cutouts, attachments, reinforcing, piping, electrical devices, sizes and locations with laboratory casework and other laboratory items.
- B. Manufacturer shall identify and designate a full-time factory representative for on-site supervision and coordination during the installation of laboratory casework and laboratory accessories.

- C. Single Source Responsibility: Laboratory casework manufacturer shall provide and install all laboratory accessories in order to maintain single source responsibility for laboratory fit-up items.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver laboratory accessories until painting, utility roughing-in, and similar operations that could damage, soil, or deteriorate materials or assemblies have been completed in installation areas. If items must be stored in other than installation areas, store only in areas whose environmental conditions meet requirements specified in "Project Conditions" Article below.
- B. Protect finished surfaces from soiling and damage during handling and installation. Keep covered with polyethylene film or other protective covering.

#### 1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install laboratory accessories until building is enclosed, wet-work is completed, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels through remainder of construction period.

#### 1.8 COORDINATION

- A. Coordinate layout and installation of metal framing and reinforcement in gypsum board assemblies for support of laboratory accessories.

#### 1.9 EXTRA MATERIALS

- A. Furnish complete touchup kit for each type and color of laboratory accessory provided. Include fillers, primers, paints, fabric patches, and other materials necessary to perform permanent repairs to damaged items.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, other manufacturers offering products may be incorporated into the Work subject to approval by laboratory architect.

#### 2.2 MATERIALS

- A. Unless specified otherwise under an individual laboratory accessory, provide the following materials.
  - 1. Metal: Commercial-quality, cold-rolled, carbon-steel sheet, complying with ASTM A 366 (ASTM A 366M); matte finish; suitable for exposed applications; and stretcher leveled or roller leveled to stretcher-leveled flatness. Minimum 18 ga.

2. Stainless Steel: AISI Type 304 with No. 4 satin finish unless otherwise indicated.
3. Chemical-Resistant Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard 2-coat, chemical-resistant, baked-enamel finish consisting of prime coat and thermosetting topcoat with a minimum dry film thickness of 1 mil (0.025 mm) for topcoat and 2 mils (0.05 mm) for system.

## 2.3 FABRICATION

### A. Laboratory Benchtops, General:

1. Provide and install type and configuration of laboratory benchtops as indicated on drawings.
2. Fabricate benchtops in as large components as practicable to minimize field jointing.
3. Provide separate box curbs and splash trims with benchtops.
4. Field Jointing: Where possible, make in the same manner as shop jointing using dowels, splines, adhesives, and fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project site processing of top and edge surfaces is not required. Locate field joints where shown on approved Shop Drawings.
5. Abut top and edge surfaces in one true plane, with internal supports placed to prevent deflection. Provide flush hairline joints in tops using clamping devices.
  - a. Where necessary to penetrate tops with fasteners, countersink heads approximately 1/8 inch (3 mm) and plug hole flush with material equal to top in chemical resistance, hardness, and appearance.
6. Provide required holes and cutouts for service fittings.
7. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
8. Provide scribe moldings for closures at junctures of top, curb, and splash, with walls as recommended by manufacturer for materials involved. Match materials and finish to adjacent casework. Use chemical-resistant, permanently elastic sealing compound where recommended by manufacturer.

## 2.4 (E-#) EPOXY RESIN BENCHTOPS

- A. Benchtopy Thickness: Maintain 1" thickness, except as otherwise specified with tolerance not exceeding plus or minus 1/32". Provide front and end overhang of 1" beyond face of base cabinets, formed with continuous drip groove on under surface 1/2" from edge.
- B. Backsplash, side splashes and curbs: Same material as top, 4" high back and side splashes and 6" high curbs butt jointed and cemented to top. Provide back and side splashes where tops abut wall surfaces, tall cabinets and fume hoods. Provide and 6" high x 6" wide curbs at locations as indicated on laboratory equipment plans.
- C. Reagent Pedestals and Shelves: Same material as top. Provide 6" high x 7-1/2" wide single faced units and 6" high x 9" wide double faced units as indicated on laboratory equipment

drawings. Pedestal face shall permit installation of panel mounted service fixtures and top shall be removable for access to service utilities.

- D. Factory molded of modified epoxy-resin formulation, uniform mixture throughout full thickness with smooth, non-glare and non-specular finish.
- E. Physical Properties: Comply with the following minimum requirements:
  1. Flexural Strength: 15,000 psi (100 Mpa).
  2. Compressive Strength: 30,000 psi (200 Mpa).
  3. Tensile Strength: 10,000 psi ( 69 Mpa).
  4. Flexural Modulus:  $2 \times 10^6$
  5. Density: 2.03 g/cc
  6. Hardness (Rockwell M): 100.
  7. Water Absorption (24 hours): 0.02 % (maximum).
  8. Heat Distortion Point: 350 deg F (177 deg C).
  9. Thermal-shock Resistance: Highly restraint.
- F. Chemical Resistance: Epoxy-resin material has the following ratings when tested with indicated reagents according to NEMA LD 3, test procedure 3.9.5:

|     | <u>CHEMICAL - ACIDS</u>    | <u>RATING</u> |
|-----|----------------------------|---------------|
| 1.  | Hydrochloric Acid, 20%     | No Effect     |
| 2.  | Hydrochloric Acid, 37%     | No Effect     |
| 3.  | Nitric Acid, 20%           | Excellent     |
| 4.  | Nitric Acid, 70%           | Good          |
| 5.  | Sulfuric Acid, 30%         | No Effect     |
| 6.  | Sulfuric Acid, 77%         | No Effect     |
| 7.  | Sulfuric Acid, 96%         | Poor          |
| 8.  | Phosphoric Acid, 85%       | No Effect     |
| 9.  | Perchloric Acid, 60%       | No Effect     |
| 10. | Aqua Regia                 | No Effect     |
| 11. | Chromic Acid, 60%          | Good          |
| 12. | Acetic Acid, 98%           | No Effect     |
| 13. | Formic Acid, 90%           | No Effect     |
| 14. | Boric Acid, Sat.           | No Effect     |
| 15. | Citric Acid, Sat.          | No Effect     |
| 16. | Oxalic Acid, Sat.          | No Effect     |
| 17. | Hydrobromic Acid, 48%      | No Effect     |
| 18. | Hydroflouric Acid, 48%     | Good          |
| 19. | Vinegar                    | No Effect     |
|     |                            |               |
|     | <u>CHEMICAL - BASES</u>    |               |
| 20. | Ammonium Hydroxide, 28%    | No Effect     |
| 21. | Sodium Hydroxide, 10%      | No Effect     |
| 22. | Sodium Hydroxide, 40%      | No Effect     |
| 23. | Sodium Hydroxide, Flake    | No Effect     |
| 24. | Potassium Hydroxide, 10%   | No Effect     |
|     |                            |               |
|     | <u>CHEMICAL - SALTS</u>    |               |
| 25. | Zinc Chloride, Sat.        | No Effect     |
| 26. | Calcium Hypochlorite, Sat. | No Effect     |

|     |                       |           |
|-----|-----------------------|-----------|
| 27. | Clorox Bleach         | No Effect |
| 28. | Silver Nitrate, 10%   | No Effect |
| 29. | Sodium Sulfide, Sat.  | No Effect |
| 30. | Sodium Chloride, Sat. | No Effect |
| 31. | Iodine, Tincture      | No Effect |
| 32. | Hydrogen Peroxide     | No Effect |
| 33. | Phenol, 80%           | No Effect |
| 34. | Cresol                | No Effect |
| 35. | Formaldehyde, 40%     | No Effect |
| 36. | Mineral Oil, 100%     | No Effect |
| 37. | Glycerin, 100%        | No Effect |

CHEMICAL - SOLVENTS

|     |                              |           |
|-----|------------------------------|-----------|
| 38. | Methyl Alcohol, 100%         | No Effect |
| 39. | Ethyl Alcohol, 100%          | No Effect |
| 40. | Buty Alcohol, 100%           | No Effect |
| 41. | Naphtha, 100%                | No Effect |
| 42. | Turpentine, 100%             | No Effect |
| 43. | Kerosine, 100%               | No Effect |
| 44. | Heptane, 100%                | No Effect |
| 45. | Gasoline, 100%               | No Effect |
| 46. | Benzene, 100%                | No Effect |
| 47. | Toluene, 100%                | No Effect |
| 48. | Xylene, 100%                 | No Effect |
| 49. | Acetone, 100%                | No Effect |
| 50. | Methyl Ethyl Ketone, 100%    | No Effect |
| 51. | Methyl Isobutyl Ketone, 100% | No Effect |
| 52. | Ethyl Acetate, 100%          | No Effect |
| 53. | Ethyl Ether, 100%            | No Effect |
| 54. | Chloroform, 100%             | No Effect |
| 55. | Methyl Chloride, 100%        | No Effect |
| 56. | Trichlorethylene, 100%       | No Effect |
| 57. | Carbon Tetrachloride, 100%   | Excellent |
| 58. | Monochloro Benzene, 100%     | No Effect |
| 59. | Dioxane, 100%                | No Effect |
| 60. | Furfural                     | No Effect |

CHEMICAL - DYES

|     |                            |           |
|-----|----------------------------|-----------|
| 61. | Congo Red, 1%              | No Effect |
| 62. | Eosin Y, 0.5%              | No Effect |
| 63. | Gentian Violet, 1%         | No Effect |
| 64. | Indigo Carmen, 0.5%        | No Effect |
| 65. | Methyl Green, 0.5%         | No Effect |
| 66. | Wrights Blood Stain, 0.35% | No Effect |

G. Colors: Provide products that result in colors complying with the following requirements:

1. Color: Color to be selected from manufacturers' standard by laboratory architect.

H. Top Fabrication: Fabricate with factory cutouts for sinks and with plain butt-type joints assembled with epoxy adhesive and pre-fitted, concealed metal splines.

1. Top Configuration: Square edge with drip groove and separate backsplashes. Ease outside corners and edges to prevent sharp edges to the touch.
- I. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. American Epoxy Scientific Inc.
  2. Durcon Company, Inc.
  3. Epoxyn, Products
  4. Kemresin
  5. Laboratory Tops, Inc.

## 2.5 (P) PHENOLIC RESIN BENCHTOP

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Fundermax Lab Work Surfaces
  2. Trespa Toplab and Toplab PLUS

## 2.6 (LS-#) LABORATORY SINKS

- A. Laboratory Sinks: Provide and install laboratory sinks in materials and sizes as indicated on laboratory equipment drawings. Provide sizes as indicated or manufacturers' closest stock size of equal or greater volume. Provide all sinks complete with strainers, tail pieces, traps, stops and escutcheons.
  1. Provide ¼" high marine edge around cup sinks in fume hoods for spill containment.
- B. Outlets: 1-1/2" diameter, manufacturer's standard length, fabricated of silicon iron, cast epoxy resin, stainless steel, glass, or lead; of same material as sink wherever possible, or as otherwise acceptable to laboratory architect.
- C. Overflows: For each sink, except cup sinks, provide overflow of standard beehive or open top design and with separate strainer. Height 2" less than sink depth. Provide in same material as sink.
- D. Material:
  1. Cast Epoxy Resin Sinks: Non-glare molded in one piece with surfaces smooth, corners, coved and bottom sloped to outlet. Minimum physical properties, chemical resistance and color as specified for cast epoxy resin tops. Thickness, ½" minimum.
- E. Installation of Sinks:
  1. Flush Drop-in Installation for Epoxy Resin sinks: Rout groove in top to receive sink rim if not prepared in shop. Set sink in adhesive and fill remainder of groove with sealant or adhesive. Use procedures and products recommended by sink and top manufacturers. Remove excess adhesive and sealant while still wet and finish joint for neat appearance.

## 2.7 (PB-#) PEGBOARD GLASS DRYING RACKS

- A. Provide and install Glass Drying Racks as described here and as indicated on drawings. Unless otherwise indicated on drawings the size shall be:

24" W x 24" H.

- B. Glass drying rack assemblies shall include the following components:
1. Front Panel: 1" thick epoxy resin or 1" stainless steel with No. 4 finish.
  2. Glassware Pegs: Replaceable stainless steel or solid black polypropylene with glassware protector bases.
  3. Drip Trough: Stainless steel drip trough with PVC drainage hose.
  4. Finished Back Panels: Matching finish and material at front panel.
  5. Provide all fittings, fasteners, bracing, brackets, etc., for installation illustrated on drawings. Coordinate all reinforcing requirements for wall, frame or service drop mounting. Identify mounting method on shop drawings.

## 2.8 (SC-#) SERVICE CHASES

- A. Fabrication: Fabricate and install painted sheet metal service chases in configurations as detailed on drawings consisting of removable and fixed panels.
1. Removable and fixed service chase panels are to fit together flush showing a minimum joint where they join.
  2. Removable access panels are to have concealed-to-view pins, catches, clips, strikes, etc., that allow removal of panel with an upward motion.
  3. Fabricate and install service chase 1" lower than the bottom of light fixture line or ceiling if applicable to facilitate removal of access panel in an upward motion.
  4. All panels are to interlock with benchtop backsplashes so as the face of the backsplash and service chase panel are flush, unless otherwise detailed on laboratory equipment drawings.
  5. Fixed service chase panels shall be fastened to the wall or support unistrut -- whichever is applicable. Fixed panels shall be fitted with internal horizontal unistrut spaced vertically at 24 in on center to facilitate the internal fastening and support of mechanical piping and ductwork.
  6. Welds shall be continuous, ground smooth, and finished to match adjacent surfaces.
- B. Finish: Service chase shall be shop prime painted with corrosion resisting primer and receive shop finish coating. Provide color as listed in the Laboratory Component Finish Schedule on the drawings.
- C. Installation: Install service chases plumb, level and true.

## 2.9 (TL-1) TASK LIGHT



- A. The design standard for this project is the Reed Premier fixture by Light Corp.
  - 1. Quantity of (25) task lights.
  - 2. Size: 17", 24", 31", 44" or 58"
  - 3. Finish: Silver with White endcaps
  - 4. Cord Color: White
  - 5. Mounting: Screw
  - 6. Model to feature 9-ft cord and standard 120V plug. (no transformer).
  - 7. Locations: Not determined, provide to owner for use as needed.
  - 8. Automatic turn off.

#### 2.10 (CR-1) GAS CYLINDER RESTRAINT RACKS AND STRAPS

- A. Cylinder Restraint Manufacturer: The design standard for cylinder restraints with straps and buckles are:
  - 1. McMaster Carr, Cylinder Holder, Type "F" Steel with 1 1/2" Wide Polypropylene Strap.
    - a. Provide model# 2283T72, 2283T17 or 2283T18 for 2, 3 or 4 cylinders respectively as indicated on laboratory equipment plans.
  - 2. Finish: Racks shall be manufacturer's standard finish.
- B. Installation: Install cylinder restraint racks plumb, level and square to walls unless otherwise indicated on drawings. Brace rack assemblies to walls to prevent sway. Fabricate and install with all components for a complete assembly.

#### 2.11 (US-#) UNISTRUT SUPPORT FRAMING

- A. Provide, fabricate and install metal, FRP and stainless steel Unistrut framing as detailed and indicated on drawings.
- B. The following lists Unistrut framing integral with the installation of laboratory casework, fume hoods, service fittings and accessories.
  - 1. Overhead service carriers.
  - 2. Pipe and service drop supports.
  - 3. Gas cylinder storage racks.
  - 4. Shelving standards.
  - 5. Suspended equipment supports.
  - 6. Exhaust snorkel support framing.
  - 7. Miscellaneous structures and supports as detailed on drawings.
  - 8. Suspended structural ceiling grids for equipment and lighting support.
- C. Provide unistrut framing as indicated, complete with all nuts, bolts, fittings, and accessories as required.
- D. Exposed Metal unistrut framing shall be shop prime painted with corrosion resisting primer and receive a shop finish coating. Provide color as listed in the Laboratory Component Finish Schedule on the drawings.
- E. Non-exposed: All metal unistrut framing located above a drop ceiling which will not be visible to room occupants shall be finished with manufacturer's standard finish.

- F. Provide Owner with 12 copies of current parts catalog and price guide.
- G. Install unistrut framing prior to the installation of any ductwork, conduit and piping.
- H. Install unistrut framing plumb, level and true. Secure framing to structure and walls with fasteners, appropriate for the intended use. Provide engineering data and locations of all fasteners used.

#### 2.12 (LC-1) LAB COAT RACKS

- A. Manufacturer: The design standard for the lab coat racks is Glaro Modular Racks, solid rustproof aluminum construction model #9000C-SA-36".
- B. Finish: Racks shall be manufacturer's standard satin aluminum finish.
- C. Installation: Install coat racks plumb, level and square to walls unless otherwise indicated on drawings. Brace rack assemblies to walls to prevent sway. Fabricate and install with all components for a complete assembly.

#### 2.13 CONCEALED STEEL BRACKETS

- A. Material: Steel
  - 1. Finish: Powder Coated Black
- B. Design: Front Mounting Plus Countertop Support.
- C. Loads: Up to 400 lbs. per bracket, evenly distributed
- D. Thickness: 3/16 inch x 2 inch, A-36 steel
- E. Edges: rounded for safety
- F. Manufacturers: Steel Design Solutions and Centerline Brackets

### PART 3 - EXECUTION

#### 3.1 INSTALLATION AND CLEANING

- A. Install accessories according to approved Shop Drawings and manufacturer's written instructions.
- B. General: Install all items plumb, level, properly aligned, rigid, and securely anchored to building and casework components.
- C. Repair, remove or replace defective work as directed on completion of installation.
- D. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.

END OF LABORATORY ACCESSORIES



STAINLESS STEEL PEGBOARDS



INTER DYNE  
SYSTEMS

## INTER DYNE SYSTEMS MOD-RACK™ PEGBOARDS

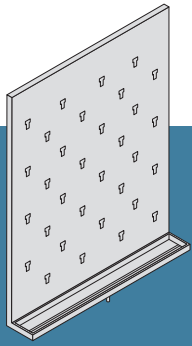
At Inter Dyne Systems we believe that an organized workstation functions better and helps you to operate more efficiently. That's why we've developed a full line of versatile workstation solutions, including our Mod-Rack™ pegboards. Mod-Rack pegboards serve a dual purpose in a modern laboratory. First, they allow you to quickly dry important, and often fragile, equipment in a sanitary manner. Second, our well-crafted pegboards are a safe place to store often used materials so they are readily at-hand when you need them. Mod-Rack pegboards come in a wide variety of sizes and mounting options and our selection of accessories allow you to completely customize your workstation. Custom sizes are available at a not so custom price and are furnished in a timely manner.



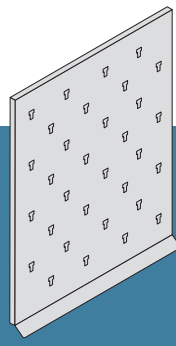
**INTER DYNE SYSTEMS:  
VERSATILE WORK STATION SOLUTIONS**

Inter Dyne Systems began over 25 years ago as an innovator of modular laboratory equipment by fabricating and selling stainless steel pegboards.

Over time we gained a reputation as the leader in the laboratory pegboard market. We've built upon that foundation by continuing to offer high quality pegboards with dependable service, consistent quality and on time delivery. We also offer shelving components, narcotics storage cabinets, countertops and innovative acrylic products.



**"V" VICTORIA  
STYLE**



**"B" BARON  
STYLE**

**MOD-RACK™ PEGBOARDS:  
VICTORIA AND BARON STYLE**

The Victoria or "V" pegboard is constructed of lightweight stainless steel, offered in a range of sizes and variety of mounting options. Along the bottom is a drip trough that funnels water away to a drain, allowing equipment to dry quickly and remain sanitized. Each "V" style pegboard includes an integral drip trough, wall bracket, standard 6" white pegs and 3 ft. of clear plastic drain hose.

The "B" Baron is also made of lightweight stainless steel. It is offered in three sizes and a variety of mounting options. A drip deflector at the bottom diverts water away from walls and directs it to a sink or drain. Each "B" style pegboard includes a wall bracket and standard 6" white pegs.

**"V" VICTORIA STYLE PEGBOARDS**



| MODEL NO. | SIZE WxH | NO. OF PEGS | SHIPPING WT. |
|-----------|----------|-------------|--------------|
|-----------|----------|-------------|--------------|

|       |           |    |         |
|-------|-----------|----|---------|
| V1824 | 18" x 24" | 15 | 13 lbs. |
| V2418 | 24" x 18" | 16 | 13 lbs. |
| V2424 | 24" x 24" | 20 | 16 lbs. |
| V2430 | 24" x 30" | 32 | 23 lbs. |
| V2436 | 24" x 36" | 40 | 25 lbs. |
| V3024 | 30" x 24" | 25 | 23 lbs. |
| V3030 | 30" x 30" | 50 | 24 lbs. |
| V3036 | 30" x 36" | 40 | 23 lbs. |
| V3624 | 36" x 24" | 30 | 25 lbs. |
| V3630 | 36" x 30" | 60 | 23 lbs. |
| V3636 | 36" x 36" | 66 | 25 lbs. |
| V4824 | 48" x 24" | 40 | 24 lbs. |
| V4830 | 48" x 30" | 48 | 28 lbs. |
| V4836 | 48" x 36" | 88 | 31 lbs. |

**"B" BARON STYLE PEGBOARDS**



| MODEL NO. | SIZE WxH | NO. OF PEGS | SHIPPING WT. |
|-----------|----------|-------------|--------------|
|-----------|----------|-------------|--------------|

|       |           |    |         |
|-------|-----------|----|---------|
| B2430 | 24" x 30" | 32 | 14 lbs. |
| B3030 | 30" x 30" | 50 | 17 lbs. |
| B3630 | 36" x 30" | 50 | 21 lbs. |

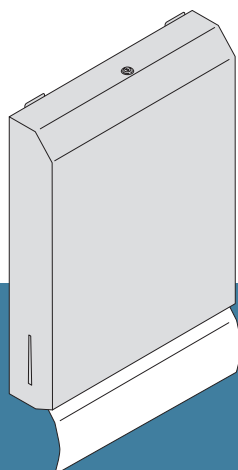


## PEGBOARDS CAN BE WORKSTATIONS

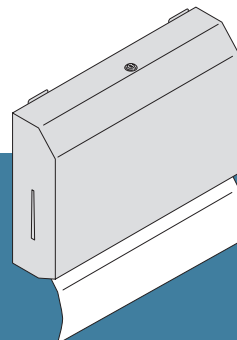
The addition of our accessories such as drain shelves, cylinder yolks and drain baskets can change a simple pegboard into a customized and efficient workstation. We offer a variety of accessories and peg options, so no matter where you are working or what you are working with, you can get what you need right away.

## ACCESSORIES

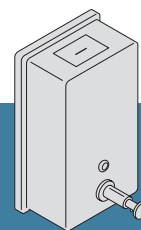
All of our accessories are made of the same high quality stainless steel as our pegboards. They come with a 5 year guarantee, can be sterilized by an autoclave and will easily help transform your Mod-Rack™ pegboard into your own customized workstation.



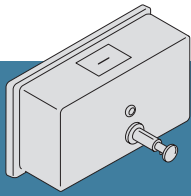
**0210 Paper Towel**  
Holds up to 400 c-fold or 535 multi fold paper towels, 11" x 14.5" x 4".



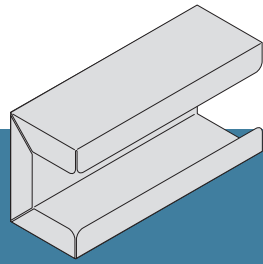
**0215 Paper Towel**  
Holds up to 150 c-fold or multi fold paper towels, 11" x 8" x 4".



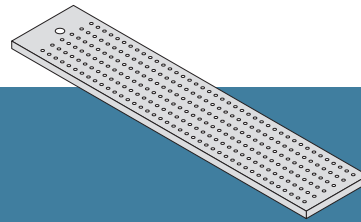
**0343 Soap Dispenser**  
Holds up to 40 fl. oz. of liquid 4.75" x 8.5" x 3" Comes with pegboard & wall mount clips.



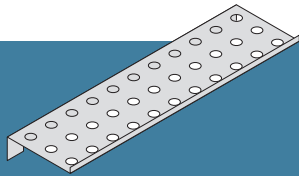
**0342 Soap Dispenser**  
Holds up to 40 fl. oz. of liquid, 8.5" x 4.75" x 3". Comes with pegboard & wall mount clips.



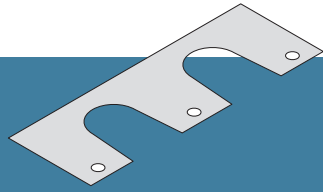
**GD-10 Glove Dispenser**  
Holds most standard glove boxes.



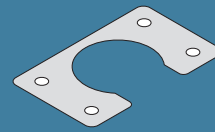
**DG-2 & DG-4 Drain Grid**  
To accommodate smaller tools and equipment. 2" or 4" wide drain grid for drip trough.



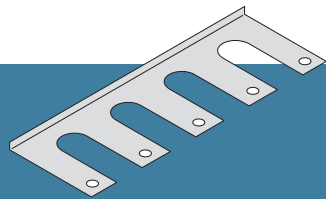
**DS-12 Drain Shelf**  
12" shelf for drying small tools, cylinders and equipment. Shipped with required support pegs for installation.



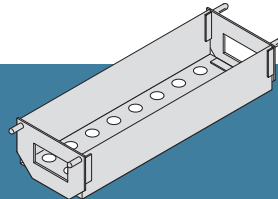
**CY-12 Cylinder Yolk**  
12" yolk holds large cylinders or flasks. Shipped with required support pegs for installation.



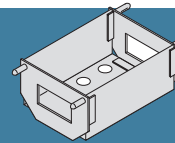
**FH-6 Flask Holder**  
6" holder for drying Erlenmeyer flasks or large cylinders. Shipped with required support pegs for installation.



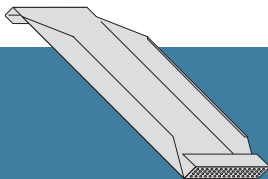
**FR-12 Funnel Rack**  
12" rack holds up to four cylinders. Shipped with required support pegs for installation.



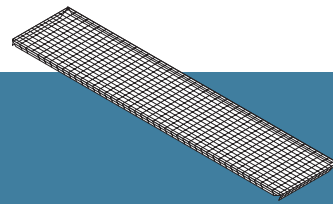
**DB-12 Drain Basket**  
12" basket for drying smaller tools, cylinders and equipment. Shipped with required support pegs for installation.



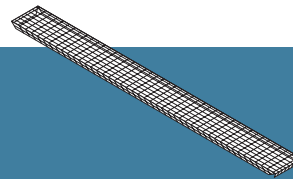
**DB-6 Drain Basket**  
6" basket for drying smaller tools, cylinders and equipment. Shipped with required support pegs for installation.



**PR-12 Pipette Rack**  
12" shelf for drying glass or bulbous pipettes. Shipped with required support pegs for installation.

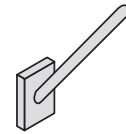


**SI-4 Screen Insert**  
4" wide screen insert for drip troughs.

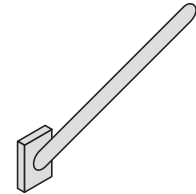


**SI-2 Screen Insert**  
2" wide screen insert for drip troughs.

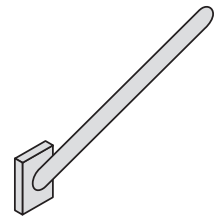
## PEG OPTIONS



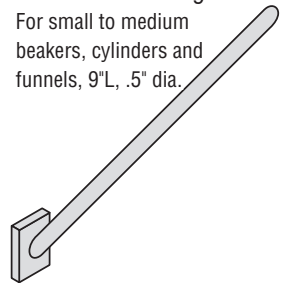
**TP-4 Tube Peg**  
Perfect for smaller beakers, cylinders and funnels, 4"L, .25" dia.



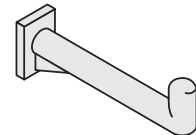
**BP-6 Tube Peg**  
Perfect for smaller beakers, cylinders and funnels, 6"L, .5" dia.



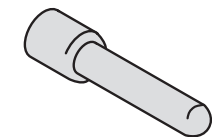
**LP-9 Medium Peg**  
For small to medium beakers, cylinders and funnels, 9"L, .5" dia.



**LP-12 Long Peg**  
Can accommodate medium to large beakers, cylinders and funnels, 12"L, .5" dia.



**SP-4 Support Peg**  
Used for mounting racks, shelves and baskets, 4"L.



**PE-3 Peg Extender**  
Lengthen all pegs an additional 3 inches.



**HP-1 Peg Hole Cover**  
Seals unused peg holes.

## ACCESSORY PACKAGES

To easily help customize your Mod-Rack™ pegboard, we've created functional package options that include some of our most popular accessories.



0210 Paper Towel Dispenser



0215 Paper Towel Dispenser



0343 Soap Dispenser



0342 Soap Dispenser



GD-10 Glove Dispenser



DB-12 Drain Basket



DB-6 Drain Basket



DG-2 or DG-4  
Drain Grid



DS-12 Drain Shelf



FH-6 Flask Holder



FR-12 Funnel Rack



CY-12 Cylinder Holder



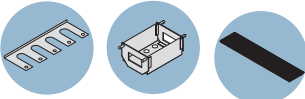
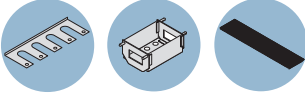
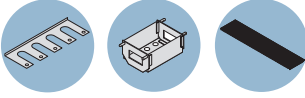
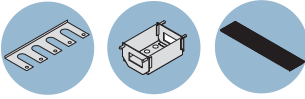
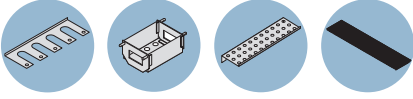
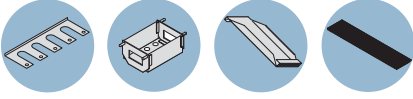
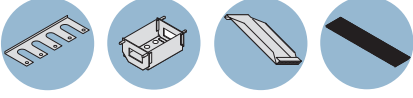
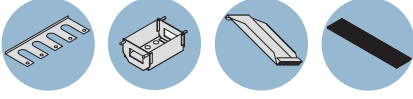
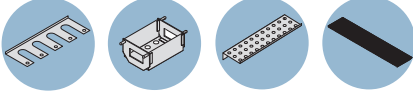
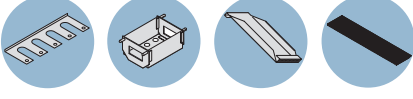
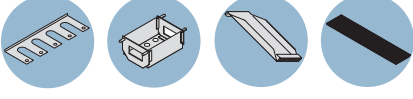

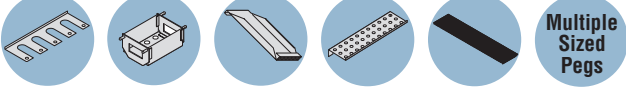

PR-12 Pipette Rack



SI-4 Screen Insert



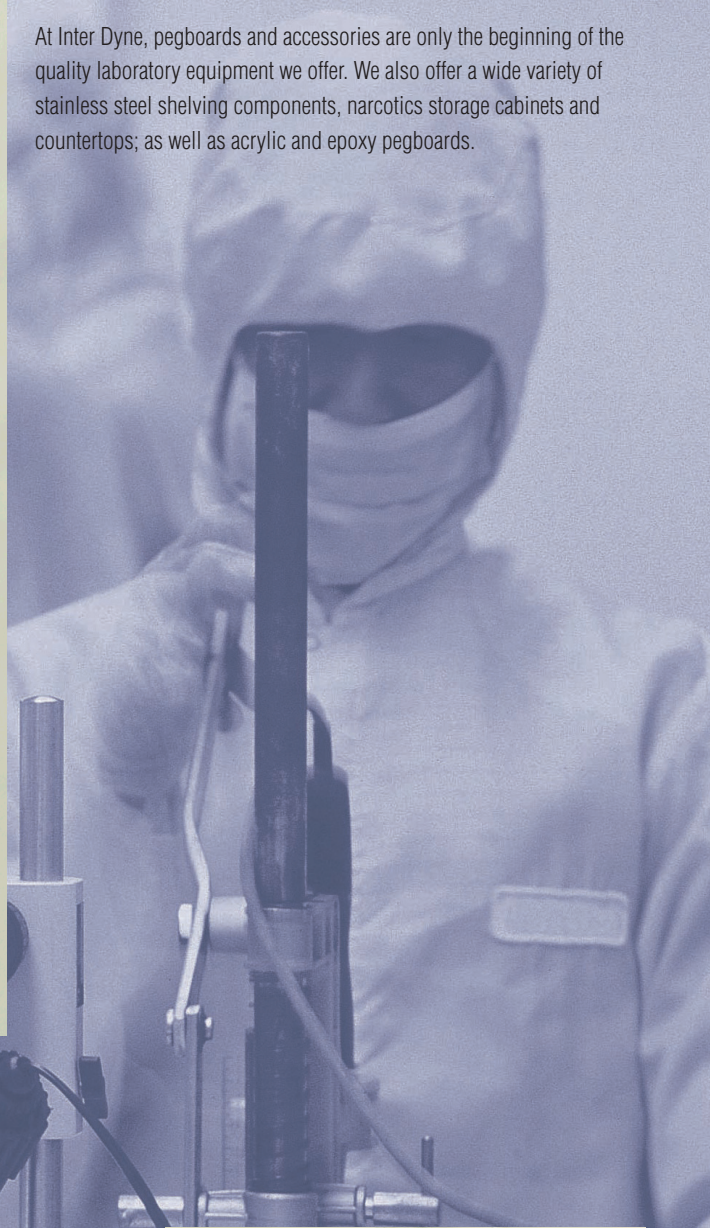
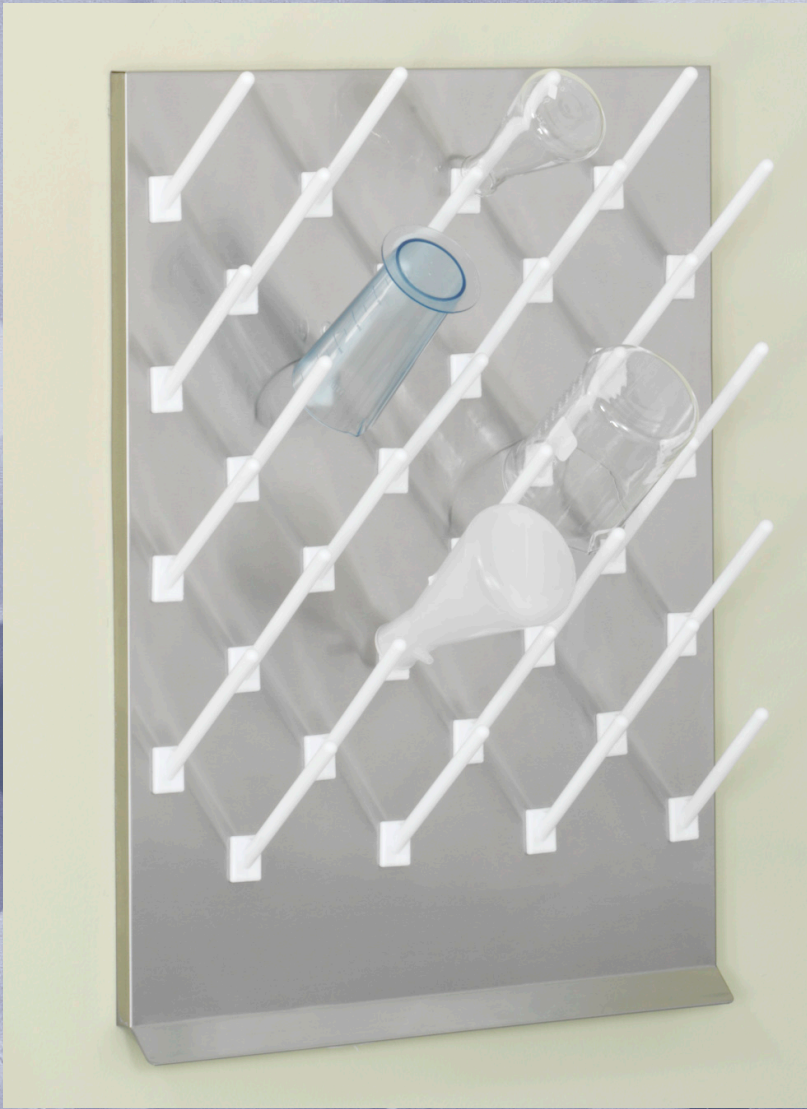
SI-2 Screen Insert

| MODEL NO. | SIZE WxH | NUMBER PEGS | COMPLETE WITH  |
|-----------|----------|-------------|--|
| V1824/PKG | 18"x24"  | 15          |    |
| V2418/PKG | 24"x18"  | 16          |    |
| V2424/PKG | 24"x24"  | 20          |    |
| V2430/PKG | 24"x30"  | 32          |    |
| V2436/PKG | 24"x36"  | 40          |    |
| V3024/PKG | 30"x24"  | 25          |   |
| V3030/PKG | 30"x30"  | 50          |  |
| V3036/PKG | 30"x36"  | 40          |  |
| V3624/PKG | 36"x24"  | 30          |  |
| V3630/PKG | 36"x30"  | 60          |  |
| V3636/PKG | 36"x36"  | 66          |  |
| V4824/PKG | 48"x24"  | 40          |  |
| V4830/PKG | 48"x30"  | 48          |  |
| V4836/PKG | 48"x36"  | 88          |  |



## PEGBOARDS ARE ONLY THE BEGINNING

At Inter Dyne, pegboards and accessories are only the beginning of the quality laboratory equipment we offer. We also offer a wide variety of stainless steel shelving components, narcotics storage cabinets and countertops; as well as acrylic and epoxy pegboards.



Our stainless steel countertops can be ordered to size with or without back/side splashes and integral sinks.



We have narcotics cabinets and specimen pass-through boxes in a variety of size, locking and mounting options.



Convenient and safe storage is a necessity in any lab. Our shelves and shelving components put everything you need right at your finger tips.

## PEGBOARD MOUNTING OPTIONS



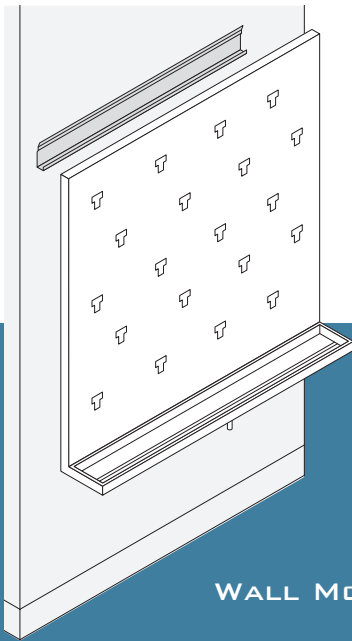
### Wall Mount

All Mod-Rack Pegboards are shipped complete with our standard wall bracket that is clearly labeled for easy installation. All 4" trough pegboards also come with a stabilizer bracket that attaches to the wall at the bottom of the pegboard and slips over the drain spout; keeping the pegboard secure against the wall.

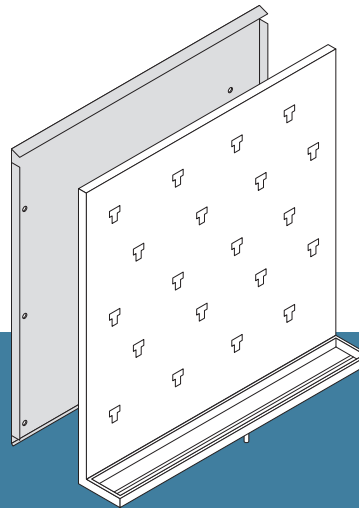


### Finished Back

In today's ever evolving lab environments wall space is not always available. Islands have become a mainstream design character in labs and can make installing pegboards slightly more challenging. However, by adding a finished back panel to your pegboard it will easily install to any utility chase, or reagent shelf system.



WALL MOUNT

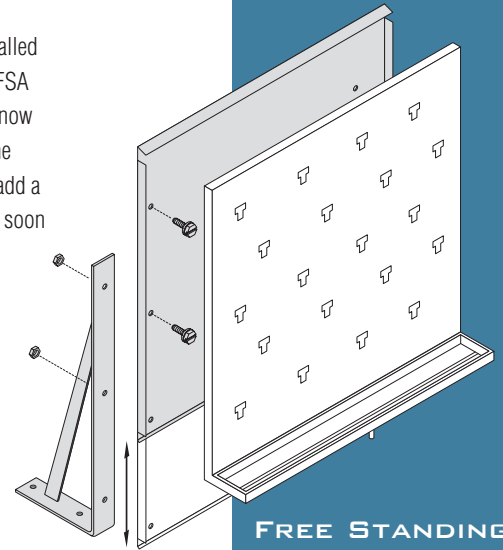


FINISHED BACK



### Free Standing Assembly Brackets

If space becomes limited any Mod-Rack can be installed to a laboratory work surface. By simply adding our FSA brackets that are 23" tall x 7.5" at the base, the unit now becomes free standing. They are supplied with all the necessary hardware for attaching to a counter. Just add a finished back panel to the pegboard for support and soon your countertop becomes a workstation.

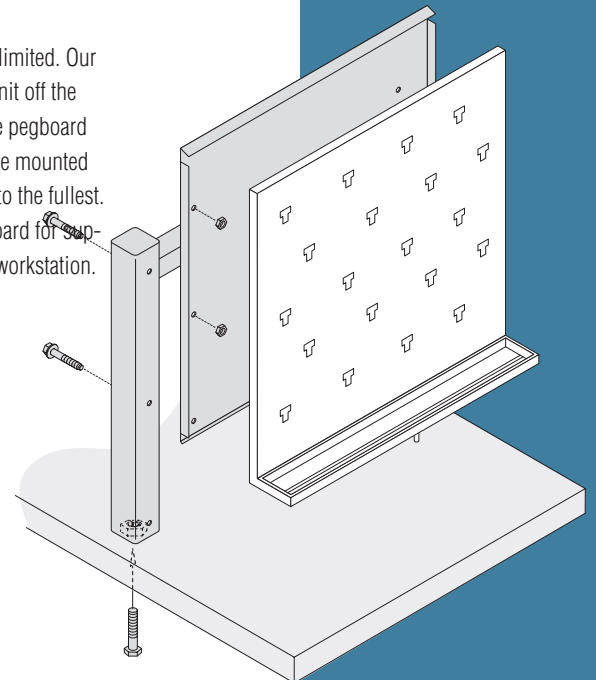


FREE STANDING ASSEMBLY

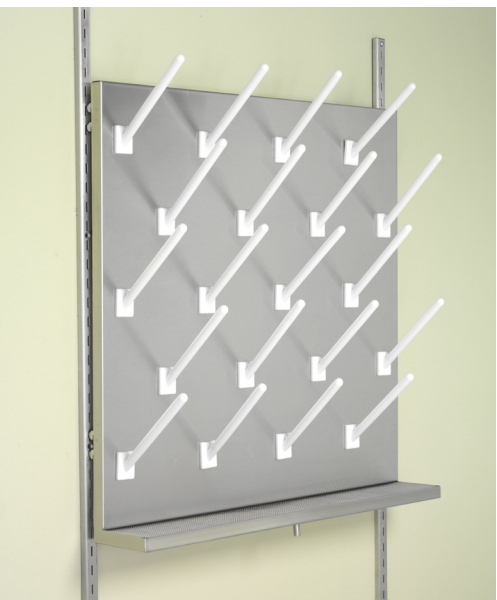


### Raised Top Assembly

If wall, utility chase or countertop space is limited. Our raised top assembly allows you to lift the unit off the work surface as far as 12". Space below the pegboard is free and, if desired, two pegboards can be mounted back to back – maximizing your lab space to the fullest. Just add a finished back panel to the pegboard for support and soon your countertop becomes a workstation.

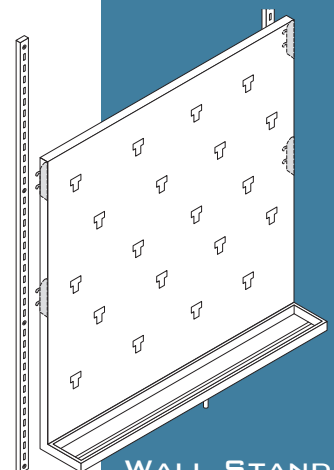


RAISED TOP ASSEMBLY



### Wall Standard Mount

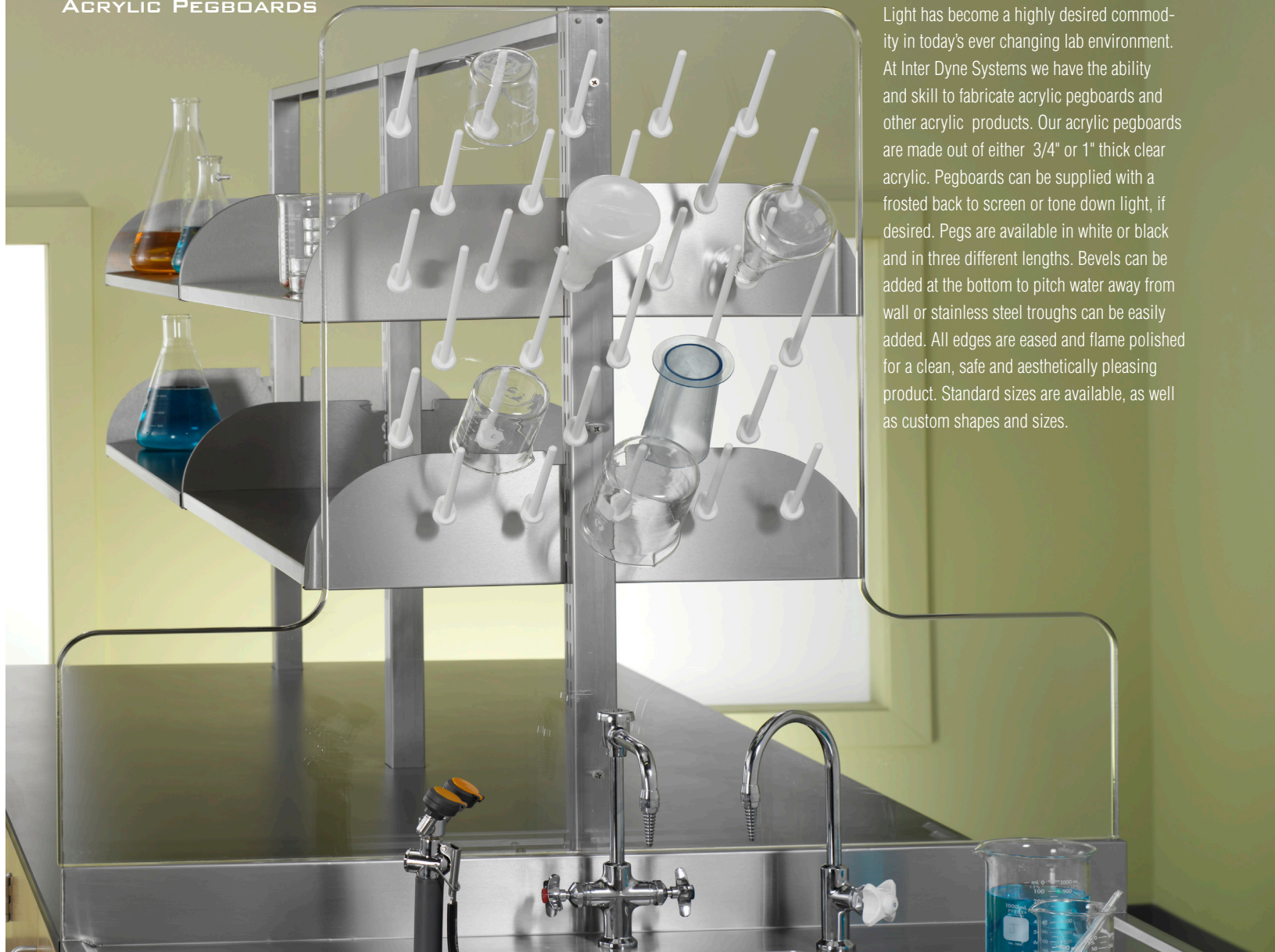
Mod-Racks can be mounted so they are fully adjustable, allowing you to raise or lower the unit to your desired height. The addition of an integral clip system to the back of the pegboard makes adjustment simple and any workstation that much more versatile. Just lift and clip it to the wall and now your pegboard is positioned at the height best for you. When ordering please add the suffix "AHB" to the pegboard product number and remember to order standards also.



WALL STANDARD MOUNT



## ACRYLIC PEGBOARDS



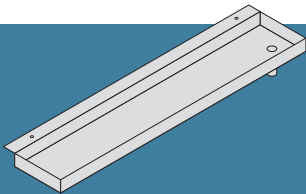
Light has become a highly desired commodity in today's ever changing lab environment. At Inter Dyne Systems we have the ability and skill to fabricate acrylic pegboards and other acrylic products. Our acrylic pegboards are made out of either 3/4" or 1" thick clear acrylic. Pegboards can be supplied with a frosted back to screen or tone down light, if desired. Pegs are available in white or black and in three different lengths. Bevels can be added at the bottom to pitch water away from wall or stainless steel troughs can be easily added. All edges are eased and flame polished for a clean, safe and aesthetically pleasing product. Standard sizes are available, as well as custom shapes and sizes.

## EPOXY PEGBOARDS

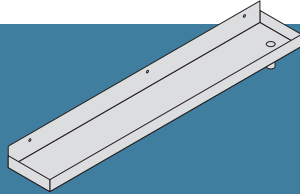
At Inter Dyne Systems we understand how time can be of the essence for many lab dealers or end users. With this issue in mind we stock various standard sized epoxy pegboards that can be shipped quickly for immediate resolve. A stainless steel drip trough can be easily mounted to the bottom edge. Epoxy pegboards are black 1" thick and available with white or black pegs in a variety of lengths.



## DRIP TROUGHS AND ACCESSORY OPTIONS



**PEGBOARD MOUNT**



**FACE MOUNT**

Stainless steel drip troughs can be mounted to the bottom of any acrylic or epoxy pegboard. All troughs come with three feet of clear PVC tubing and pre-drilled holes for easy installation. You can select a stainless steel screen insert or drain grid to create an additional shelf-like surface for drying. All sizes are stocked and ready for immediate shipping.

Stainless steel face-mount drip troughs are designed for use with any pegboard. Troughs come complete with three feet of clear PVC tubing and pre-drilled holes for easy installation. Face-mount drip troughs can be ordered with a screen insert or drain grid to add additional drying or storage space. They are manufactured from high-quality stainless steel and are stocked for immediate shipment.

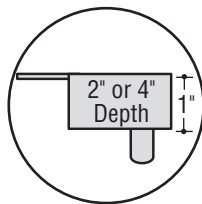
### PEGBOARD MOUNT



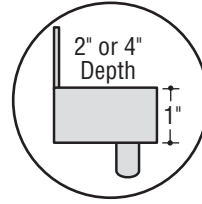
### FACE MOUNT



| PEGBOARD MOUNT | FACE MOUNT | SCREEN INSERT | DRAIN GRID |
|----------------|------------|---------------|------------|
| HDT-18-2       | FDT-18-2   | SI-18-2       | DG-18-2    |
| HDT-18-4       | FDT-18-4   | SI-18-4       | DG-18-4    |
| HDT-20-2       | FDT-20-2   | SI-20-2       | DG-20-2    |
| HDT-20-4       | FDT-20-4   | SI-20-4       | DG-20-4    |
| HDT-24-2       | FDT-24-2   | SI-24-2       | DG-24-2    |
| HDT-24-4       | FDT-24-4   | SI-24-4       | DG-24-4    |
| HDT-30-2       | FDT-30-2   | SI-30-2       | DG-30-2    |
| HDT-30-4       | FDT-30-4   | SI-30-4       | DG-30-4    |
| HDT-32-2       | FDT-32-2   | SI-32-2       | DG-32-2    |
| HDT-32-4       | FDT-32-4   | SI-32-4       | DG-32-4    |
| HDT-36-2       | FDT-36-2   | SI-36-2       | DG-36-2    |
| HDT-36-4       | FDT-36-4   | SI-36-4       | DG-36-4    |
| HDT-42-2       | FDT-42-2   | SI-42-2       | DG-42-2    |
| HDT-42-4       | FDT-42-4   | SI-42-4       | DG-42-4    |
| HDT-48-2       | FDT-48-2   | SI-48-2       | DG-48-2    |
| HDT-48-4       | FDT-48-4   | SI-48-4       | DG-48-4    |

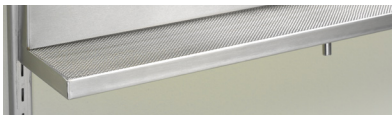


End View



End View

### STAINLESS STEEL SCREEN INSERTS & DRAIN GRIDS



**SCREEN INSERT**



**DRAIN GRID**

The stainless steel screen inserts & drain grids are ideal for keeping items off the bottom of the trough. Also they can be utilized as a drying shelf. These items can be used with any Inter Dyne Systems drip trough or Victoria Style pegboard. 4" wide screen insert and drain grid shown at left.

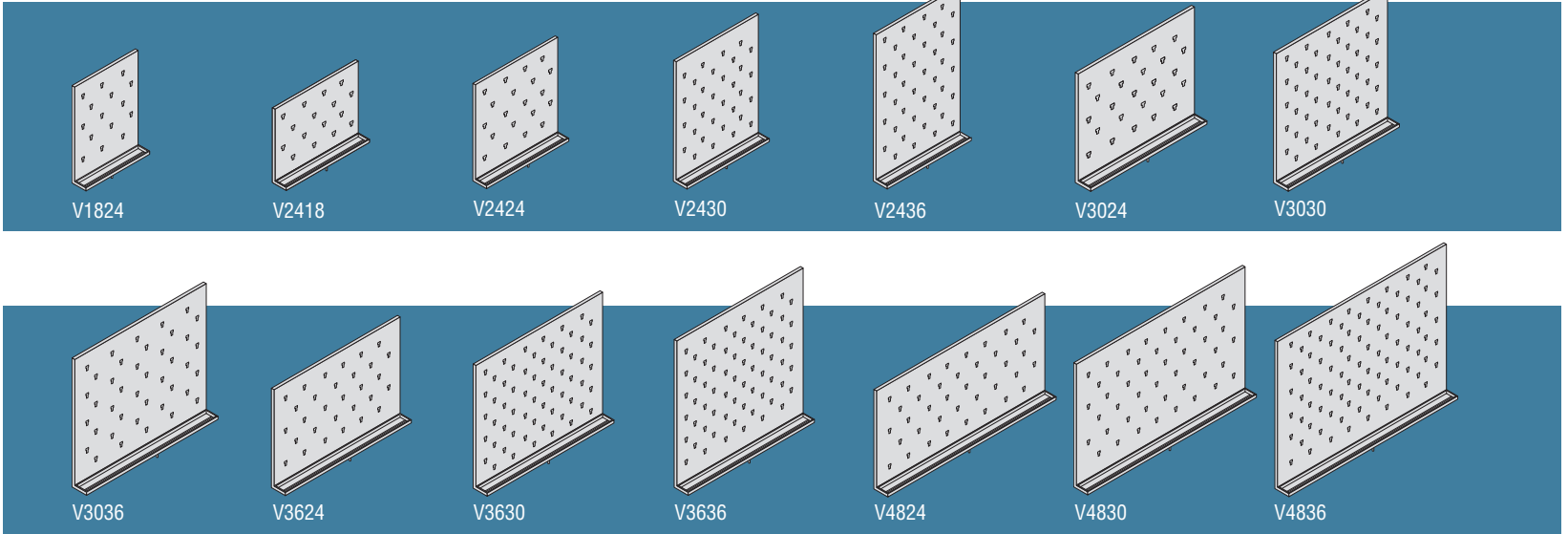
## PEGBOARDS & ACCESSORIES

Inter Dyne Systems is the solution for outfitting your laboratory. Our pegboards, shelves, countertops, narcotic cabinets and specimen pass-through boxes are made of high-quality stainless steel to ensure a sterile and versatile workstation.

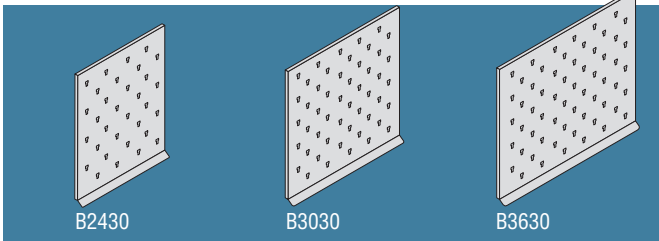
Our Mod-Rack™ pegboards come in a variety of sizes and mounting options and can be easily modified with our wide-selection of accessory options to meet the specific needs of your facility.

Contact a member of our friendly sales staff today to begin building your customized workstation.

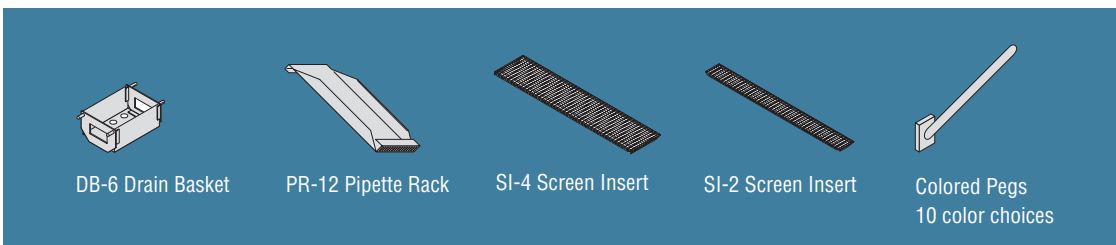
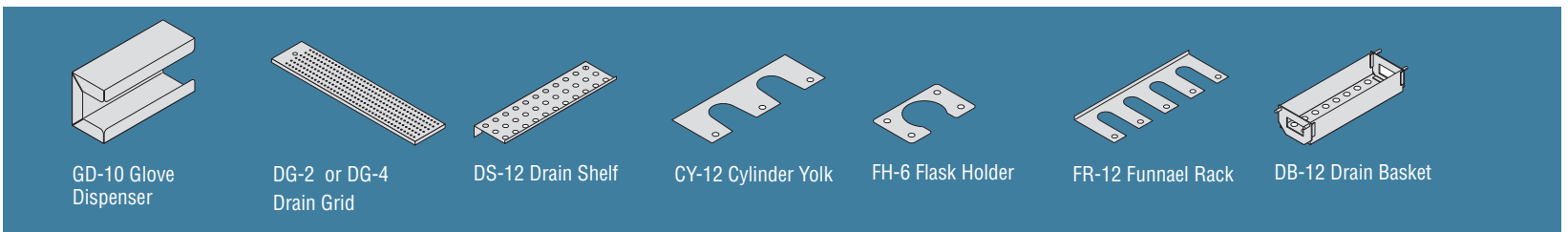
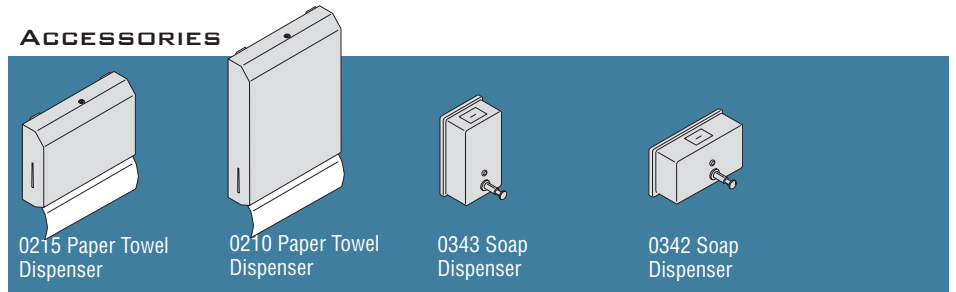
### “V” VICTORIA PEGBOARDS



### “B” BARON PEGBOARDS



### ACCESSORIES



These products are covered by one or more of the following patents:  
4,485,929; 3,912,212; 3,770,392; 5,163,567; 5,884,784



Inter Dyne Systems, Inc.  
676 E. Ellis Road  
Norton Shores, MI 49441

P: 877.477.5227 F: 231.799.9690  
E: jack@interdynesystems.com  
W: www.interdynesystems.com

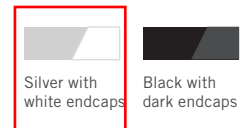
TASKLIGHTS TO BE ATTACHED TO SHELVES WITH FASTENERS, NOT MAGNETS.

LIGHTCORP

# REED PREMIER

Available in five lengths, in either standard or high output and with interlinking capabilities, Reed Premier creates customized lighting solutions for any space. Designed to attach directly beneath underbin cabinetry, its slim profile mounts effortlessly to provide superb quality illumination exactly where it's needed. Its multiple energy-saving components include an automatic shut-off feature, optional occupancy or vacancy sensor and a capacitive touch dimming feature with last state memory that allows the user to tailor its intensity to any specific task with ease. **Proudly designed and manufactured in Grand Haven, Michigan.**

## Finishes



# REED PREMIER

## Features

- Choose from standard or high output
- Interlinkable
- Automatic shut-off after 10 hours (± 15 mins.)
- Continuous dimming from 100%–15% with last state memory
- Optional occupancy or vacancy sensor available as a modular accessory or integrated into the fixture

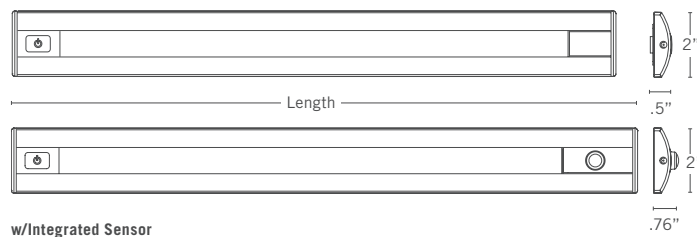
## Specifications

|                               |  |
|-------------------------------|--|
| <b>Lengths:</b>               | 17", 24", 31", 44", 58"                                |
| <b>Power consumption:</b>     | see chart below  |
| <b>Color temperature:</b>     | 3500K; 4000K available on request                      |
| <b>Luminosity:</b>            | see chart below  |
| <b>Color rendering index:</b> | 83+ CRI  |
| <b>Rated lifespan:</b>        | > 50,000 hours   |
| <b>Number of LEDs:</b>        | see chart below  |
| <b>Power supply:</b>          | 9' (18W) or 11' (65W); choose from black or white cord |

Provide cord with plug only, no adapter box.

|     | # of LEDs<br>SO/HO | Lumens<br>SO/HO | Wattage<br>SO/HO | System<br>SO/HO |
|-----|--------------------|-----------------|------------------|-----------------|
| 17" | 24/47              | 430/755         | 8.0/13.0         | 9.1/14.6        |
| 24" | 36/70              | 708/1217        | 12.4/20.4        | 14.1/23.7       |
| 31" | 48/94              | 916/1394        | 16.4/26.4        | 17.6/28.4       |
| 44" | 72/141             | 1293/2080       | 24.2/38.8        | 25.9/41.4       |
| 58" | 96/188             | 1751/2920       | 31.2/50.0        | 33.7/54.0       |

## Dimensions



## Sustainability Notes

- Made with fully-recyclable anodized aluminum and plastic
- Energy-saving features such as auto shut-off and dimming included; occupancy/vacancy sensors available
- Lower power consumption
- Mercury-free
- Potential LEED points: **Interior Lighting** (possible 2 points), **Interior Lighting Controls** (possible 1 point). For more LEED information please visit <https://new.usgbc.org/leed-v41>

## Certifications



ETL listed: compliant to UL 153/8750 & CSA C22.2 No. 9; FCC Part 15 Class B; TAA; BAA; CEC Title 20, NYC #10A0477

## Warranty

The Reed Premier fixture is warranted for a period of 10 years. Reed Premier power supplies are warranted for 5 years.

|     | Actual Length | Actual Length w/Integrated Sensor | Suggested Shelf Size |
|-----|---------------|-----------------------------------|----------------------|
| 17" | 16.4"         | 17.2"                             | 24"–36"              |
| 24" | 23.3"         | 24.1"                             | 30"–42"              |
| 31" | 30.1"         | 30.9"                             | 42"–48"              |
| 44" | 43.7"         | 44.5"                             | 54"–60"              |
| 58" | 57.4"         | 58.2"                             | ≥ 72"                |



# REED PREMIER

## Photometric Data

Footcandle outputs measured at 18" from the work surface.

| 17" Standard Output | 18" | 12" | 6" | CL        | 6" | 12" | 18" |
|---------------------|-----|-----|----|-----------|----|-----|-----|
| 12"                 | 10  | 18  | 27 | 31        | 27 | 18  | 11  |
| 6"                  | 15  | 30  | 49 | 59        | 49 | 30  | 15  |
| CL                  | 18  | 38  | 64 | <b>79</b> | 65 | 38  | 19  |
| 6"                  | 16  | 32  | 54 | 65        | 64 | 33  | 17  |
| 12"                 | 12  | 21  | 31 | 37        | 31 | 21  | 12  |

| 17" High Output | 18" | 12" | 6"  | CL         | 6"  | 12" | 18" |
|-----------------|-----|-----|-----|------------|-----|-----|-----|
| 12"             | 17  | 30  | 44  | 51         | 44  | 30  | 18  |
| 6"              | 26  | 50  | 82  | 97         | 81  | 51  | 26  |
| CL              | 31  | 63  | 109 | <b>132</b> | 109 | 65  | 32  |
| 6"              | 28  | 56  | 90  | 108        | 91  | 55  | 29  |
| 12"             | 20  | 36  | 53  | 59         | 53  | 36  | 21  |

| 24" Standard Output | 18" | 12" | 6" | CL         | 6" | 12" | 18" |
|---------------------|-----|-----|----|------------|----|-----|-----|
| 12"                 | 18  | 29  | 39 | 43         | 39 | 28  | 17  |
| 6"                  | 27  | 49  | 71 | 80         | 70 | 48  | 26  |
| CL                  | 33  | 63  | 95 | <b>106</b> | 92 | 60  | 32  |
| 6"                  | 30  | 54  | 80 | 89         | 78 | 53  | 29  |
| 12"                 | 21  | 34  | 47 | 52         | 47 | 33  | 20  |

| 24" High Output | 18" | 12" | 6"  | CL         | 6"  | 12" | 18" |
|-----------------|-----|-----|-----|------------|-----|-----|-----|
| 12"             | 28  | 45  | 61  | 67         | 60  | 44  | 27  |
| 6"              | 43  | 78  | 113 | 127        | 111 | 76  | 42  |
| CL              | 53  | 101 | 152 | <b>171</b> | 150 | 99  | 52  |
| 6"              | 48  | 87  | 127 | 144        | 126 | 86  | 46  |
| 12"             | 33  | 55  | 75  | 83         | 74  | 54  | 33  |

| 31" Standard Output | 18" | 12" | 6"  | CL         | 6"  | 12" | 18" |
|---------------------|-----|-----|-----|------------|-----|-----|-----|
| 12"                 | 25  | 38  | 49  | 53         | 50  | 39  | 26  |
| 6"                  | 41  | 67  | 88  | 95         | 87  | 67  | 42  |
| CL                  | 50  | 86  | 114 | <b>125</b> | 115 | 87  | 52  |
| 6"                  | 43  | 73  | 96  | 104        | 97  | 74  | 45  |
| 12"                 | 29  | 45  | 57  | 62         | 58  | 46  | 30  |

| 31" High Output | 18" | 12" | 6"  | CL         | 6"  | 12" | 18" |
|-----------------|-----|-----|-----|------------|-----|-----|-----|
| 12"             | 40  | 61  | 78  | 85         | 79  | 62  | 42  |
| 6"              | 64  | 106 | 140 | 152        | 141 | 108 | 67  |
| CL              | 80  | 137 | 183 | <b>200</b> | 186 | 141 | 84  |
| 6"              | 70  | 116 | 154 | 168        | 156 | 119 | 73  |
| 12"             | 47  | 72  | 92  | 99         | 93  | 73  | 49  |

| 44" Standard Output | 18" | 12" | 6"  | CL         | 6"  | 12" | 18" |
|---------------------|-----|-----|-----|------------|-----|-----|-----|
| 12"                 | 42  | 54  | 61  | 63         | 61  | 54  | 42  |
| 6"                  | 73  | 95  | 106 | 109        | 104 | 93  | 72  |
| CL                  | 94  | 124 | 138 | <b>141</b> | 137 | 122 | 94  |
| 6"                  | 80  | 105 | 117 | 121        | 117 | 104 | 80  |
| 12"                 | 50  | 64  | 72  | 75         | 72  | 64  | 50  |

| 44" High Output | 18" | 12" | 6"  | CL         | 6"  | 12" | 18" |
|-----------------|-----|-----|-----|------------|-----|-----|-----|
| 12"             | 69  | 88  | 100 | 104        | 100 | 89  | 71  |
| 6"              | 118 | 155 | 174 | 180        | 174 | 154 | 120 |
| CL              | 151 | 199 | 224 | <b>232</b> | 225 | 202 | 155 |
| 6"              | 127 | 167 | 188 | 194        | 189 | 168 | 131 |
| 12"             | 79  | 102 | 115 | 120        | 115 | 103 | 81  |

| 58" Standard Output | 18" | 12" | 6"  | CL         | 6"  | 12" | 18" |
|---------------------|-----|-----|-----|------------|-----|-----|-----|
| 12"                 | 58  | 65  | 68  | 69         | 68  | 64  | 57  |
| 6"                  | 101 | 113 | 117 | 118        | 116 | 110 | 98  |
| CL                  | 131 | 144 | 150 | <b>151</b> | 149 | 143 | 128 |
| 6"                  | 109 | 122 | 127 | 129        | 127 | 121 | 108 |
| 12"                 | 67  | 75  | 79  | 80         | 79  | 75  | 67  |

| 58" High Output | 18" | 12" | 6"  | CL         | 6"  | 12" | 18" |
|-----------------|-----|-----|-----|------------|-----|-----|-----|
| 12"             | 93  | 104 | 110 | 110        | 111 | 104 | 95  |
| 6"              | 160 | 179 | 187 | 189        | 187 | 178 | 162 |
| CL              | 205 | 228 | 238 | <b>240</b> | 239 | 229 | 207 |
| 6"              | 172 | 192 | 202 | 204        | 203 | 194 | 176 |
| 12"             | 104 | 120 | 126 | 129        | 127 | 121 | 108 |

## (CR-1) CYLINDER RESTRAINT

### Wall Mount



E



F



G



H

Wall mount holders attach to any wall; fasteners are not included. The base of **style H** must rest on the floor in addition to being secured to the wall.

|  | Holds No.<br>of Cylinders | Cylinder<br>Dia. Range | Overall Size |        |        | Mounting<br>Holes |        | Each            |
|--|---------------------------|------------------------|--------------|--------|--------|-------------------|--------|-----------------|
|  |                           |                        | Wd.          | Ht.    | Dp.    | No.               | Dia.   |                 |
| <b>Steel with Steel Chain—Zinc-Plated Finish</b>             |                           |                        |              |        |        |                   |        |                 |
| E  | 1                         | 7"-9"                  | 10 1/2"      | 1 1/4" | 3"     | 2                 | 3/8"   | 2283T1* \$14.67 |
| E  | 1                         | 9"-16"                 | 19 1/2"      | 1 1/4" | 6"     | 2                 | 3/8"   | 2283T3* 21.58   |
| E  | 2                         | 9 1/4"-12 7/8"         | 23"          | 3"     | 6"     | 3                 | 5/8"   | 2283T7†° 70.68  |
| <b>Steel with 1 1/2" Wide Polypropylene Strap—Light Gray</b> |                           |                        |              |        |        |                   |        |                 |
| F  | 1                         | 4"-12"                 | 8"           | 4 1/4" | 2 1/4" | 2                 | 13/32" | 2283T22 26.12   |
| F  | 2                         | 4"-12"                 | 24"          | 4 1/4" | 2 1/4" | 4                 | 13/32" | 2283T72 52.96   |
| F  | 3                         | 4"-12"                 | 36"          | 4 1/4" | 2 1/4" | 4                 | 3/8"   | 2283T17 72.60   |
| F  | 4                         | 4"-12"                 | 48"          | 4 1/4" | 2 1/4" | 8                 | 3/8"   | 2283T18 99.64   |

\* Made of 3/32" thick steel channel.

† Made of 3/16" thick steel channel. Color is green.

° One side holds a cylinder up to 9 1/4" dia.; the other side holds a cylinder up to 12 7/8" dia.

|   | Holds No.<br>of Cylinders | Cylinder<br>Dia. Range | Overall Size |        |        | Mounting<br>Holes |        | Each            |
|---|---------------------------|------------------------|--------------|--------|--------|-------------------|--------|-----------------|
|   |                           |                        | Wd.          | Ht.    | Dp.    | No.               | Dia.   |                 |
| <b>Type 304 Stainless Steel with 1 1/2" Wide Polypropylene Strap</b>          |                           |                        |              |        |        |                   |        |                 |
| F   | 1                         | 4"-12"                 | 8"           | 4 1/4" | 2 1/4" | 2                 | 13/32" | 2283T61 \$57.70 |
| F   | 2                         | 4"-12"                 | 24"          | 4 1/4" | 2 1/4" | 4                 | 13/32" | 2283T63 108.90  |
| <b>Polypropylene with 1 1/2" Wide Polypropylene Strap and Steel Chain—Red</b> |                           |                        |              |        |        |                   |        |                 |
| G   | 1                         | 4"-14"                 | 9"           | 4"     | 2"     | 2                 | 5/16"  | 2283T11 24.49   |
| G   | 2                         | 4"-12"                 | 24"          | 4 1/2" | 2"     | 4                 | 5/16"  | 2283T67 53.54   |
| <b>Polyethylene with 1" Wide Nylon Strap—Yellow</b>                           |                           |                        |              |        |        |                   |        |                 |
| H   | 2                         | 3"-12 3/8"             | 28"          | 30"    | 14"    | 4                 | 3/4"   | 2283T95 146.55  |

## (LC-1) LAB COAT SHELF AND RACK

### **Glaro Professional Strength, Modular Wall Mounted Coat Rack with Shelf**

— **Including Solid Aluminum Hangers** —

**SATIN ALUMINUM** or **ANODIZED BRASS**



For those who demand the best, these wall mounted coat racks are superior to all other coat racks at any price.

Glaro all satin aluminum, professional strength clothing / coat racks are visually appealing so that they can be used in places that are not enclosed. Any length can be created easily. These standard coat racks are supplied in 24", 30", and 36" sections to construct one continuous rack. There is no limit to the overall length that can be created and the **interlocking modular design** makes the longest lengths just as sturdy and strong as our shortest 24" model. The convenient top shelf adds extra storage space and its tubular design prevents items from becoming air locked, discouraging mold or mites from forming in enclosed areas. All racks extend approximately 13 inches from the wall and the solid aluminum wall brackets are approximately 10 inches tall. Glaro wall racks are designed to mount on any type of wall surface. Standard lengths are 24", 30", 36", 48" and 6" increments there after. Please call us for any size not listed below.

Glaro Solid Aluminum, Riveted **Coat Hangers ARE included** with Open Loops unless Closed Loops are otherwise specified (at no additional cost). All racks can hold up to 6 coats per foot, so additional hangers are **available with open or closed loops here.**

Glaro Solid Aluminum Hangers and the extremely durable wall mounted coat racks will lasts for many years under constant use. You've seen them everywhere from your Doctor's Office, your Favorite Restaurants, your place of Worship and the Hotels or Motels you may have visited. **Busy places like these can't be bothered hanging up new coat racks each year ... Can you?**

#### **MORE CHOICES BELOW!**

#### **Glaro Satin Aluminum Modular Coat Racks with Tubular Top Shelf and Solid Aluminum Hangers**

##### **24" Wall Mounted Coat Rack**

**Including 6 Solid Aluminum Hangers**

List Price \$207.00

**SALE PRICE \$151.50**

[Add to Cart](#)

**30" Wall Mounted Coat Rack**  
**Including 6 Solid Aluminum Hangers**  
List Price \$215.00  
**SALE PRICE \$157.00**

[Add to Cart](#)

**36" Wall Mounted Coat Rack**  
**Including 6 Solid Aluminum Hangers**  
List Price \$234.00  
**SALE PRICE \$172.00**

[Add to Cart](#)

**48" Wall Mounted Coat Rack**  
**Including 8 Solid Aluminum Hangers**  
List Price \$301.00  
**SALE PRICE \$221.00**

[Add to Cart](#)

**60" Wall Mounted Coat Rack**  
**Including 10 Solid Aluminum Hangers**  
List Price \$357.00  
**SALE PRICE \$261.50**

[Add to Cart](#)

**72" Wall Mounted Coat Rack**  
**Including 12 Solid Aluminum Hangers**  
List Price \$396.00  
**SALE PRICE \$289.50**

[Add to Cart](#)

**84" Wall Mounted Coat Rack**  
**Including 14 Solid Aluminum Hangers**  
List Price \$468.00  
**SALE PRICE \$342.00**

[Add to Cart](#)

**96" Wall Mounted Coat Rack**  
**Including 16 Solid Aluminum Hangers**  
List Price \$494.00  
**SALE PRICE \$361.00**

[Add to Cart](#)

**108" Wall Mounted Coat Rack**  
**Including 18 Solid Aluminum Hangers**  
List Price \$557.00  
**SALE PRICE \$407.00**

[Add to Cart](#)

SECTION 12 24 13

WINDOW ROLLER SHADES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Roller shades, manual operation and accessories.
- B. Shade fabric.

1.2 RELATED SECTIONS

- A. Section 06100 - Rough Carpentry: Wood blocking and grounds for mounting roller shades and accessories.

1.3 REFERENCES

- A. ASTM International (ASTM):
  - 1. ASTM G21 and E 2180 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- B. National Fire Protection Association (NFPA):
  - 1. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films.
- C. Window Covering Manufacturers Association (WCMA):
  - 1. ANSI/WCMA A100.1-2022- Safety of Window Covering Products; 2022.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. 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 3000 - 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.
- C. Shop Drawings: Plans, elevations, sections, product details, installation details, operational clearances, and relationship to adjacent work.

- A. 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.
- B. 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.
- C. Warranty: Provide manufacturer's warranty documents as specified in this Section.

#### 1.6 QUALITY ASSURANCE

- A. 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.
- B. 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.
- C. Fire-Test-Response Characteristics: Passes NFPA 701 small and large-scale vertical burn. Materials tested shall be identical to products proposed for use.
- D. ShadeCloth Anti-Microbial Characteristics: 'No Growth' per ASTM G 21 results for fungi ATCC9642, ATCC9644 and ATCC9645, and E2180.
- E. ShadeCloth Cleanability and Disinfecting: ShadeCloth must meet cleanability and disinfecting requirements via 3<sup>rd</sup> party testing to comply with BIFMA HCF 8.1-2014 standards using chemical solutions compliant with EPA guidelines for use against COVID-19.

#### 1.7 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.

#### 1.8 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.

#### 1.9 WARRANTY

- A. Roller Shade Hardware and Chain Warranty: Manufacturer's standard non-depreciating, transferrable warranty for interior shading.
  - 1. Shade Hardware – 10 years unless otherwise indicated:
  - 2. Standard Shadecloth: Manufacturer's standard 25-year warranty.
  - 3. Sheer Shadecloth: Manufacturer's standard 10-year warranty.

4. Roller Shade Installation: One year from date of Substantial Completion, not including scaffolding, lifts or other means to reach inaccessible areas, which are deemed owners responsibility.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable Manufacturer for Window Shade Control System as basis of design, performance and warranty: Mecho Shade Systems
  - a. Contact: The Sheer Shop, 7393 23 Mile Road, Shelby Twp, MI 48316.  
jen@sheershop.com
- B. Requests for substitutions will be considered in accordance with provisions of Section 01600.

### 2.2 APPLICATIONS/SCOPE

- A. Roller Shade Schedule:
  1. Shade Type WTT-1: Manual operating, chain drive, sunscreen single roller shades and related mounting systems and accessories as indicated on drawings.
  2. Shade Type WTT-2: Manual operating, chain drive, room darkening opaque single roller shades and related mounting systems and accessories as indicated on drawings.
  3. WCMA Compliance: Chain tensioning device complying with ANSI/WCMA A100.1-2022 manufactured on every manual roller shade.

### 2.3 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. Smoothly operation raising or lowering shades.
- B. Basis of Design: Mecho/5 System as manufactured by Mecho, or equal.
  1. Description: Manually operated fabric window shades.
    - a. Shade Type: Single Roller.
    - b. Drop Position: Regular roll.
    - c. Mounting: Window Jamb Mounting.
    - d. 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.
  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.
  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. 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. Maximum shade hanging weight of 18 pounds (8.2 kg).
6. Drive Chain: Continuous loop stainless steel beaded ball chain, 100 pound (45 kg) minimum breaking strength. Provide upper and lower limit stops.
  - a. Chain Tensioner: Chain tensioning device complying with ANSI/WCMA A100.1-2022.
  - 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. Accessories:
  - a. Fascia: Removable extruded aluminum fascia, size as required to conceal shade mounting, attachable to brackets without exposed fasteners.
    - 1) Finish: Baked enamel.
      - a) Color: To be selected by Architect from standard options.
    - 2) Can be installed across two or more shade bands in one piece.
    - 3) Single Fascia: Accommodate regular roll shades.
    - 4) Profile: Square.
  - b. Room-Darkening Channels: Extruded aluminum side and center channels with brush pile edge seals, SnapLoc mounting base, and concealed fasteners. Channels to accept one-piece exposed blackout hembar to assure side light control and sill light control.

## 2.4 ROLLER SHADE FABRICATION

- A. Field measure finished openings prior to ordering or fabrication.
- B. Dimensional Tolerances: Fabricate shades to fit openings within specified tolerances.
  1. Vertical Dimensions: Fill Opening from Head to Sill: 1/2 inch (13 mm) space between bottom bar and window sill.
  2. Horizontal Dimensions: Inside Mounting.
    - a. Fill openings from jamb to jamb. No light gap.
- C. Openings Requiring Continuous Multiple Shade Units with Separate Rollers: Locate roller joints at window mullion centers; butt rollers end-to-end.

## 2.5 SHADE FABRIC

- A. Basis of Design: Shade fabric as manufactured by MechoShade Systems LLC.
  1. Solar Shadecloths:



- a. Fabric: Soho: 1600 series. 3 percent open. 2 x 2 basket-weave pattern of fine yarn PVC and polyester blend, also 126 inches (3200 mm) wide.
  - 1) NRC Rating: 0.25.
  - 2) SAA Rating: 0.29.
  - 3) Low-Emitting Material Certification: Greenguard Gold certified and listed in UL (GGG).
  - 4) Health Product Declaration (HPD): Published declaration with full disclosure of known hazards.
2. Blackout Shadecloths:
  - a. Fabric: Chelsea: 0270 series. Opaque. Solid white-colored backing.
    - 1) Low-Emitting Material Certification: Greenguard Gold certified and listed in UL (GGG).
    - 2) Health Product Declaration (HPD): Published declaration with full disclosure of known hazards.
3. Performance Requirements:
  - a. Flammability per NFPA 701: Pass. Large or small scale test.
  - b. Fungal Resistance: No growth when tested per ASTM G21.
  - c. Cleanability and Disinfecting: ShadeCloth must meet cleanability and disinfecting requirements via 3<sup>rd</sup> party testing to comply with BIFMA HCF 8.1-2014 standards using chemical solutions compliant with EPA guidelines for use against COVID-19.
4. Fabrication:
  - a. Fabric Orientation: Railroaded, fabric is turned 90 degrees off the roll.
  - b. Battens: Manufacturer's standard material, full width of shade, and enclosed in welded shade fabric pocket; locate as indicated on drawings.
  - c. Seams for Railroaded Fabric: Manufacturer's standard seam; locate as indicated on drawings.
  - d. Welded Zipper Edge: Full height on both sides of fabric ensuring smooth operation within ShadeLoc channels.

## 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

**iDesign Solutions, LLC 1184-2 | Synergy Consulting Engineers**

SPECIFICATIONS

WINDOW ROLLER SHADES

12 24 13-5

- A. Contractor Furnish and Install Responsibilities:
1. Window Covering Contractor (WC) shall provide an on site, Project Manager, and shall be present for all related jobsite scheduling meetings.
  2. WC shall supervise the roller shade installation, and setting of intermediate stops of all shades.
  3. WC shall be responsible for field inspection on an area-by- area and floor-by-floor basis during construction to confirm proper mounting conditions per approved shop drawings.
  4. Verification of Conditions: examine the areas to receive the work and the conditions under which the work would be performed and notify General Contractor and Owner of conditions detrimental to the proper and timely completion of the work. Do not proceed until unsatisfactory conditions have been corrected. Commencement of installation shall constitute acceptance of substrate conditions by the installer.
  5. WC shall provide accurate to 0.0625" inch (1.5875mm); field measurements for custom shade fabrication on the Roller Shades manufacturers input forms.
  6. WC Installer shall install roller shades level, plumb, square, and true according to manufacturer's written instructions, and as specified here in. Blocking for roller shades installed under the contract of the interior General Contractor shall be installed plumb, level, and fitted to window mullion as per interior architect's design documents and in accordance with industry standard tolerances. The horizontal surface of the shade pocket shall not be out-of-level more than 0.625" (15.875mm) over 20 linear feet (6.096 meters)
  7. Shades shall be located so the shade band is not closer than 2 inches (50 mm) to the interior face of the glass. Allow proper clearances for window operation hardware.
  8. Adjust, align and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.
  9. Installer shall set Upper and Lower limits of all manual shade bands, and assure alignment in accordance with the above requirements.
  10. Clean roller shade surfaces after installation, according to manufacturer's written instructions.
  11. WC shall train Owner's maintenance personnel to adjust, operate and maintain roller shade systems.
    - a. 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

SECTION 12 56 53.13

PAINTED METAL LABORATORY CASEWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:

1. Painted metal laboratory casework.
2. Provide and install painted metal casework in locations listed and as indicated on laboratory equipment drawings.

- B. Related Sections include the following:

1. Division 9 Section "Gypsum Board Assemblies" for sheet metal fastening ground in gypsum board partitions for anchoring laboratory casework.
2. Division 9 Section "Resilient Wall Base and Accessories" for resilient base applied to metal laboratory casework.
3. Division 11 Section 11621, "Laboratory Service Fixtures and Safety Equipment".
4. Division 11, Section 11622, "Laboratory Accessories", for benchtops, sinks, service chases, drying racks, adjustable shelving, cylinder restraints, etc.

1.3 PERFORMANCE REQUIREMENTS

- A. General Performance: Provide certification that casework, components and hardware has been tested in accordance to and meet the structural performance requirements as described in SEFA 8.

- B. Structural Performance: Provide metal laboratory casework capable of withstanding the following minimum loads without permanent deformation, excessive deflection, or binding of drawers and doors:

1. Shelves of Base, Wall, and Storage Cabinets: 100 lbs (45 kg).
2. Drawers: 150 lb (68 kg).
3. Wall Cabinets: 150 lb/ft (224 kg/m) along the width of the cabinet.
4. Floor-Supported Base Cabinets: 250 lb/ft (373 kg/m) along the width of the cabinet.

- C. Seismic Performance: Provide metal laboratory casework system capable of withstanding the effects of earthquake motions determined according to the building code in effect for

this Project or ASCE 7, "Minimum Design Loads for Buildings and Other Structures," Section 9, "Earthquake Loads," whichever is more stringent.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product specified.
- B. Shop Drawings: For metal laboratory casework. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Indicate locations of blocking and other supports required for installing casework.
  - 2. Indicate locations and types of service fittings, together with associated service supply connection required.
  - 3. Include details of utility spaces including service chases showing supports for conduits and piping.
  - 4. Show adjacent walls, doors, windows, other building components, and other laboratory equipment. Indicate clearances from above items.
  - 5. Include coordinated dimensions for laboratory equipment, fume hoods and laboratory accessories specified in other Sections.
- C. Samples for Verification: 6-inch- (150-mm-) square samples for each type of finish, including top material.
- D. Qualification Data: For firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience.
- E. Product Test Reports: Based on tests performed by a qualified independent testing agency, indicate compliance with SEFA 3 and 8 for laboratory casework finishes and countertops with requirements specified for chemical and physical resistance.
- F. Coordinate shop drawings with other work involved.

#### 1.5 QUALITY ASSURANCE

- A. Manufacturer shall identify and designate a full time factory representative for on-site supervision and coordination during the installation of laboratory casework and all components.
- B. Single Source Responsibility: Provide laboratory casework with tops, sinks, accessories, fume hoods and service fixtures, manufactured or furnished by same laboratory furniture company for single responsibility.
- C. Product Designations: Drawings indicate sizes and configurations of casework. Manufacturers' of casework of similar sizes, similar door and drawer configurations, and complying with the Specifications may be considered.
- D. Flammable Liquid Storage: Provide units that are listed and labeled as complying with the requirements of NFPA 30 for design, construction, and capacity of storage cabinets by UL, Warnock Hersey, or another testing and inspection agency acceptable to authorities

having jurisdiction.

1. Cabinets shall be grounded and vented. *(verify with Mechanical Engineer, Client, Safety Officer and Code Official)*
2. Coordinate with Electrical Contractor grounding lug locations.
3. Flammable base cabinets shall be fitted with two (2) 2" round flanged metal supply and exhaust connections directed toward service chase for connection to building exhaust system. Freestanding flammable storage cabinets shall be fitted with 2" round flanged connections as detailed on drawings. *(verify with Mechanical Engineer, Client, Safety Officer and Code Official)*
4. Cabinets shall have a minimum 2 inch deep liquid tight pan in bottom of same size as cabinet.
5. All OSHA cabinets shall be labeled in conspicuous lettering: "FLAMMABLE – KEEP FIRE AWAY".

E. Acid and Ventilated Storage-Cabinet:

1. Acid storage cabinets shall contain one full-width shelf. It shall be possible to locate shelf in four positions on 75mm (3") increments. Shelf supports shall be integrally molded into cabinet liner.
2. Cabinet and shelves shall each have a minimum 2 inch deep liquid tight pan of the same size of the shelf for spill containment.
3. Secure removable back panels in place with stainless steel screws fixed to vertical back framing members.
4. Provide plastic door roller catch.
5. All acid cabinets shall be labeled in conspicuous lettering: "ACID STORAGE".
6. Provide one threaded connection fusion welded to the rear of the cabinet. Thread shall be 2" NPT for connection to exhaust source. To be vented separately, see MECH for exhaust connection.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver laboratory casework until painting, utility roughing-in, and similar operations that could damage, soil, or deteriorate casework have been completed in installation areas. If casework must be stored in other than installation areas, store only in areas whose environmental conditions meet requirements specified in "Project Conditions" Article below.
- B. Protect finished surfaces from soiling and damage during handling and installation. Keep covered with polyethylene film or other protective covering.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install laboratory casework until building is enclosed, wet-work is completed, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels through remainder of construction period.
- B. Existing Conditions: Verify casework dimensions with field measurements. Entry ways, corridors, and door openings shall be verified to ensure casework and equipment can be

properly installed.

## 1.8 COORDINATION

- A. Coordinate layout and installation of metal framing, reinforcement and sheet metal fastening grounds in gypsum board assemblies for support of metal laboratory casework.

## 1.9 EXTRA MATERIALS

- A. Furnish to Owner complete touchup kit for each type and color of laboratory casework provided. Include fillers, primers, paints, and other materials necessary to perform permanent repairs to damaged casework finish.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

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

- 1. Metal Laboratory Casework:

- a. Air Master Systems Corp.
- b. BMC National Products, Inc.
- c. CiF Lab Solutions, c/o Stonecreek Interior Systems, LLC
- d. ICI Institutional Casework Inc., Scientific c/o Farnell Contracting Inc.
- e. Kewaunee Scientific Corp. c/o Farnell Equipment Company
- f. Labcase c/o Detroit Technical Company
- g. Lab Crafters
- h. Mott Manufacturing Ltd. c/o Detroit Technical Company

- 2. Substitutions: are subject to the review and approval of the architect. All products for consideration require documentation of equivalent performance to be submitted by the contractor.

### 2.2 MATERIALS

- A. Metal: Commercial-quality, cold-rolled, carbon-steel sheet, complying with ASTM A 366 (ASTM A 366M); matte finish; suitable for exposed applications; and stretcher leveled or roller leveled to stretcher-leveled flatness.
- B. Minimum Metal Thickness: Provide metal laboratory furniture components of the following minimum thicknesses:
  - 1. Fixed Panels including sides, ends, backs, bottoms, tops, soffits, and items not otherwise indicated: 18 ga., 0.0478 in (1.2 mm). Except for flammable liquid storage

- cabinets, bottoms may be 20 ga., 0.0359 in (0.9 mm) if reinforced.
2. Removable access panels, doors, drawer fronts and cabinet bodies, security panels, sloped tops and shelves: 20 ga., 0.0359 in (0.9 mm). For back panels and doors for flammable storage cabinets, use 18 ga., 0.0478 in (1.2 mm) thick metal. For shelves more than 36 in (900 mm) long, use 18 ga., 0.0478 in (1.2 mm) thick metal or provide suitable reinforcement.
  3. Top, front and intermediate horizontal rails, aprons, stretchers, cross rails, table legs, center posts, frames and gussets: 16 ga., 0.0598 in (1.5 mm).
  4. Drawer suspensions, L-shaped front corner gussets sink supports, and hinge reinforcements: 14 ga., 0.0747 in (1.9 mm).
  5. Table leg corner brackets and leveler gussets: 12 ga., 0.1046 in (2.7 mm).
- C. Acid and Ventilated Storage-Cabinet Lining: ¼ inch (6 mm) thick, glass-fiber cement board complying with ASTM C 1186.
- D. Clear Tempered Glass for Glazed Doors: with ground edges ASTM C 1048, Kind FT, Condition A, Type I, Class 1, Quality q3, 7/32 in (5.5 mm) thick or Clear Laminated Safety Glass for Doors: ASTM C 1172, Kind LT; Kind FT, Condition A, Type I, Class I, Quality q3 lites with clear, polyvinyl butyryl interlayer.

## 2.3 FABRICATION

- A. General: Complete assembly and finish work at point of manufacture. Perform assembly on precision jigs to provide units which are square; fully reinforced with angles, gussets, and channels; and integrally framed and welded to form a dirt and vermin-retardant enclosure. Where applicable, reinforce base cabinets for sink support. Maintain uniform clearance around door and drawer fronts of 1/16 to 3/32 inch (1.5 to 2.4 mm).
- B. Fabricate units on precision dies for interchangeability of like-size drawers, doors, and similar parts.
- C. Design: Full Flush Overlay.
- D. Flat Panel Doors: Outer and inner pans formed and telescoped into box formation, with channel reinforcement's full height on center of each pan. Fill doors solid with noncombustible, sound-deadening material.
- E. Glazed Doors: Hollow-metal stiles and rails of similar construction as flat panel doors and welded corners, with glass held in resilient channels or gasket material.
- F. Hinged Doors: Mortise at flanges for hinges and reinforce with angles, welded inside inner pans at hinge edge.
- G. Flat Panel Drawers: Assemble fronts from telescoping outer and inner pans, designed to eliminate raw edge of steel at top. Fabricate sides, back, and bottom of one piece with rolled or formed top of sides for stiffening and comfortable grasp for drawer removal. Weld drawer front to sides, back, and bottom to form a single, integral unit. Provide drawers with rubber bumpers, runners, and positive stops to prevent metal-to-metal contact or accidental removal.

- H. Adjustable Shelves: Front, back, and ends formed down with returned lip at front and back.
- I. Toe Space: Provide an adjustable height metal toe space, fully enclosed, adjustable in height from a minimum 4in to a maximum 6 in high set 3 inches (75 mm) back from the face of the cabinet, with no open gaps or pockets. The adjustable height shall provide backing for the resilient base in the event of varying floor elevations.
- J. Base Molding: 4 in high, vinyl.
- K. Table Legs: Not less than 2 in (50 mm) square, welded tubing. Provide leg stretchers where necessary to comply with structural performance requirements. Weld or bolt leg stretchers to legs and cross-stretchers. Securely bolt legs to table aprons. Provide leveling device welded to bottom of each leg.
- L. Leg Shoes: Vinyl or rubber, black, open-bottom type.
- M. Utilities: Provide space, cutouts, and holes for pipes, ductwork, conduits, and fittings in cabinet bodies to accommodate utility services and their support-strut assemblies.
- N. Service Chase Framing: Manufacturer's standard steel framing units consisting of 2 cold-rolled C-channel uprights, not less than 1-5/8 inches (41 mm) square by 0.10 inch (2.5 mm) thick, connected together at the top and bottom by U-shaped brackets made from 1-1/4-by-1/4-inch (32-by-6-mm) flat bars. Framing units may be made by welding C-channel material specified for uprights into rectangular frames instead of using U-shaped brackets.
- O. Filler Strips: Provide as needed to close space between cabinets and walls, ceilings, and indicated equipment. Fabricate from the same material and with the same finish as cabinets. Hem exposed edges.
- P. Closure Panels: Closure panels shall be fabricated from the same material and with the same finish as cabinets, and shall mount flush with the front edge of the cabinet, self supporting and extend vertically to underside of finished ceiling.
- Q. Coat Hooks: Hooks shall be formed cold roll steel with ball end tips and welded in stamped steel base. Three (3) under mount designs (double, triple, wardrobe) and three (3) wall mount designs (single, double, schoolhouse). Styles shall be design coordinated with quality matte nickel plated finish. Attachment with #10 screws. (Cast hooks susceptible to breakage, non-matching finishes or designs, and smaller screw mounting not acceptable.)

#### 2.4 FINISH FOR METAL LABORATORY CASEWORK

- A. Cleaning and Pretreatment: After assembly, thoroughly clean surfaces of grease, dirt, oil, flux, and other foreign matter by physical and chemical means. Treat entire unit with metallic phosphate process, leaving surfaces with uniform, fine-grained, crystalline phosphate coating to provide bond for finish.
- B. Chemical-Resistant Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard 2-coat, chemical-resistant, baked-enamel finish consisting of



prime coat and thermosetting topcoat with a minimum dry film thickness of 1 mil (0.025 mm) for topcoat and 2 mils (0.05 mm) for system.

C. Chemical and Physical Resistance of Finish System: Provide metal laboratory casework with finish system complying with the following requirements for chemical and physical resistance:

1. Chemical Resistance, Moisture Resistance, Cold Crack and Adhesion and Flexibility: Compliant testing and performance requirements as outlined by with SEFA 3 and SEFA 8 standards.
2. Chemical Resistance: Capable of withstanding application of not less than 5 drops (0.25 mL) of the following reagents applied to finish surface; covered with a watch glass for 60 minutes, rinsed, and dried; with no permanent change in gloss, color, film hardness, adhesion, or film protection.

- 1) Acetic acid (98%)
- 2) Acetone
- 3) Acid Dichromate (5%)
- 4) Ammonium hydroxide (28 %)
- 5) Amyl Acetate
- 6) Benzene
- 7) Carbon tetrachloride
- 8) Chloroform
- 9) Chromic Acid (60%)
- 10) Cresol
- 11) Dichlor Acetic Acid
- 12) Dimethylformamide
- 13) Dioxane
- 14) Ethyl acetate
- 15) Ethyl alcohol
- 16) Ethyl ether
- 17) Formaldehyde (37 %)
- 18) Formic acid (90%)
- 19) Furfural
- 20) Hydrochloric acid (37 %)
- 21) Hydrofluoric Acid (48%)
- 22) Hydrogen peroxide (5%)
- 23) Iodine
- 24) Methyl ethyl ketone
- 25) Methylene chloride
- 26) Mono chlorobenzene
- 27) Napthalene
- 28) Nitric acid (60 %)
- 29) Phenol (90%)
- 30) Phosphoric acid (85 %)
- 31) Potassium hydroxide (40 %)
- 32) Silver nitrate
- 33) Sodium carbonate (saturated)

- 34) Sodium chloride (saturated)
- 35) Sodium hydroxide (40 %)
- 36) Sodium sulfide (saturated)
- 37) Sulfuric acid (85 %)
- 38) Toluene
- 39) Trichloroethylene
- 40) Xylene
- 41) Zinc chloride (saturated)

- 3. Moisture Resistance: No visible effect when exposed to the following:
  - a. Hot water at a temperature of 190 to 205 deg F (88 to 96 deg C), trickled down the surface at a 45-degree angle for 5 minutes.
  - b. Constant moisture using a 2 in x 3 in x 1 in (51 mm x 76 mm x 25 mm) cellulose sponge, soaked with water, in contact with surface for 100 hours.
- 4. Cold Crack: No effect when subjected to 10 cycles of temperature change from 20 deg F (minus 7 deg C) for 60 minutes to 125 deg F (52 deg C) for 60 minutes.
- 5. Adhesion and Flexibility: No peeling or cracking or exposure of metal when metal is bent 180 degrees over a ½ in (13 mm) diameter mandrel.

D. Colors: Comply with the following requirements for colors of metal laboratory casework finish:

- 1. Colors: Provide manufacturer's full range of standard colors and finishes for selection by laboratory architect.

## 2.5 CASEWORK HARDWARE

- A. Hardware, General: Provide manufacturer's standard satin-finish, commercial-quality, heavy-duty hardware complying with requirements indicated for each type.
- B. Hinges: Stainless-steel, 5-knuckle hinges complying with BHMA 156.9, Grade 1, with antifriction bearings and rounded tips. Provide 2 for doors less than 48 inches (1200 mm) high and 3 for doors more than 48 inches (1200 mm) high.
- C. Pulls: Stainless steel, fastened from back with 2 screws. For sliding doors, provide stainless-steel recessed flush pulls. Provide 2 pulls for drawers more than 24 inches (600 mm) wide.
- D. Door Catches: Nylon-roller spring catch or dual, self-aligning, permanent magnet catch with strike. Provide 2 catches on doors more than 48 inches (1200 mm) high.
- E. Drawer Guides: Metal-channel, self-closing drawer guides, designed to prevent rebound when drawers are closed, with nylon-tired, ball-bearing rollers for self centering operation, capable of supporting 100 lbs. (45 kg.) and complying with BHMA A156.9, Type B05091.
- F. Full Extension Interior Drawer Guides: Accuride or equivalent drawer guide all ball bearing, rail mount, clear zinc finish and capable of supporting 100 lbs. (45kg.) at 33 inches wide or less or 200 lbs (90 kg) for 42 inches wide or less.

1. Provide where indicated on drawings.
- G. Shelf Clips: Die-formed steel, zinc plated or 14 ga steel. They are to be adjustable vertically in 1 in increments.
- H. Number Plates and Label Holders: Stainless steel or chrome plated, sized to receive standard label cards approximately 1 by 2 ½ inches (25 by 63 mm), attached with screws or rivets.
1. Provide where indicated on drawings.
- I. Drawer and Cupboard Locks: Half-mortise or cylindrical type, 5-pin tumbler and dead bolt or cam, only cylinder exposed, brass with chrome-plated finish, complying with BHMA A156.11, Grade 1. *Tumbler lock hardware option.*
1. Provide minimum of 2 keys per lock and 6 master keys.
  2. Provide where indicated on drawings.
- J. Sliding-Door Hardware Sets: Manufacturer's standard extruded aluminum shoe with integral pulls and ball bearing wheel assemblies which slides in top and bottom extruded aluminum track.
- K. Sinks, General: Provide sizes as indicated on drawings or manufacturer's closest standard size of equal or greater volume, as approved by Architect.
1. Shelf Thickness: 3/4 inch (19 mm) for spans up to 36".
  2. Match Architect's sample.
- L. Security Panel: Provide panels at every drawer requiring a lock.
1. Provide as indicated on drawings.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of reinforcement, and other conditions affecting performance of metal laboratory casework installation.
1. Do not proceed with installation until unsatisfactory conditions have been corrected.

### 3.2 CASEWORK INSTALLATION

- A. Install plumb, level, and true; shim as required, using concealed shims. Where laboratory casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.

- B. Utility-Space Framing: Secure to floor with 2 fasteners at each frame. Fasten to partition framing, wood blocking, or metal reinforcements in partitions and to base cabinets.
- C. Base Cabinets: Set cabinets straight, plumb, and level. Adjust subtops within 1/16 inch (1.5 mm) of a single plane. Fasten cabinets to utility-space framing, partition framing, wood blocking, or reinforcements in partitions with fasteners spaced 24 inches (600 mm) o.c. Bolt adjacent cabinets together with joints flush, tight, and uniform. Align similar adjoining doors and drawers to a tolerance of 1/16 inch (1.5 mm).
  - 1. Where base cabinets are not installed adjacent to walls, fasten to floor at toe space with concealed fasteners spaced 24 inches (600 mm) o.c. Secure sides of cabinets to floor, where they do not adjoin other cabinets, with not less than 2 fasteners.
- D. Wall Cabinets: Hang cabinets straight, plumb, and level. Adjust fronts and bottoms within 1/16 inch (1.5 mm) of a single plane. Fasten to hanging strips, masonry, partition framing, blocking, or reinforcements in partitions. Fasten each cabinet through back, near top, at not less than 24 inches (600 mm) o.c. Align similar adjoining doors to a tolerance of 1/16 inch (1.5 mm).
- E. Install hardware uniformly and precisely. Set hinges snug and flat in mortises, unless otherwise indicated. Adjust and align hardware so moving parts operate freely and contact points meet accurately. Allow for final adjustment after installation.
- F. Adjust casework and hardware so doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

### 3.3 INSTALLATION OF ACCESSORIES

- A. Install accessories according to approved Shop Drawings and manufacturer's written instructions. Coordinate locations and installation at all laboratory accessories specified in Section 11622.
- B. Securely fasten all casework, service chase frames, shelving, to metal fastening grounds or walls.

### 3.4 CLEANING AND PROTECTING

- A. Repair or remove and replace defective work as directed on completion of installation.
- B. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.
- C. Protection: Provide 6-mil (0.15-mm) plastic or other suitable water-resistant covering over countertop surfaces. Tape to underside of countertop at minimum of 48 inches (1200 mm) o.c.

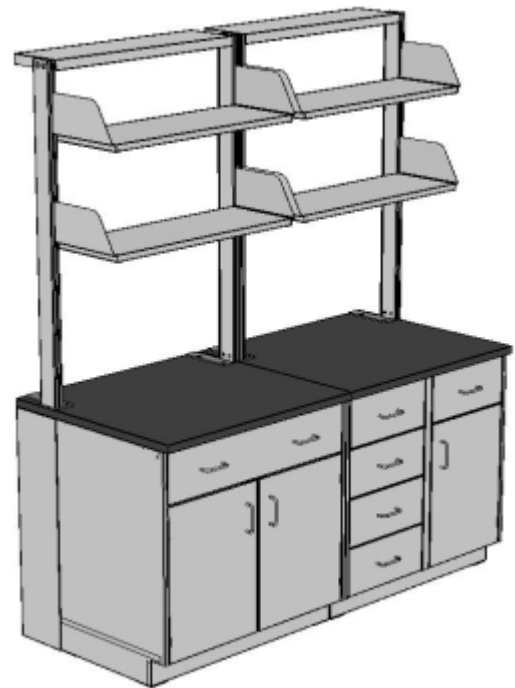
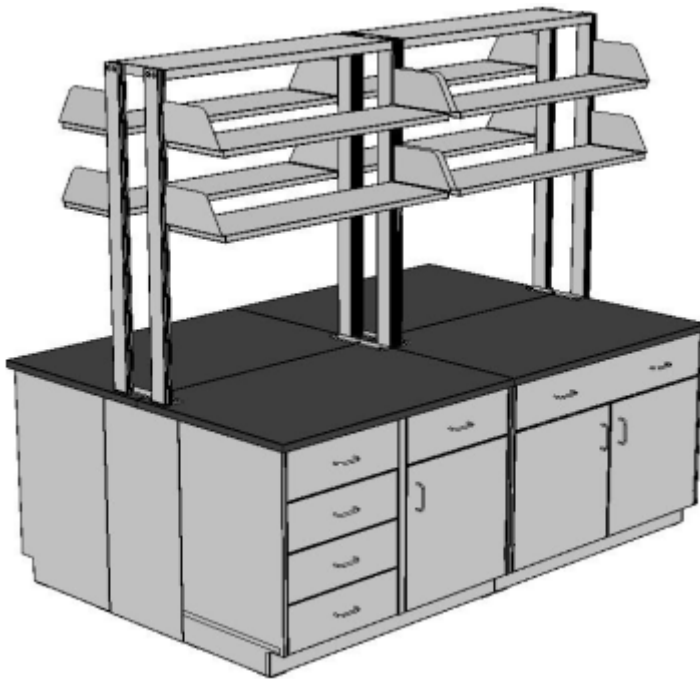
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SIGMA FLEX™

COUNTERTOP UPRIGHTS

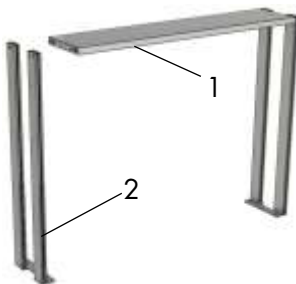
Countertop Uprights

Countertop Uprights makes the most of the work surface space. Island or wall Countertop Uprights assemblies can be mounted to any new or existing work surface and suspend shelving components (accommodates a maximum of 6 Sigma Flex™ shelves). Uprights are 49" high and are offered in island or wall mounted assemblies in various widths.

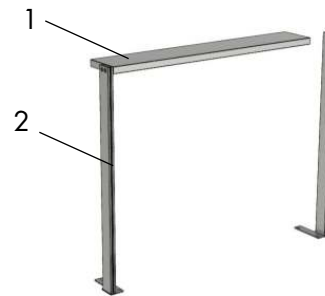


Parts List

- 1) Top Shelf
- 2) Flex Post with welded mounting plate



Countertop Island Upright

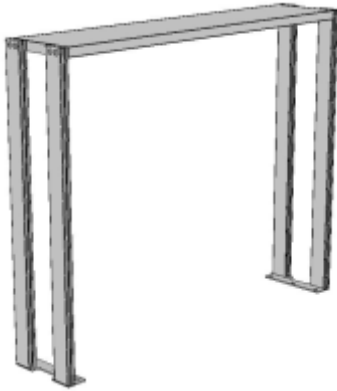


Countertop Wall Upright

**SIGMA FLEX™**

**49" HIGH COUNTERTOP UPRIGHTS**

Island Countertop Uprights



| Width | Item Number |
|-------|-------------|
| 24"   | BIU1024     |
| 30"   | BIU1030     |
| 36"   | BIU1036     |
| 42"   | BIU1042     |
| 48"   | BIU1048     |
| 54"   | BIU1054     |
| 60"   | BIU1060     |
| 66"   | BIU1066     |
| 72"   | BIU1072     |

- 49" high. 12" deep.
- Countertop upright assemblies can be mounted to any new or existing work surface.
- Accommodates a maximum of 6 Sigma Flex™ shelves, adjustable in 1" increments.
- Ensure work surface is of sufficient strength to support additional load.
- Mounting requires drilling bolt holes in work surface (3/8" countersunk bolts recommended for mounting are included).

Island Countertop Upright Cover Plates

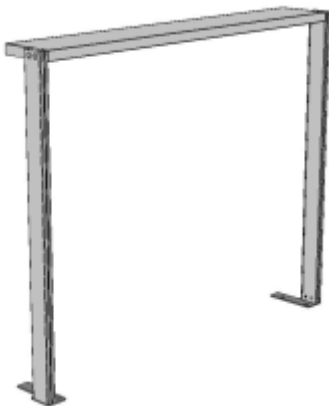


| Island Upright Cover Panels |                          |
|-----------------------------|--------------------------|
| With Service Cut-outs       | Without Service Cut-outs |
| BIC0001                     | BIC0000                  |

| Island Upright Double Sided Cover Panels |                          |
|--|--------------------------|
| With Service Cut-outs                    | Without Service Cut-outs |
| BIC0003                                  | BIC0002                  |

- For BIU Island Countertop Uprights only.
- Used to cover visible screws that install a BIU.
- Available with and without service cut-out.

Wall Countertop Uprights



| Width | Item Number |
|-------|-------------|
| 24"   | BWU1024     |
| 30"   | BWU1030     |
| 36"   | BWU1036     |
| 42"   | BWU1042     |
| 48"   | BWU1048     |
| 54"   | BWU1054     |
| 60"   | BWU1060     |
| 66"   | BWU1066     |
| 72"   | BWU1072     |

- 49" high. 8-3/4" deep.
- Countertop upright assemblies can be mounted to any new or existing work surface.
- Accommodates a maximum of 3 Sigma Flex™ shelves, adjustable in 1" increments.
- Ensure work surface is of sufficient strength to support additional load.
- Mounting requires drilling bolt holes in work surface (3/8" countersunk bolts recommended for mounting are included).

Wall Countertop Upright Cover Plates



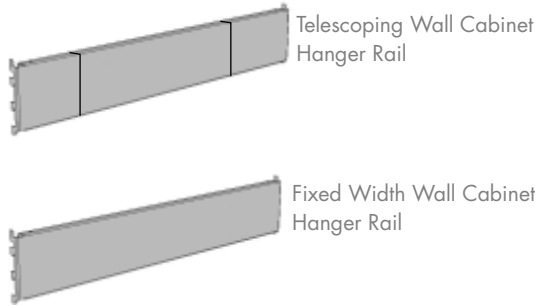
| Item Number |
|-------------|
| BIC0004     |

- For BWU Wall Countertop Uprights only.
- Used to cover visible screws that install a BIU.

SIGMA FLEX™

CORE COMPONENTS

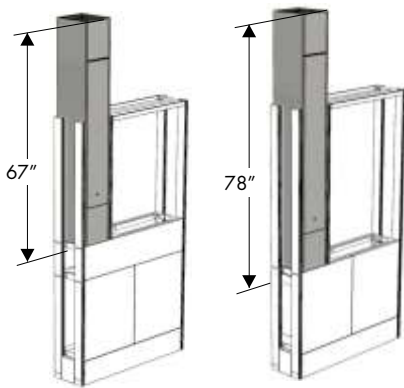
Sigma Flex™ Wall Cabinet Hanger Rails



| Width | Telescoping Rail | Fixed Width Rail |
|-------|------------------|------------------|
| 24"   | TWR0024          | FWR0024          |
| 30"   | TWR0030          | FWR0030          |
| 36"   | TWR0036          | FWR0036          |
| 42"   | TWR0042          | FWR0042          |
| 48"   | TWR0048          | FWR0048          |
| 54"   | TWR0054          | FWR0054          |
| 60"   | TWR0060          | FWR0060          |
| 72"   | TWR0072          | FWR0072          |

- Sigma Flex™ Wall Cabinet Hanger Rails are required to hang above-counter storage cabinets on to Sigma Flex™ systems.
- Order rails to match width of support structure frame (Telescoping Rails are not suitable for cabinets smaller than 24" wide). If ordering rails larger than the wall cabinet, two rails are required for support.
- Telescoping Rail is adjustable up to 5".
- Wall cabinets must be ordered with option code "FR" to suspend from Sigma Flex™ and Sigma Cart™ products. See wall cabinet section to order cabinets.

Island Service Drop For 12" Deep Cores



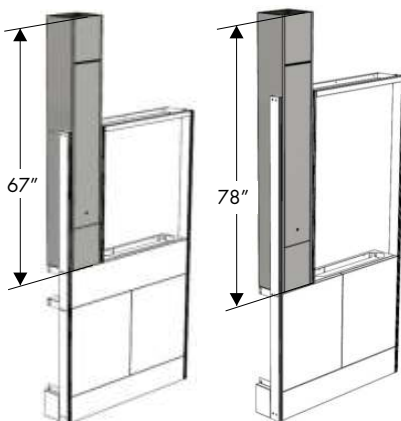
Full Height Island Raised Core      Full Height Island Core

Option Code

R1

- Use this option code when ordering Sigma Flex™ 12" deep Island Core assemblies.
- For new installations only.
- For use to run utilities and services on Sigma Flex™ 12" deep island cores and counter top uprights.
- Additional uprights allow for center shelves.
- Center shelves must be ordered 12" less in width to accommodate service drop.
- Detachable inserts are easy to remove, allowing access to services on both sides of service drop.
- Wall cabinets cannot be added with option R1 due to load capabilities.
- Full Height Island Raised Core with R1 option is a standard height of 67".
- Full Height Island Core with R1 option is a standard height of 78".
- Custom heights are available, please specify when ordering.

Wall Service Drop For 8-3/4" Deep Cores



Full Height Wall Core with Left Hand Service Drop shown      Full Height Wall Raised Core with Left Hand Service Drop shown

Right Hand Option Code

Left Hand Option Code

R3

R4

- Use this option code when ordering Sigma Flex™ 8-3/4" deep Wall Core assemblies.
- For new installations only.
- For use to run utilities and services on Sigma Flex™ 8-3/4" deep wall cores and counter top uprights.
- Additional uprights allow for center shelves.
- Center shelves must be ordered 12" less in width to accommodate service drop.
- Detachable insert are easy to remove, allowing access to services.
- Wall cabinets cannot be added with option R3 or R4 due to load capabilities.
- Full Height Wall Raised Core with R3 and R4 option is a standard height of 67".
- Full Height Wall Core with R3 and R4 option is a standard height of 78".
- Custom heights are available, please specify when ordering.

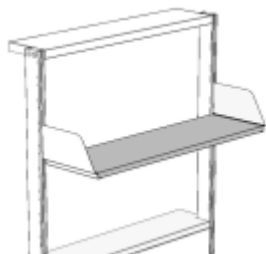
**SIGMA FLEX™**

**SHELF COMPONENTS**

Shelves

Sigma Flex™ is designed and manufactured to accommodate upper storage cabinets and shelving. Shelves are adjustable in height and available in various widths for island and wall cores.

Outer and Top Shelves

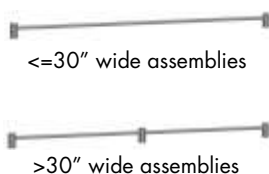


| Steel Shelves |         |         |          |          |          |          |
|---------------|---------|---------|----------|----------|----------|----------|
| Width         | 6"Depth | 8"Depth | 10"Depth | 12"Depth | 14" Deep | 18" Deep |
| 24"           | FSH0624 | FSH0824 | FSH1024  | FSH1224  | FSH1424  | FSH1824  |
| 30"           | FSH0630 | FSH0830 | FSH1030  | FSH1230  | FSH1430  | FSH1830  |
| 36"           | FSH0636 | FSH0836 | FSH1036  | FSH1236  | FSH1436  | FSH1836  |
| 42"           | FSH0642 | FSH0842 | FSH1042  | FSH1242  | FSH1442  | FSH1842  |
| 48"           | FSH0648 | FSH0848 | FSH1048  | FSH1248  | FSH1448  | FSH1848  |
| 54"           | FSH0654 | FSH0854 | FSH1054  | FSH1254  | FSH1454  | FSH1854  |
| 60"           | FSH0660 | FSH0860 | FSH1060  | FSH1260  | FSH1460  | FSH1860  |
| 66"           | FSH0666 | FSH0866 | FSH1066  | FSH1266  | FSH1466  | FSH1866  |
| 72"           | FSH0672 | FSH0872 | FSH1072  | FSH1272  | FSH1472  | FSH1872  |

| Wood Shelves |          |          |          |          |          |          |
|--------------|----------|----------|----------|----------|----------|----------|
| Width        | 6"Depth  | 8"Depth  | 10"Depth | 12"Depth | 14" Deep | 18" Deep |
| 24"          | FSH0624W | FSH0824W | FSH1024W | FSH1224W | FSH1424W | FSH1824W |
| 30"          | FSH0630W | FSH0830W | FSH1030W | FSH1230W | FSH1430W | FSH1830W |
| 36"          | FSH0636W | FSH0836W | FSH1036W | FSH1236W | FSH1436W | FSH1836W |
| 42"          | FSH0642W | FSH0842W | FSH1042W | FSH1242W | FSH1442W | FSH1842W |
| 48"          | FSH0648W | FSH0848W | FSH1048W | FSH1248W | FSH1448W | FSH1848W |
| 54"          | FSH0654W | FSH0854W | FSH1054W | FSH1254W | FSH1454W | FSH1854W |
| 60"          | FSH0660W | FSH0860W | FSH1060W | FSH1260W | FSH1460W | FSH1860W |

- . Shelf suitable for any Sigma Flex™ or Sigma Cart™.
- . Attach to shelf brackets with screws (screws not included).
- . Nominal width.
- . To order Under Mount Shelf Task Light refer to Steel Miscellaneous Section.
- . Add option code EW for exact width.

Shelf Retainer Rods



| Width | Steel Shelves |                 | Wood Shelves  |                 | Retainer Rod Sizes<br>Measured on Centers |
|-------|---------------|-----------------|---------------|-----------------|---|
|       | Powder Coated | Stainless Steel | Powder Coated | Stainless Steel |   |
| 24"   | PRR0024-FX    | SRR0024-FX      | PRR0024-FXW   | SRR0024-FXW     | 1 rod & 2 turrets                         |
| 30"   | PRR0030-FX    | SRR0030-FX      | PRR0030-FXW   | SRR0030-FXW     | 1 rod & 2 turrets                         |
| 36"   | PRR0036-FX    | SRR0036-FX      | PRR0036-FXW   | SRR0036-FXW     | 1 rod & 3 turrets                         |
| 42"   | PRR0042-FX    | SRR0042-FX      | PRR0042-FXW   | SRR0042-FXW     | 1 rod & 3 turrets                         |
| 48"   | PRR0048-FX    | SRR0048-FX      | PRR0048-FXW   | SRR0048-FXW     | 1 rod & 3 turrets                         |
| 54"   | PRR0054-FX    | SRR0054-FX      | PRR0054-FXW   | SRR0054-FXW     | 1 rod & 3 turrets                         |
| 60"   | PRR0060-FX    | SRR0060-FX      | PRR0060-FXW   | SRR0060-FXW     | 1 rod & 3 turrets                         |
| 66"   | PRR0066-FX    | SRR0066-FX      | PRR0066-FXW   | SRR0066-FXW     | 1 rod & 4 turrets                         |
| 72"   | PRR0072-FX    | SRR0072-FX      | -             | -               | 1 rod & 4 turrets                         |

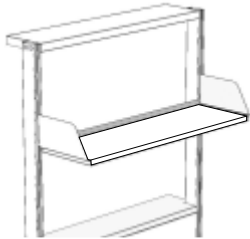
- . 1" high retainer rod (5/16" dia.) Prevents articles from falling off the shelf.
- . Retainer rods are measured on centers.
- . Can be added to existing shelves.
- . Available in stainless steel or powder coated stainless steel.
- . Threaded turrets includes hardware for mounting to shelf (shelf must have holes drilled to accept turrets).
- . Ships loose.
- . FX and FXW at the end of the part numbers represent option codes.



## SIGMA FLEX™

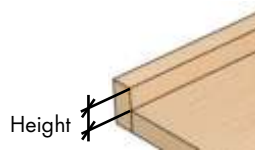
## SHELF COMPONENTS

## Steel Shelf Angles



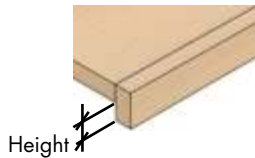
- Shelf with rear angle is suitable for any Sigma Flex™ structure or Sigma Cart™.
- Use option codes below to add angles to steel shelves only:
  - AR (Rear Shelf Angle welded to shelf)
  - AF (Front Shelf Angle welded to shelf)
  - AB (Rear and Front Shelf Angle welded to shelf)

## Wood Shelving Options



| Height | Back Lip | Front Lip | Back & Front Lip |
|--------|----------|-----------|------------------|
| 1"     | ARW1     | AFW1      | ABW1             |
| 2"     | ARW2     | AFW2      | ABW2             |
| 3"     | ARW3     | AFW3      | ABW3             |
| 4"     | ARW4     | AFW4      | ABW4             |

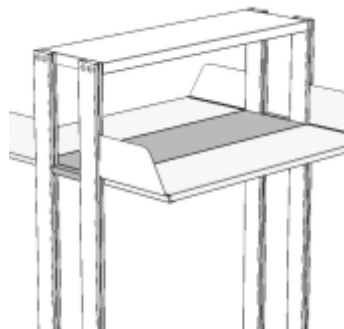
- Height of the lip is measured from the top of the shelf to the top of the lip. Lip is 3/4" thick.
- Shelves are 1" thick.



| Height | Front Valance |
|--------|---------------|
| 1"     | FV1           |
| 2"     | FV2           |
| 3"     | FV3           |
| 4"     | FV4           |

- Height of the valance is measured from the bottom of the shelf to the bottom of the valance. Valance is 3/4" thick.
- Shelves are 1" thick.

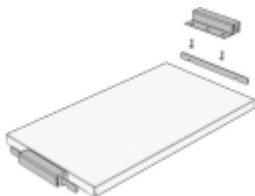
## Island Center Shelves For 12" Deep Cores



| Width | Steel Shelves | Wood Shelves |
|-------|---------------|--------------|
| 24"   | FSC1224       | FSC1224W     |
| 30"   | FSC1230       | FSC1230W     |
| 36"   | FSC1236       | FSC1236W     |
| 42"   | FSC1242       | FSC1242W     |
| 48"   | FSC1248       | FSC1248W     |
| 54"   | FSC1254       | FSC1254W     |
| 60"   | FSC1260       | FSC1260W     |
| 66"   | FSC1266       | FSC1266W     |
| 72"   | FSC1272       | FSC1272W     |

- Shelf designed for 12" deep Sigma Flex™ cores (part numbers - FLS's and BIU's)
- Installed between uprights on the inside of the island core upper frames.
- Steel shelf complete with brackets and keys. Wood shelves require Island Center Shelf Brackets, see below to order.
- Nominal width.

## Island Center Shelf Brackets For 12" Deep Cores



| Item Number |
|-------------|
|-------------|

FSB2012

- Pair of brackets designed for non-metal center shelves for 12" deep Sigma Flex™ cores (part numbers - FLS's and BIU's).
- Installed between uprights on the inside of the island core upper frames.
- Adjustable in 1" increments.
- Attach to Sigma Flex™ uprights with screws.

**SIGMA FLEX™**

**SHELF COMPONENTS**

**15° Angled Outer Shelf Brackets**



| Depth | Item Number |
|-------|-------------|
| 10"   | ASB0010     |
| 12"   | ASB0012     |
| 14"   | ASB0014     |
| 18"   | ASB0018     |

- Pair of steel end brackets designed to fit Outer Shelves and can be used for shelves of different materials.
- Shelf brackets designed at a fixed 15 degree angle.
- Adjustable in 1" increments.
- Brackets only compatible with Sigma Flex™ structure or Sigma Cart™.

**Outer Shelf Brackets**



| Depth | Item Number |
|-------|-------------|
| 6"    | FSB0006     |
| 8"    | FSB0008     |
| 9"    | FSB0009     |
| 10"   | FSB0010     |
| 12"   | FSB0012     |
| 14"   | FSB0014     |
| 18"   | FSB0018     |

- Pair of top end shelf brackets, can be used for shelves of different materials.
- Adjustable in 1" increments.
- Only compatible with Sigma Flex™ structure or Sigma Cart™.

**Top Shelf Brackets**



| Depth | Item Number |
|-------|-------------|
| 6"    | FIB0006     |
| 8"    | FIB0008     |
| 10"   | FIB0010     |
| 12"   | FIB0012     |
| 14"   | FIB0014     |
| 18"   | FIB0018     |

- Pair of top end shelf brackets, can be used for shelves of different materials.
- Adjustable in 1" increments.
- Only compatible with Sigma Flex™ structure or Sigma Cart™.

**Radius Outer Shelf Brackets**



| Depth | Item Number |
|-------|-------------|
| 6"    | FSB3006     |
| 8"    | FSB3008     |
| 9"    | FSB3009     |
| 10"   | FSB3010     |
| 12"   | FSB3012     |
| 14"   | FSB3014     |
| 18"   | FSB3018     |

- Pair of top end shelf brackets, can be used for shelves of different materials.
- Adjustable in 1" increments.
- Only compatible with Sigma Flex™ structure or Sigma Cart™.

**Radius Top Shelf Brackets**



| Depth | Item Number |
|-------|-------------|
| 6"    | FIB3006     |
| 8"    | FIB3008     |
| 10"   | FIB3010     |
| 12"   | FIB3012     |
| 14"   | FIB3014     |
| 18"   | FIB3018     |

- Pair of top end shelf brackets, can be used for shelves of different materials.
- Adjustable in 1" increments.
- Only compatible with Sigma Flex™ structure or Sigma Cart™.

**Tapered Outer Shelf Brackets**



| Depth | Item Number |
|-------|-------------|
| 6"    | FSB4006     |
| 8"    | FSB4008     |
| 9"    | FSB4009     |
| 10"   | FSB4010     |
| 12"   | FSB4012     |
| 14"   | FSB4014     |
| 18"   | FSB4018     |

- Pair of top end shelf brackets, can be used for shelves of different materials.
- Adjustable in 1" increments.
- Only compatible with Sigma Flex™ structure or Sigma Cart™.

**Tapered Top Shelf Brackets**



| Depth | Item Number |
|-------|-------------|
| 6"    | FIB4006     |
| 8"    | FIB4008     |
| 10"   | FIB4010     |
| 12"   | FIB4012     |
| 14"   | FIB4014     |
| 18"   | FIB4018     |

- Pair of top end shelf brackets, can be used for shelves of different materials.
- Adjustable in 1" increments.
- Only compatible with Sigma Flex™ structure or Sigma Cart™.

## SIGMA FLEX™

## SHELF COMPONENTS

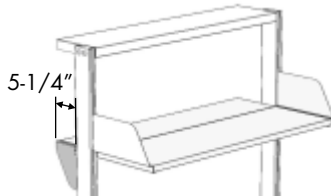
## Wall Center Shelves For 8-3/4" Deep Cores



| Width | Steel Shelves | Wood Shelves |
|-------|---------------|--------------|
| 24"   | FSW0924       | FSW0924W     |
| 30"   | FSW0930       | FSW0930W     |
| 36"   | FSW0936       | FSW0936W     |
| 42"   | FSW0942       | FSW0942W     |
| 48"   | FSW0948       | FSW0948W     |
| 54"   | FSW0954       | FSW0954W     |
| 60"   | FSW0960       | FSW0960W     |
| 66"   | FSW0966       | FSW0966W     |
| 72"   | FSW0972       | FSW0972W     |

- Shelf designed for wall conditions, only between back of upright and wall on 8-3/4" deep Sigma Flex™ wall cores (part number - FLW's).
- Nominal width.

## Wall Center Shelf Brackets For 8-3/4" Deep Cores



| Item Number |
|-------------|
| FSB1006     |

- Pair of steel end brackets 5-1/4" deep used to support Wall Center Shelf between back of upright and wall.
- Adjustable in 1" increments.
- Brackets only compatible with Sigma Flex™ 8-3/4" Deep Wall Core assemblies.
- This bracket cannot be modified.

## Monitor Arm and Mounting Brackets



| Anodized Silver Finish | Black Finish |
|------------------------|--------------|
| MONARMA                | MONARMF      |

- LCD Monitor Arm with brackets to attach to Sigma Flex™ uprights.
- Adjustable in 1" increments.
- Brackets only compatible with Sigma Flex™ and Sigma Carts™ structures.

## Under Mount Shelf Task Lights



| Length of Light | Item Number |
|-----------------|-------------|
| 14"             | TLW0014     |
| 23"             | TLW0023     |
| 36"             | TLW0036     |
| 48"             | TLW0048     |
| 59"             | TLW0059     |

- Order light a minimum 6" shorter than the shelf.
- Low profile (.98" wide by 1.65" high) T5 fluorescent task light mounts to underside of the shelf.
- Shatterproof polycarbonate lens protects the lamp.
- Easily linkable in one continuous line using Flexible Connectors. 6" Flexible Connector comes standard with each light. See below to order longer Flexible Connectors.
- On-off rocker switch located on the side of the fixture.
- 8000 hour, cool white replaceable T5 lamp included.
- UL listed.
- Ships loose, includes Mott's mounting brackets.

## Task Light Flexible Connectors



| Length | Item Number |
|--------|-------------|
| 12"    | LFC0012     |
| 24"    | LFC0024     |
| 36"    | LFC0036     |

- Flexible Connector allows to easily link T5 fluorescent lights in one continuous line.

## SECTION 12 56 53

### FLEXIBLE LABORATORY FURNITURE SYSTEM

#### PART 1 – GENERAL

##### Summary:

This Specification identifies the minimum material and construction standards that are required to deliver a quality installation of the flexible laboratory furniture system. Laboratory furniture shall be supplied in accordance with the requirements of this Specification. The laboratory furniture identified in this Specification shall include the miscellaneous metal panels and other related components as identified on the drawings and that are necessary for the complete installation.

#### 1.1 SECTION INCLUDES

- A. Modular Support Structure
- B. Structural Table Base
- C. Mobile Base / Wall Cabinets
- D. Shelves
- E. Fixtures
- F. Service Connections

#### 1.2 RELATED SECTIONS

- 1. Section 07 92 00, "Joint Sealers.
- 2. Section 09 21 16, "Gypsum Board Assemblies" for sheet metal fastening ground in gypsum board partitions for anchoring laboratory casework.
- 3. Section 09 65 13 "Resilient Wall Base and Accessories" for resilient base applied to metal laboratory casework.
- 4. Section 11 53 33, "Laboratory Safety Equipment".
- 5. Section 11 53 43.10, "Laboratory Accessories", for benchtops, sinks, service chases, drying racks, adjustable shelving, cylinder restraints, etc.
- 6. Divisions 22 and 26, Sections for plumbing and electrical requirements.
- 7. Divisions 22 and 26, Sections for final connections to building services and systems.

#### 1.3 REFERENCES

- A. SEFA 8: Laboratory Furniture – Casework, Shelving and Tables Guidelines  
Science Equipment and Furniture Association (SEFA)
- B. ISO 9001:2000 – Quality Management  
International Standards Organization (ISO)

C. ADA (ATBCB ADAAG) Americans with Disabilities Act Accessibility Guidelines  
Americans with Disabilities Act (ADA)

1.4 SUBMITTALS

Refer to Section 01 33 00, "Submittal Procedures," for requirements, procedures, etc.

A. Product Data:

Drawings shall include data and details for construction of the laboratory furniture as well as information regarding the name, quantity, type and construction of materials (such as hardware, gauges, etc), that will be used to complete the project.

B. Shop Drawings:

1. The laboratory furniture manufacturer shall furnish shop drawings illustrating the layout and placement of all laboratory furniture, casework and fume hoods as well as any products included in this section.
2. Indicate the type and location of all service fittings and associated supply connections.
3. Preparation instructions and recommendations.
4. Storage and handling requirements and recommendations.
5. Installation methods.

C. Selection Samples:

Submit the following:

1. One complete set of color chips representing the manufacturer's full range of available colors. Minimum sample size 2 inches by 3 inches (50mm x 76mm).

D. Quality Assurance/Control

1. Design Data/Test Reports: Manufacturer shall submit test data and design criteria which are in compliance with the project specifications.
2. Certificates: All certifications required in the specifications shall be submitted with the original submittal package under separate cover. Certificates must be provided with the signature of a qualified individual of the supplier.
3. Manufacturers' Instructions: Provide manufacturer's instructions for installation and maintenance of all products provided and installed within this section. Instructions will be in bound form, tabbed and organized by section number.

## 1.5 QUALITY ASSURANCE

### A. Manufacturer Qualifications:

The following list of information will be provide to the Architect at least ten (10) days prior to the bid opening:

1. List of manufacturing facilities;
2. Construction details depicting the materials, sizes and methods of construction;

## 1.6 DELIVERY, STORAGE AND HANDLING

### A. Packaging, Shipping, Handling and Unloading

1. Packaging: Products shall have packaging adequate enough to protect finished surfaces from soiling or damage during shipping, delivery and installation.
2. Delivery: Casework delivery shall only take place after painting, utility rough-ins and related activities are completed that could otherwise damage, soil or deteriorate casework in installation areas.
3. Handling: Care, such as the use of proper moving equipment, experienced movers, etc., shall be used at all times to avoid damaging the casework. Until installation takes place, any wrapping, insulation or other method of protection applied to products from the factory will be left in place to avoid accidental damage.

### B. Acceptance at Site:

Casework will not be delivered or installed until the conditions specified under Part 3, Installation section of this document have been met.

### C. Storage:

Casework shall be stored in the area of installation. If, prior to installation, it is necessary for casework to be temporarily stored in an area other than the installation area, the environmental conditions shall meet the environmental requirements specified under the Project Site Conditions article of this section.

### D. Waste Management and Disposal:

The supplier of the laboratory casework is responsible for removing any waste or refuse resulting from the installation of, or work pertaining to laboratory casework; thereby leaving the project site clean and free of debris. Trash container(s) to be provided by others.

## 1.7 PROJECT SITE CONDITIONS

- A. Building must be enclosed (windows and doors sealed and weather-tight);

- B. An operational HVAC system that maintains temperature and humidity at occupancy levels must be in place;
- C. Adjacent and related work shall be complete;
- D. Ceiling, overhead ductwork and lighting must be installed;
- E. Site must be free of any further construction such as "wet work";
- F. Required backing and reinforcements must be installed accurately and the project must be ready for casework installation.

## 1.8 WARRANTY

- A. Furnish a written warranty that work performed under this section shall remain free from defects as to materials and workmanship for a period of two (2) years from date of shipment. Defects in materials and workmanship that may develop within this time are to be replaced without cost or expense to the Owner.

Defects include, but are not limited to:

- 1. Ruptured, cracked, or stained coating
  - 2. Discoloration or lack of finish integrity
  - 3. Cracking or peeling of finish
  - 4. Slippage, shift, or failure of attachment to wall, floor, or ceiling
  - 5. Weld or structural failure
  - 6. Warping or unloaded deflection of components
  - 7. Failure of hardware
- B. The warranty with respect to products of another manufacturer sold by Mott Manufacturing is limited to the warranty extended by that manufacturer to Mott Manufacturing.

## PART 2 – PRODUCTS

### 2.1 MANUFACTURER

- A. Acceptable Manufacturers:
  - 1. Flexible Furniture:
    - a. Air Master Systems Corp.
    - b. Case Systems, c/o Stonecreek Interior Systems, LLC
    - c. CiF Lab Solutions, c/o Stonecreek Interior Systems, LLC

- d. HLS Hanson Lab Solutions.
- e. ICI Institutional Casework Inc., Scientific c/o Farnell Contracting Inc.
- f. Kewaunee Scientific Corp. c/o Farnell Equipment Company
- g. Labcase c/o Detroit Technical Company
- h. Lab Crafters
- i. Mott Manufacturing Ltd. c/o Detroit Technical Company
- j. VWR.

B. Substitutions:

- 1. Must meet all specification requirements and have prior approval.
- 2. Must meet the minimum design and performance requirements of SEFA and UL 962.

C. Requests for substitutions:

All requests will be considered in accordance with provisions of Section 01 60 00.

## 2.2 MATERIALS

A. Sheet Steel:

Mild steel, cold rolled furniture grade to requirements of ASTM A1008/A1008M, Grade C or higher, with smooth surfaces to furniture quality.

B. Galvanized Sheet Steel:

Commercial quality galvanised sheet steel to ASTM 653, Designation Z275.

C. Stainless Steel:

- 1. Sheet: ASTM A240, type 304 and 316 alloy.
- 2. Finish: Unless otherwise indicated, AISI No. 4 brushed finish.

D. Glass:

Glass, ½" thick with steel frame work to protect edges.

## 2.3 DESIGN REQUIREMENTS:

\*Basis of design: Mott Manufacturing Altus Series Table system\*

- A. Modular system to be made of tubular style framing combined with rectangular formed steel uprights.
- B. Tubular Frames / Table Supports to be adjustable height in 1" increments and complete with levelers.
- C. Rear frame to be used for carrying services and electrical conduit.
  - 1. Rear upright supports to be equipped with slots for adjustable shelving and levelers.
  - 2. All services supplied with hose and quick disconnect to reach ceiling panel supply.
- D. Assembled frame to be self-supporting without needing to be anchored to the building.
- E. The modular system must ship complete from the factory with minimal on-site assembly.

## 2.4 ALTUS CONSTRUCTION

A. Rear Support Structure:



1. Nominal rear frame dimensions: Width: 48", 60", 72", Depth: 3", Height: 84"
  2. Rear Uprights:
    1. 2" x 3" 14 ga. powder coated cold rolled steel or stainless steel.
    2. 2" diameter nylon leveling glide 3/8" x 2-1/2" long threaded stem.
  3. Upper Cross Rail: 16 ga. powder coated cold rolled steel or stainless steel.
  4. Load Capacity: Rear Upright to support up to 3 shelves loaded to a combined maximum of 300lbs. Shelf depths available as 12" or 15" deep.
  5. Uprights to house services, electrical and data cables: High voltage cabling to be in a separate upright from gas piping.
  6. Wire management tray to be under countertop.
  7. Rear posts have slots punched on 1" increments starting at nominal 59" above the finished floor.
- B. Tubular Table Assembly:
1. Nominal table assembly dimensions: Width: 48", 60", 72", Depth: 23" or 29", Height: Adjustable from 29" – 36" (not including work surface).
  2. Tubular Table Legs:
    1. 2" outside square, 14ga. powder coated cold rolled steel or stainless steel outer leg.
    2. 1-3/4" outside square, 11 ga. powder coated cold rolled steel or stainless steel inner telescoping leg.
    3. 2" diameter nylon leveling glide 3/8" x 2-1/2" long threaded stem
  3. Capable of vertical height adjustment in 1" increments.
  4. Table assembly to be fastened to the rear upright with two (2) hex 3/8" socket head bolts.
  5. Hanging Rails: Front apron and rear support are to have rails allowing suspended cabinets to hang from.
  6. Leveling Bolt: Frame to be fitted with a leveling bolt which will allow the legs to be adjusted for proper alignment of work surface height.
  7. Load Capacity: Table frame to support 1000lbs including the work surface.
- C. Shelves:
1. Nominal shelf dimensions: Width: 48", 60", 72". Depth: 12" or 15" for shelves. 1" thick.
  2. Shelf requirements:
    1. Shelves constructed of powder coated cold rolled steel, or stainless steel.
    2. Wood Shelves are only available for table widths up to 60".
    3. Shelves to be flush with the face of the rear rectangular posts.
    4. Shelf brackets to be constructed powder coated cold rolled steel or stainless steel.
    5. Bottom and middle shelves to have a rear 1" high retaining lip. Top shelf assemblies do not come with retaining lip.
    6. Vertical shelf adjustment in 1" increments.
    7. Optional 1" tall x 5/16" dia. shelf retainer rods, available in #304 stainless steel or #304 powder coated stainless steel.
- D. Suspended/Mobile Base Cabinets:
1. Design and construction to be as in section 12 35 53 - Laboratory Metal Casework and 12 35 53 – Laboratory Wood Casework.
  2. Mobile cabinets to have casters in lieu of a toe kick. Casters to all be rated for 165lbs minimum each and to be locking type. Cabinet height must ensure 2-1/2" of clearance under the table frame.
  3. Suspended base cabinets: Provide a system of steel hanger rails attached to the casework frames. Installation and removal to be accomplished without the use of tools.
- E. Plumbing/Fixtures:
1. Rear upright structure to support a maximum of three plumbing fixtures on left side.

2. Fixtures to be needle valve style with a single serrated hose end angled down towards countertop. Fixture finish as per Section 11 53 43 - Service Fittings and Fixtures.
  3. Plumbing lines to be polyurethane routed out the top of the upright.
  4. All burning gas tubing to be specified as stainless steel.
  5. All plumbing to have service hose at the top of the upright with additional 4' of hose length to reach the ceiling supply panel.
  6. Plumbing to be arranged that they services cannot be intermixed.
  7. All service valves and quick disconnects to be keyed and color coded. Only plug and body connects of the same key will couple and allow flow.
- F. Service Connections:
1. Electrical, data and plumbing services to terminate with cable or hose coming out of the top of the rear support upright.
  2. Electrical services to have a 20 amp cord extending 4' above the top of the upright.
  3. Data services to have a male plug extending 4' above the top of the upright.

### 2.3 STEEL FURNITURE FINISH

1. Metal finish to be as per finish schedule.

## PART 3 – EXECUTION

### 3.1 INSTALLATION

1. Install casework within system, align and set level with levelling devices, in accordance with shop drawings.
2. At wall locations secure wall cabinets to face of finished walls and partitions, applying self-tapping screws through wall finish material into each concealed stud flange.
3. Install components to effect a secure, neat and complete installation.

END OF SECTION

SECTION 210500  
COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Above ground piping.
- B. Fire rated enclosures.
- C. Mechanical couplings.
- D. Pipe hangers and supports.
- E. Pipe sleeves.
- F. Pipe sleeve-seal systems.

1.02 RELATED REQUIREMENTS

- A. Section 078400 - Firestopping.
- B. Section 210523 - General-Duty Valves for Water-Based Fire-Suppression Piping.
- C. Section 210553 - Identification for Fire Suppression Piping and Equipment: Piping identification.
- D. Section 211300 - Fire-Suppression Sprinkler Systems: Sprinkler systems design.

1.03 REFERENCE STANDARDS

- A. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2023.
- B. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2020.
- C. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2021.
- D. ASME B16.4 - Gray Iron Threaded Fittings: Classes 125 and 250; 2021.
- E. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard; 2020.
- F. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2022).
- G. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984, with Editorial Revision (2019).

- H. ASTM A795/A795M - Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use; 2021.
- I. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2022a.
- J. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a (Reapproved 2017).
- K. AWWA C606 - Grooved and Shouldered Joints; 2022.
- L. NFPA 13 - Standard for the Installation of Sprinkler Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- M. UL (DIR) - Online Certifications Directory; Current Edition.

#### 1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.

#### 1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of the type specified in this section.
  - 1. Minimum three years experience.
  - 2. Approved by manufacturer.
- B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store valves in shipping containers, with labeling in place.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

#### 1.07 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.

### PART 2 PRODUCTS

#### 2.01 GENERAL REQUIREMENTS

- A. Sprinkler-based System:
  - 1. Comply with NFPA 13.

2. See Section 211300.

B. Welding Materials and Procedures: Comply with ASME BPVC-IX.

C. Provide system pipes, fittings, sleeves, escutcheons, seals, and other related accessories.

## 2.02 ABOVE GROUND PIPING

A. Steel Pipe: ASTM A795 Schedule 40, black.

1. Steel Fittings: ASME B16.5 steel flanges and fittings.
2. Cast Iron Fittings: ASME B16.1, flanges and flanged fittings and ASME B16.4, threaded fittings.
3. Malleable Iron Fittings: ASME B16.3, threaded fittings and ASTM A47/A47M.
4. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped elastomeric sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe.

B. Flexible, Sprinkler Hose Fittings:

1. Standard: UL 1474
2. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
3. Pressure rating: 175 psig minimum
4. Size: Same as connected piping, for sprinkler.
5. Manufacturers:
  - a. Armstrong CWorld Industries; FlexHead: [armstrongceilings.com/#sle](http://armstrongceilings.com/#sle)
  - b. VicFlex: [vicflex.com/#sle](http://vicflex.com/#sle)
  - c. Victaulic; AquaFlex: [victaulic.com/#sle](http://victaulic.com/#sle)
  - d. Substitutions: See Section 016000-Product Requirements.

## 2.03 PIPE SLEEVES

A. Plastic, Sheet Metal, or Moisture-Resistant Fiber: Pipe passing through interior walls, partitions, and floors, unless steel or brass sleeves are specified below.

B. Clearances:

1. Provide allowance for insulated piping.
2. Wall, Floor, Floor, Partitions, and Beam Flanges: 1 inch (25 mm) greater than external; pipe diameter.
3. Rated Openings: Caulked tight with firestopping material complying with ASTM E814 in accordance with Section 078400 to prevent the spread of fire, smoke, and gases.

## 2.04 PIPE SLEEVE-SEAL SYSTEMS

A. Manufacturers:

1. Advance Products & Systems, Inc: [www.apsonline.com/#sle](http://www.apsonline.com/#sle).
2. GPT, a company of Enpro Industries, Inc: [www.gptindustries.com/#sle](http://www.gptindustries.com/#sle).
3. The Metraflex Company: [www.metraflex.com/#sle](http://www.metraflex.com/#sle).
4. Substitutions: See Section 016000 - Product Requirements.

- B. Modular Mechanical Seals:
  - 1. Elastomer-based interlocking links to continuously fill annular space between pipe and wall-sleeve, wall or casing opening.
  - 2. Watertight seal between pipe and wall-sleeve, wall or casing opening.
  - 3. Size and select seal component materials in accordance with service requirements.
  - 4. Service Requirements:
    - a. Fire Resistance: 1 hour, UL (DIR) approved.
  - 5. Glass-reinforced plastic pressure end plates.
- C. Wall Sleeve: Steel material with waterstop collar, and nailer end caps.
- D. Sleeve-Forming Disk: Nonconductive plastic-based material, 3 inch (76.2 mm) thick.
- E. Pipeline-Casing Seals:
  - 1. End Seals: 1/8 inch (3.1 mm), pull-on type, rubber or synthetic rubber based.

## 2.05 FIRE-RATED ENCLOSURES

- A. Manufacturers:
  - 1. Fire Rated Product Specialties Corp: [www.frpsonline.com/#sle](http://www.frpsonline.com/#sle).
- B. Provide as required to preserve fire resistance rating of building elements.

## 2.06 PIPE HANGERS AND SUPPORTS

- A. Hangers for Pipe Sizes 1/2 to 1-1/2 inch (15 to 40 mm): Malleable iron, adjustable swivel, split ring.
  - 1. Manufacturers:
    - a. AFCON, a brand of Anvil International: [www.anvilintl.com/#sle](http://www.anvilintl.com/#sle).
    - b. FNW: [www.fnw.com/#sle](http://www.fnw.com/#sle).
    - c. Substitutions: See Section 016000 - Product Requirements.
- B. Hangers for Pipe Sizes 2 inches (50 mm) and Over: Carbon steel, adjustable, clevis.
  - 1. Manufacturers:
    - a. AFCON, a brand of Anvil International: [www.anvilintl.com/#sle](http://www.anvilintl.com/#sle).
    - b. FNW: [www.fnw.com/#sle](http://www.fnw.com/#sle).
    - c. Substitutions: See Section 016000 - Product Requirements.
- C. Nonmetallic Piping Hangers:
  - 1. Manufacturers:
    - a. DecoShield Systems, Inc; Snap-2 Hangers: [www.decoshield.com/#sle](http://www.decoshield.com/#sle).
    - b. Substitutions: See Section 016000 - Product Requirements.
- D. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

## 2.07 MECHANICAL COUPLINGS

- A. Manufacturers:
  - 1. Anvil International: [www.anvilintl.com/#sle](http://www.anvilintl.com/#sle).

2. Shurjoint Piping Products, Inc: [www.shurjoint.com/#sle](http://www.shurjoint.com/#sle).
3. Tyco Fire Protection Products: [www.tyco-fire.com/#sle](http://www.tyco-fire.com/#sle).
4. Victaulic Company; FireLock Style 009H: [www.victaulic.com/#sle](http://www.victaulic.com/#sle).
5. Substitutions: See Section 016000 - Product Requirements.

B. Rigid Mechanical Couplings for Grooved Joints:

1. Dimensions and Testing: Comply with AWWA C606.
2. Minimum Working Pressure: 300 psig (2065 kPa).
3. Housing Material: Fabricate of ductile iron complying with ASTM A536.
4. Housing Coating: Factory applied orange enamel.
5. Gasket Material: EPDM suitable for operating temperature range from minus 30 degrees F (minus 34 degrees C) to 230 degrees F (110 degrees C).
6. Bolts and Nuts: Hot-dipped-galvanized or zinc-electroplated steel.

2.08 MECHANICAL PRESSED FITTINGS

A. Manufacturers:

1. Apollo Valves: [www.apollovalves.com/#sle](http://www.apollovalves.com/#sle).
2. Viega LLC; MegaPress: [www.viega.us/#sle](http://www.viega.us/#sle).
3. Substitutions: See Section 016000 - Product Requirements.

- B. Provide double-pressed type, utilizing EPDM, nontoxic, synthetic rubber sealing elements for use with Schedule 40 carbon steel piping.

PART 3 EXECUTION

3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and foreign material, from inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.02 INSTALLATION

- A. Install sprinkler system and service main piping, hangers, and supports in accordance with NFPA 13.
- B. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- C. Install piping to conserve building space, to not interfere with use of space and other work.
- D. Group piping whenever practical at common elevations.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. Pipe Hangers and Supports:

1. Install hangers to provide minimum 1/2 inch (15 mm) space between finished covering and adjacent work.
  2. Place hangers within 12 inches (300 mm) of each horizontal elbow.
  3. Use hangers with 1-1/2 inch (40 mm) minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
  4. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
  5. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- G. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.
- H. Prepare pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welding.
- I. Provide sleeves when penetrating walls and partitions. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.
1. Aboveground Piping:
    - a. Pack solid using mineral fiber complying with ASTM C592.
    - b. Fill space with an elastomer caulk to a depth of 0.50 inch (15 mm) where penetrations occur between conditioned and unconditioned spaces.
  2. All Rated Openings: Caulk tight with firestopping material complying with ASTM E814 in accordance with Section 078400 to prevent the spread of fire, smoke, and gases.
- J. Manufactured Sleeve-Seal Systems:
1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
  2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
  3. Locate piping in center of sleeve or penetration.
  4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
  5. Tighten bolting for a watertight seal.
  6. Install in accordance with manufacturer's recommendations.
- K. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, unions, and couplings for servicing are consistently provided.
- 3.03 CLEANING
- A. Upon completion of work, clean all parts of the installation.
  - B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

END OF SECTION 210500



SECTION 210523  
GENERAL-DUTY VALVES FOR WATER-BASED FIRE-SUPPRESSION PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Two-piece ball valves with indicators.
- B. Check valves.

1.02 RELATED REQUIREMENTS

1.03 ABBREVIATIONS AND ACRONYMS

- A. EPDM: Ethylene-propylene diene monomer.
- B. PTFE: Polytetrafluoroethylene.

1.04 REFERENCE STANDARDS

- A. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2023.
- B. NFPA 13 - Standard for the Installation of Sprinkler Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.05 ADMINISTRATIVE REQUIREMENTS

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

1.06 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- C. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.07 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
  - 1. Obtain valves for each valve type from single manufacturer.

- B. Where listed products are specified, provide products listed, classified, and labeled by FM (AG), UL (DIR), or testing firm acceptable to authorities having jurisdiction as suitable for the purpose indicated.
- C. Welding Materials and Procedures: Comply with ASME BPVC-IX.
- D. Installer Qualifications:
  - 1. Company specializing in performing the work of this section with minimum five years documented experience.
  - 2. Trained and approved by manufacturer to design, install, test and maintain the equipment specified herein.
  - 3. Complies with manufacturer's certification requirements.

#### 1.08 DELIVERY, STORAGE, AND HANDLING

- A. Use the following precautions during storage:
  - 1. Maintain valve end protection and protect flanges and specialties from dirt.
    - a. Provide temporary inlet and outlet caps.
    - b. Maintain caps in place until installation.
  - 2. Store valves in shipping containers and maintain in place until installation.
    - a. Store valves indoors and maintain at higher than ambient dew point temperature.
    - b. If outdoor storage is unavoidable, store valves off the ground in watertight enclosures.

### PART 2 PRODUCTS

#### 2.01 GENERAL REQUIREMENTS

- A. UL Listed: Provide valves listed in UL (DIR) under following headings and bearing UL mark:
  - 1. Main Level: VDGT - Sprinkler System & Water Spray System Devices.
    - a. Level 1: VQGU - Valves, Trim, and Drain.
- B. FM Global Approved: Provide valves listed in FM (AG) Approval Guide under the following headings:
  - 1. Automated Sprinkler Systems:
    - a. Valves:
      - 1) Gate valves.
      - 2) Single check valves.
- C. ASME Compliance:
  - 1. ASME B1.20.1 for threads on threaded-end valves.
- D. Comply with AWWA C606 for grooved-end connections.
- E. Comply with NFPA 13 and NFPA 13R for valves.
- F. Valve Pressure Ratings: Not less than minimum pressure rating indicated or higher as required.
- G. Valve Sizes: Same as upstream piping unless otherwise indicated.

- H. Valve Actuator Types:
  - 1. Handwheel: For other than quarter-turn trim and drain valves.
  - 2. Hand-lever: For quarter-turn trim and drain valves 2 NPS (50 DN) and smaller.

## 2.02 TWO-PIECE BALL VALVES WITH INDICATORS

- A. Manufacturers:
  - 1. FNW: [www.fnw.com/#sle](http://www.fnw.com/#sle).
  - 2. Substitutions: See Section 016000 - Product Requirements.
- B. UL 1091, except with ball instead of disc and FM (AG) standard listing for indicating valves (butterfly or ball type), Class Number 1112.
- C. Description:
  - 1. Minimum Pressure Rating: 175 psig (1200 kPa).
  - 2. Body Design: Two piece.
  - 3. Body Material: Forged brass or bronze.
  - 4. Port Size: Full or standard.
  - 5. Seat: PTFE.
  - 6. Stem: Bronze or stainless steel.
  - 7. Ball: Chrome-plated brass.
  - 8. Actuator: Worm gear or traveling nut.
  - 9. End Connections for Valves 1 NPS (25 DN) through 2 NPS (50 DN): Threaded ends.
  - 10. End Connections for Valves 2-1/2 NPS (65 DN): Grooved ends.

## 2.03 BRONZE BUTTERFLY VALVES WITH INDICATORS

- A. Manufacturers:
  - 1. FNW: [www.fnw.com/#sle](http://www.fnw.com/#sle).
  - 2. Substitutions: See Section 016000 - Product Requirements.
- B. UL 1091 and FM (AG) standard listing for indicating valves, (butterfly or ball type), Class Number 1112.
- C. Minimum Pressure Rating: 175 psig (1200 kPa).
- D. Body Material: Bronze.
- E. Seat: EPDM.
- F. Stem: Bronze or stainless steel.
- G. Disc: Bronze with EPDM coating.
- H. Actuator: Worm gear or traveling nut.
- I. Supervisory Switch: Internal or external.
- J. End Connections for Valves 1 NPS (25 DN) through 2 NPS (50 DN): Threaded ends.
- K. End Connections for Valves 2-1/2 NPS (65 DN): Grooved ends.

## 2.04 CHECK VALVES

- A. Manufacturers:
  - 1. FNW: [www.fnw.com/#sle](http://www.fnw.com/#sle).
  - 2. Kennedy Valve; AWWA Compliant: [www.kennedyvalve.com/#sle](http://www.kennedyvalve.com/#sle).
  - 3. Substitutions: See Section 016000 - Product Requirements.
- B. UL 312 and FM (AG) standard listing for check valves, Class Number 1045.
- C. AWWA C508 compliant check valves.
- D. Minimum Pressure Rating: 175 psig (1200 kPa).
- E. Type: Center guided check valve.
- F. Body Material: Cast iron, ductile iron.
- G. Center guided check with elastomeric seal.
- H. Hinge Spring: Stainless steel.
- I. End Connections: Flanged, grooved, or threaded.

## 2.05 TRIM AND DRAIN VALVES

- A. Ball Valves:
  - 1. 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. Seat: PTFE.
    - f. Stem: Bronze or stainless steel.
    - g. Ball: Chrome-plated brass.
    - h. Actuator: Hand-lever.
    - i. End Connections for Valves 1 NPS (25 DN) through 2-1/2 NPS (65 DN): Threaded ends.
    - j. End Connections for Valves 1-1/4 NPS (32 DN) and 2-1/2 NPS (65 DN): Grooved ends.
- B. Globe Valves:
  - 1. 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

#### 3.01 EXAMINATION

- A. Confirm valve interior to be free of foreign matter and corrosion.
- B. Remove packing materials.
- C. Examine guides and seats by operating valves from the fully open position to the fully closed position.
- D. Examine valve threads and mating pipe for form and cleanliness.
- E. Examine mating flange faces for conditions that might cause leakage.
  - 1. Check bolting for proper size, length, and material.
  - 2. Verify gasket for size, defects, damage, and suitable material composition for service.
  - 3. Replace all defective valves with new valves.

#### 3.02 INSTALLATION

- A. Comply with specific valve installation requirements and application in the following Sections:
  - 1. Section 211300 for application of valves in wet and 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.
  - 1. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Valves with threaded connections to have unions at equipment arranged for easy access, service, maintenance, and equipment removal without system shutdown.
- D. Valves in horizontal piping installed with stem at or above the pipe center.
- E. Position valves to allow full stem movement.
- F. Install valve tags. Comply with Section 210553 requirements for valve tags, schedules, and signs on surfaces concealing valves; and the appropriate NFPA standard applying to the piping system in which valves are installed.

END OF SECTION 210523

SECTION 210553  
IDENTIFICATION FOR FIRE SUPPRESSION PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Pipe markers.
- D. Ceiling tacks.

1.02 REFERENCE STANDARDS

- A. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2017.

1.03 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Manufacturer's Installation Instructions: Indicate special procedures, and installation instructions.
- C. Project Record Documents: Record actual locations of tagged valves.

PART 2 PRODUCTS

2.01 IDENTIFICATION APPLICATIONS

- A. Automatic Controls: Tags.
- B. Instrumentation: Tags.
- C. Major Control Components: Nameplates.
- D. Piping: Pipe markers.
- E. Relays: Tags.
- F. Valves: Tags and ceiling tacks where above lay-in ceilings.

2.02 NAMEPLATES

- A. Manufacturers:
  - 1. Brimar Industries, Inc: [www.pipemarker.com/#sle](http://www.pipemarker.com/#sle).

2. Kolbi Pipe Marker Co: [www.kolbipipemarkers.com/#sle](http://www.kolbipipemarkers.com/#sle).
3. Seton Identification Products, a Tricor Direct Company: [www.seton.com/#sle](http://www.seton.com/#sle).
4. Substitutions: See Section 016000 - Product Requirements.

B. Description: Laminated three-layer plastic with engraved letters.

1. Letter Color: White.
2. Letter Height: 1/4 inch (6 mm).
3. Background Color: Black.
4. Thickness: 1/8 inch (3 mm).
5. Plastic: Comply with ASTM D709.

## 2.03 TAGS

A. Manufacturers:

1. Advanced Graphic Engraving, LLC: [www.advancedgraphicengraving.com/#sle](http://www.advancedgraphicengraving.com/#sle).
2. Brady Corporation: [www.bradycorp.com/#sle](http://www.bradycorp.com/#sle).
3. Brimar Industries, Inc: [www.pipemarkers.com/#sle](http://www.pipemarkers.com/#sle).
4. Craftmark Pipe Markers: [www.craftmarkid.com/#sle](http://www.craftmarkid.com/#sle).
5. Kolbi Pipe Marker Co: [www.kolbipipemarkers.com/#sle](http://www.kolbipipemarkers.com/#sle).
6. Seton Identification Products, a Tricor Direct Company: [www.seton.com/#sle](http://www.seton.com/#sle).
7. Substitutions: See Section 016000 - Product Requirements.

B. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch (40 mm) diameter with smooth edges.

## 2.04 PIPE MARKERS

A. Manufacturers:

1. Brady Corporation: [www.bradycorp.com/#sle](http://www.bradycorp.com/#sle).
2. Brimar Industries, Inc: [www.pipemarkers.com/#sle](http://www.pipemarkers.com/#sle).
3. Craftmark Pipe Markers: [www.craftmarkid.com/#sle](http://www.craftmarkid.com/#sle).
4. Kolbi Pipe Marker Co: [www.kolbipipemarkers.com/#sle](http://www.kolbipipemarkers.com/#sle).
5. Seton Identification Products, a Tricor Company: [www.seton.com/#sle](http://www.seton.com/#sle).
6. Substitutions: See Section 016000 - Product Requirements.

B. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

C. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.

D. Color code as follows:

1. Fire Quenching Fluids: Red with white letters.

## 2.05 CEILING TACKS

A. Manufacturers:

1. Craftmark Pipe Markers: [www.craftmarkid.com/#sle](http://www.craftmarkid.com/#sle).

2. Substitutions: See Section 016000 - Product Requirements.

B. Description: Steel with 3/4 inch (20 mm) diameter color coded head.

### PART 3 EXECUTION

#### 3.01 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

#### 3.02 INSTALLATION

A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B. Install tags with corrosion resistant chain.

C. Install plastic pipe markers in accordance with manufacturer's instructions.

D. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

E. Use tags on piping 3/4 inch (20 mm) diameter and smaller.

1. Install in clear view and align with axis of piping.

F. Locate ceiling tacks to locate valves above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION 210553



SECTION 211300  
FIRE-SUPPRESSION SPRINKLER SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wet-pipe sprinkler system.
- B. System design, installation, and certification.

1.02 RELATED REQUIREMENTS

- A. Section 210500 - Common Work Results for Fire Suppression: Pipe and fittings.
- B. Section 210553 - Identification for Fire Suppression Piping and Equipment.

1.03 REFERENCE STANDARDS

- A. FM (AG) - FM Approval Guide; Current Edition.
- B. NFPA 13 - Standard for the Installation of Sprinkler Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. UL (DIR) - Online Certifications Directory; Current Edition.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on sprinklers, valves, and specialties, including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- C. Shop Drawings:
  - 1. Indicate hydraulic calculations, detailed pipe layout, hangers and supports, sprinklers, components, and accessories. Indicate system controls.
  - 2. Submit shop drawings to Authorities Having Jurisdiction for approval. Submit proof of approval to Architect.
- D. Designer's qualification statement.
- E. Manufacturer's qualification statement.
- F. Installer's qualification statement.
- G. Operation and Maintenance Data: Include components of system, servicing requirements, record drawings, inspection data, replacement part numbers and availability, and location and numbers of service depot.

- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 016000 - Product Requirements for additional provisions.
  - 2. Extra Sprinklers: Type and size matching those installed in quantity required by referenced NFPA design and installation standard.
- I. Project Record Documents: Record actual locations of sprinklers and deviations of piping from drawings. Indicate drain and test locations.

#### 1.05 QUALITY ASSURANCE

- A. Comply with FM (AG) requirements.
- B. Designer Qualifications: Design system under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.
- C. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- D. Installer Qualifications: Company specializing in performing the work of this section with minimum five years experience and approved by manufacturer.
- E. Equipment and Components: Provide products that bear FM (AG) label or marking.
- F. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified and indicated.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store products in shipping containers and maintain in place until installation. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

- A. Sprinklers, Valves, and Equipment:
  - 1. Anvil International: [www.anvilintl.com/#sle](http://www.anvilintl.com/#sle).
  - 2. Tyco Fire Protection Products: [www.tyco-fire.com/#sle](http://www.tyco-fire.com/#sle).
  - 3. Viking Corporation: [www.vikinggroupinc.com/#sle](http://www.vikinggroupinc.com/#sle).
  - 4. Substitutions: See Section 016000 - Product Requirements.

#### 2.02 SPRINKLER SYSTEM

- A. Sprinkler System: Provide coverage for building areas noted.
- B. Occupancy: Ordinary hazard, Group 1; comply with NFPA 13.
- C. Water Supply: Determine volume and pressure from water flow test data.

- D. Interface system with building fire and smoke alarm system.

## 2.03 SPRINKLERS

- A. Suspended Ceiling Type: pendant type with matching push on escutcheon plate.
  - 1. Response Type: Quick.
  - 2. Coverage Type: Standard.
  - 3. Finish: Brass.
  - 4. Fusible Link: Glass bulb type temperature rated for specific area hazard.
- B. Flexible Drop System: Stainless steel, multiple use, open gate type.
  - 1. Application: Use to properly locate sprinkler heads.
  - 2. Include all supports and bracing.
  - 3. Provide braided type tube as required for the application.
  - 4. Manufacturers:
    - a. FlexHead Industries, a brand of Anvil International; \_\_\_\_\_ : [www.anvilintl.com/#sle](http://www.anvilintl.com/#sle).
    - b. Victaulic Company; Vic-Flex: [www.victaulic.com/#sle](http://www.victaulic.com/#sle).
    - c. Substitutions: See Section 016000 - Product Requirements.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Install in accordance with referenced NFPA design and installation standard.
- B. Install equipment in accordance with manufacturer's instructions.
- C. Place pipe runs to minimize obstruction to other work.
- D. Place piping in concealed spaces above finished ceilings.
- E. Center sprinklers in one direction only in ceiling tile with location in other direction variable, dependent upon spacing and coordination with ceiling elements.
- F. Apply masking tape or paper cover to ensure concealed sprinklers, cover plates, and sprinkler escutcheons do not receive field paint finish. Remove after painting. Replace painted sprinklers.
- G. Flush entire piping system of foreign matter.
- H. Hydrostatically test entire system.
- I. Require test be witnessed by Authority Having Jurisdiction.

3.02 INTERFACE WITH OTHER PRODUCTS

- A. Ensure required devices are installed and connected as required to fire alarm system.

END OF SECTION 211300

SECTION 220513  
COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. General construction and requirements.
- B. Applications.
- C. Three phase electric motors.

1.02 RELATED REQUIREMENTS

- A. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

- A. NEMA MG 1 - Motors and Generators; 2021.
- B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide wiring diagrams with electrical characteristics and connection requirements.
- C. Manufacturer's Installation Instructions: Indicate setting, mechanical connections, lubrication, and wiring instructions.
- D. Operation Data: Include instructions for safe operating procedures.
- E. Maintenance Data: Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

1.05 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

1.07 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.

PART 2 PRODUCTS

2.01 GENERAL CONSTRUCTION AND REQUIREMENTS

- A. Electrical Service:
  - 1. Motors Larger than 1/2 Horsepower: 208 volts, three phase, 60 Hz.
- B. Construction:
  - 1. Open drip-proof type except where specifically noted otherwise.
  - 2. Design for continuous operation in 104 degrees F (40 degrees C) environment.
  - 3. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
- C. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.
- D. Wiring Terminations:
  - 1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
  - 2. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Check line voltage and phase and ensure agreement with nameplate.

END OF SECTION 220513

SECTION 220516  
EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Flexible pipe connectors.
- B. Expansion joints and compensators.
- C. Pipe loops, offsets, and swing joints.

1.02 RELATED REQUIREMENTS

- A. Section 210500 - Common Work Results for Fire Suppression.
- B. Section 221005 - Plumbing Piping.

1.03 REFERENCE STANDARDS

- A. EJMA (STDS) - EJMA Standards; Tenth Edition.
- B. UL (DIR) - Online Certifications Directory; Current Edition.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data:
  - 1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot (meter) and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
  - 2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Comply with UL (DIR) requirements.

2.02 FLEXIBLE PIPE CONNECTORS - COPPER PIPING

- A. Manufacturers:
  - 1. Flex-Weld, Inc: [www.kelcoind.com/#sle](http://www.kelcoind.com/#sle).

2. Mercer Rubber Company: [www.mercer-rubber.com/#sle](http://www.mercer-rubber.com/#sle).
3. The Metraflex Company: [www.metraflex.com/#sle](http://www.metraflex.com/#sle).
4. Unisource Manufacturing, Inc; Series 411, Bronze Braided Flex Connectors:  
[www.unisource-mfg.com/#sle](http://www.unisource-mfg.com/#sle).
5. Substitutions: See Section 016000 - Product Requirements.

- B. Inner Hose: Bronze.
- C. Exterior Sleeve: Braided bronze.
- D. End Connections: As specified for pipe joints.
- E. Size: Use pipe sized units.
- F. Application: Copper piping.

## 2.03 ACCESSORIES

- A. Pipe Alignment Guides:
  1. Manufacturers:
    - a. Flex-Weld, Inc: [www.kelcoind.com/#sle](http://www.kelcoind.com/#sle).
    - b. The Metraflex Company; PGQ Glide Riser Guide: [www.metraflex.com/#sle](http://www.metraflex.com/#sle).
    - c. Substitutions: See Section 016000 - Product Requirements.
  2. Two piece welded steel with enamel paint, bolted, with spider to fit standard pipe, frame with four mounting holes, clearance for minimum 1 inch (25 mm) thick insulation, minimum 3 inches (75 mm) travel.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with EJMA (Expansion Joint Manufacturers Association) Standards.
- C. Install flexible pipe connectors on pipes connected to vibration isolated equipment. Provide line size flexible connectors.
- D. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.
- E. Anchor pipe to building structure where indicated. Provide pipe guides so movement is directed along axis of pipe only. Erect piping such that strain and weight is not on cast connections or apparatus.
- F. Provide support and equipment required to control expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where required.

END OF SECTION 220516



SECTION 220517  
SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Pipe sleeves.
- B. Pipe sleeve-seals.

1.02 RELATED REQUIREMENTS

- A. Section 078400 - Firestopping.

1.03 REFERENCE STANDARDS

- A. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2022a.
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a (Reapproved 2017).
- C. UL (DIR) - Online Certifications Directory; Current Edition.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of the type specified this section.
  - 1. Minimum three years experience.
- B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store sleeve and sleeve seals in shipping containers, with labeling in place.
- B. Provide temporary protective coating on cast iron and steel sleeves if shipped loose.

1.07 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 PIPE SLEEVES

- A. Manufacturers:
  - 1. Flexicraft Industries; Pipe Wall Sleeve: [www.flexicraft.com/#sle](http://www.flexicraft.com/#sle).
  - 2. Substitutions: See Section 016000 - Product Requirements.
- B. Plastic or Sheet Metal: Pipe passing through interior walls, partitions, and floors, unless steel or brass sleeves are specified below.
- C. Clearances:
  - 1. Provide allowance for insulated piping.
  - 2. Wall, Floor, Partitions, and Beam Flanges: 1 inch (25 mm) greater than external pipe diameter.
  - 3. All Rated Openings: Caulked tight with fire stopping material complying with ASTM E814 in accordance with Section 078400 to prevent the spread of fire, smoke, and gases.

2.02 PIPE-SLEEVE SEALS

- A. Manufacturers:
  - 1. Advance Products & Systems, LLC; Innerlynx: [www.apsonline.com/#sle](http://www.apsonline.com/#sle).
  - 2. American Polywater Corporation; PGKD Modular Seals: [www.polywater-haufftechnik.com/#sle](http://www.polywater-haufftechnik.com/#sle).
  - 3. Flexicraft Industries; PipeSeal: [www.flexicraft.com/#sle](http://www.flexicraft.com/#sle).
  - 4. Substitutions: See Section 016000 - Product Requirements.
- B. Modular Mechanical Sleeve-Seal:
  - 1. Elastomer-based interlocking links continuously fill annular space between pipe and wall-sleeve, wall or casing opening.
  - 2. Watertight seal between pipe and wall-sleeve, wall or casing opening.
  - 3. Size and select seal component materials in accordance with service requirements.
  - 4. Service Requirements:
    - a. Fire Resistant: 1 hour, UL (DIR) approved.
  - 5. Glass-reinforced plastic pressure end plates.
- C. Sealing Compounds:
  - 1. Provide packing and sealing compound to fill pipe to sleeve thickness.
  - 2. Combined packing and sealing compounding to match partition fire-resistance hourly rating.
- D. Pipe Sleeve Material:

1. Bearing Walls: Steel, cast iron, or terra-cotta pipe.
  2. Masonry Structures: Sheet metal or fiber.
- E. Wall Sleeve: PVC material with waterstop collar, and nailer end-caps.

### PART 3 EXECUTION

#### 3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and foreign material, from inside and outside, before assembly.

#### 3.02 INSTALLATION

- A. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- B. Install piping to conserve building space, to not interfere with use of space and other work.
- C. Install piping and pipe sleeves to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- D. Structural Considerations: Do not penetrate building structural members unless indicated.
- E. Provide sleeves when penetrating floors, walls, and partitions. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.
- F. Aboveground Piping:
  1. Pack solid using mineral fiber complying with ASTM C592.
  2. Fill space with an elastomer caulk to a depth of 0.50 inch (15 mm) where penetrations occur between conditioned and unconditioned spaces.
- G. All Rated Openings: Caulk tight with fire stopping material complying with ASTM E814 in accordance with Section 078400 to prevent the spread of fire, smoke, and gases.
- H. Caulk exterior wall sleeves watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed components.
- I. Manufactured Sleeve-Seal Systems:
  1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
  2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
  3. Locate piping in center of sleeve or penetration.
  4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
  5. Tighten bolting for a water-tight seal.
  6. Install in accordance with manufacturer's recommendations.
- J. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings.

Ensure flanges, union, and couplings for servicing are consistently provided.

3.03 CLEANING

- A. Upon completion of work, clean all parts of the installation.
- B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

END OF SECTION 220517

SECTION 220519  
METERS AND GAUGES FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Pressure gauges.
- B. Pressure-temperature test plugs.

1.02 REFERENCE STANDARDS

- A. ASME B40.100 - Pressure Gauges and Gauge Attachments; 2022.
- B. UL 393 - Indicating Pressure Gauges for Fire-Protection Service; Current Edition, Including All Revisions.
- C. UL 404 - Gauges, Indicating Pressure, for Compressed Gas Service; Current Edition, Including All Revisions.

1.03 ADMINISTRATIVE REQUIREMENTS

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

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide red-marked product data sheets for each furnished item with associated components and accessories.

PART 2 PRODUCTS

2.01 PRESSURE GAUGES

- A. Manufacturers:
  - 1. Ashcroft, Inc: [www.ashcroft.com/#sle](http://www.ashcroft.com/#sle).
  - 2. Dwyer Instruments, Inc: [www.dwyer-inst.com/#sle](http://www.dwyer-inst.com/#sle).
  - 3. Moeller Instrument Company, Inc: [www.moellerinstrument.com/#sle](http://www.moellerinstrument.com/#sle).
  - 4. Omega Engineering a subsidiary of Spectris, Plc: [www.omega.com/#sle](http://www.omega.com/#sle).
  - 5. Weksler Glass Thermometer Corp: [www.wekslerglass.com/#sle](http://www.wekslerglass.com/#sle).
  - 6. Substitutions: See Section 016000 - Product Requirements.
- B. Diaphragm Actuated for Gases:
  - 1. Dial Size and Cover: 3-1/2 inch (90 mm) diameter scale with polycarbonate window.

2. Dial Text and Markings: Black color on white background with scaled kPa and psi units.
3. Accuracy: ASME B40.100, adjustable commercial grade (B) with 2 percent at mid-range of span.
4. Process Connection: Lower-back, 1/4 inch (8 mm, DN) NPT male except where noted.
5. Comply with UL 404 when used for compressed gas service.

C. Accessories:

1. Gauge Cock: Stainless steel with tee or lever handle for maximum 150 psi (1034 kPa).

2.02 PRESSURE-TEMPERATURE TEST PLUGS:

- A. Size: 500 psi (34.5 bar) capacity; 1/2 inch (13 mm) MPT brass fitting with gasket, cap, and retaining strap for 1/8 inch (3 mm) pressure gauge or temperature probe.
- B. Wetted Materials per Temperature Range:
  1. Up to 200 degrees F (93 degrees C): Brass probe with neoprene core.
- C. Accessories: Brass, lever-handle cock and snubber-filter.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install pressure gauges as follows:
  1. At Pumps: Place single gauge before strainer, suction side and discharge side.
  2. Include gauge cock to isolate each gauge and extend nipples for insulation clearance.
  3. Adjust gauges to selected viewing angle, clean thoroughly, and calibrate to zero.
- B. Locate PT (pressure-temperature) test plugs as indicated on drawings.

3.02 SCHEDULES

- A. Pressure Gauges, Location and Scale Range:
  1. Pressure tanks, 0 to 150 psi (0 to 1035 kPa).
  2. Pressure reducing valves, 0 to 100 psi (0 to 690 kPa).

END OF SECTION 220519

SECTION 220523  
GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Angle valves.
- B. Ball valves.
- C. Check valves.
- D. Flow limiting valves.
- E. Gate valves.
- F. Globe valves.

1.02 RELATED REQUIREMENTS

1.03 ABBREVIATIONS AND ACRONYMS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Non-rising stem.
- E. OS&Y: Outside screw and yoke.
- F. PTFE: Polytetrafluoroethylene.
- G. RS: Rising stem.
- H. TFE: Tetrafluoroethylene.
- I. WOG: Water, oil, and gas.

1.04 REFERENCE STANDARDS

- A. ASME B1.20.1 - Pipe Threads, General Purpose, Inch; 2013 (Reaffirmed 2018).
- B. ASME B16.10 - Face-to-Face and End-to-End Dimensions of Valves; 2022.
- C. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.
- D. ASME B16.34 - Valves — Flanged, Threaded, and Welding End; 2020.

- E. ASME B31.9 - Building Services Piping; 2020.
- F. ASTM B61 - Standard Specification for Steam or Valve Bronze Castings; 2015 (Reapproved 2021).
- G. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings; 2017.
- H. MSS SP-80 - Bronze Gate, Globe, Angle, and Check Valves; 2019.
- I. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010, with Errata .
- J. NSF 61 - Drinking Water System Components - Health Effects; 2023, with Errata.
- K. NSF 372 - Drinking Water System Components - Lead Content; 2022.

#### 1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- C. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- D. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.

#### 1.06 QUALITY ASSURANCE

#### 1.07 DELIVERY, STORAGE, AND HANDLING

- A. Use the following precautions during storage:
  - 1. Maintain valve end protection and protect flanges and specialties from dirt.
    - a. Provide temporary inlet and outlet caps.
    - b. Maintain caps in place until installation.
  - 2. Store valves in shipping containers and maintain in place until installation.
    - a. Store valves indoors in dry environment.
    - b. Store valves off the ground in watertight enclosures when indoor storage is not an option.

#### 1.08 Exercise the following precautions for handling:

- A. Handle large valves with sling, modified to avoid damage to exposed parts.
- B. Avoid the use of operating handles or stems as rigging or lifting points.



## PART 2 PRODUCTS

### 2.01 APPLICATIONS

- A. Listed pipe sizes shown using nominal pipe sizes (NPS) and nominal diameter (DN).
- B. Provide the following valves for the applications if not indicated on drawings:
  - 1. Shutoff: Ball, butterfly, gate.
  - 2. Throttling: Provide globe or ball.
- C. Substitutions of valves with higher CWP classes or WSP ratings for same valve types are permitted when specified CWP ratings or WSP classes are not available.
- D. Low Pressure, Compressed Air Valves 150 psi (1035 kPa) or Less:
  - 1. 2 inch (50 mm, DN) and Smaller:
    - a. Bronze: Provide with solder-joint ends.
    - b. Ball: Two piece, full port, brass with brass trim.
    - c. Bronze Lift Check: Class 125, bronze disc.
    - d. Bronze Swing Check: Class 125, bronze disc.
    - e. Bronze Gate: Class 125, NRS.
- E. Domestic, Hot and Cold Water Valves:
  - 1. 2 inch (50 mm, DN) and Smaller:
    - a. Bronze: Provide with solder-joint ends.
    - b. Bronze Angle: Class 125, bronze disc.
    - c. Ball: One piece, full port, bronze with bronze trim.
    - d. Bronze Swing Check: Class 125, bronze disc.
    - e. Bronze Gate: Class 125, NRS.
    - f. Bronze Globe: Class 125, bronze disc.

### 2.02 GENERAL REQUIREMENTS

- A. Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.
- B. Valve Sizes: Match upstream piping unless otherwise indicated.
- C. Valve Actuator Types:
  - 1. Handwheel: Valves other than quarter-turn types.
  - 2. Hand Lever: Quarter-turn valves 6 inch (150 mm, DN) and smaller except plug valves.
- D. Insulated Piping Valves: With 2 inch (50 mm, DN) stem extensions and the following features:
  - 1. Gate Valves: Rising stem.
  - 2. Ball Valves: Extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
  - 3. Memory Stops: Fully adjustable after insulation is installed.
- E. Valve-End Connections:

1. Threaded End Valves: ASME B1.20.1.
2. Solder Joint Connections: ASME B16.18.

F. General ASME Compliance:

1. Ferrous Valve Dimensions and Design Criteria: ASME B16.10 and ASME B16.34.
2. Solder-joint Connections: ASME B16.18.
3. Building Services Piping Valves: ASME B31.9.

G. Potable Water Use:

1. Certified: Approved for use in compliance with NSF 61 and NSF 372.
2. Lead-Free Certified: Wetted surface material includes less than 0.25 percent lead content.

H. Source Limitations: Obtain each valve type from a single manufacturer.

2.03 BRONZE, ANGLE VALVES

A. Class 125; CWP Rating: 200 psi (1380 kPa):

1. Comply with MSS SP-80, Type 1.
2. Body: Bronze; ASTM B62, with integral seat and screw in bonnet.
3. End Connections: Pipe thread.
4. Stem: Bronze.
5. Disc: Bronze.
6. Packing: Asbestos free.
7. Handwheel: Bronze or aluminum.
8. Manufacturers:
  - a. Apollo Valves; [www.apollovalves.com/#sle](http://www.apollovalves.com/#sle).
  - b. FNW: [ww.fnw.com/#sle](http://ww.fnw.com/#sle).
  - c. Substitutions: See Section 016000 - Product Requirements.

2.04 BRONZE, BALL VALVES

A. General:

1. Fabricate from dezincification resistant material.
2. Copper alloys containing more than 15 percent zinc are not permitted.

B. Two Piece, Full Port with Bronze Trim:

1. Comply with MSS SP-110.
2. WSP Rating: 150 psi (1035 kPa).
3. WOG Rating: 600 psi (4140 kPa).
4. Body: Forged bronze or dezincified-brass alloy.
5. Ends Connections: Pipe thread or solder.
6. Seats: PTFE.
7. Stem: Bronze, blowout proof.
8. Ball: Chrome plated brass.
9. Operator: Provide lockable handle and stem extension.
10. Manufacturers:
  - a. Apollo Valves: [www.apollovalves.com/#sle](http://www.apollovalves.com/#sle).

- b. FNW; X450: [www.fnw.com/#sle](http://www.fnw.com/#sle).
- c. Jomar Valves, a division of Jomar Group: [www.jomarvalve.com/#sle](http://www.jomarvalve.com/#sle).
- d. Substitutions: See Section 016000 - Product Requirements.

## 2.05 BRONZE, LIFT CHECK VALVES

- A. General:
  - 1. Fabricate from dezincification resistant material.
  - 2. Copper alloys containing more than 15 percent zinc are not permitted.
- B. Class 125:
  - 1. Comply with MSS SP-80, Type 1, Metal Disc to Metal Seat and Type 2, Nonmetallic Disc to Metal Seat.
  - 2. CWP Rating: 200 psi (1380 kPa).
  - 3. Design: Vertical flow.
  - 4. Body: Comply with ASTM B61 or ASTM B62, bronze.
  - 5. End Connections: Threaded.
  - 6. Disc (Type 1): Bronze.

## 2.06 BRONZE, SWING CHECK VALVES

- A. General:
  - 1. Fabricate from dezincification resistant material.
  - 2. Copper alloys containing more than 15 percent zinc are not permitted.
- B. Class 125:
  - 1. Pressure and Temperature Rating: MSS SP-80, Type 3.
  - 2. Design: Y-pattern, horizontal or vertical flow.
  - 3. WOG Rating: 200 psi (1380 kPa).
  - 4. Body: Bronze, ASTM B62.
  - 5. End Connections: Threaded.
  - 6. Disc: Bronze.
  - 7. Manufacturers:
    - a. Apollo Valves: [www.apollovalves.com/#sle](http://www.apollovalves.com/#sle).
    - b. Jomar Valves, a division of Jomar Group: [www.jomarvalve.com/#sle](http://www.jomarvalve.com/#sle).
    - c. Substitutions: See Section 016000 - Product Requirements.

## 2.07 BRONZE, GATE VALVES

- A. General:
  - 1. Fabricate from dezincification resistant material.
  - 2. Copper alloys containing more than 15 percent zinc are not permitted.
- B. Rising Stem or OS&Y:
  - 1. Pressure-Temperature Range: MSS SP-80, Type I.
  - 2. Body: ASTM B62, bronze with integral seat and screw-in bonnet.
  - 3. End Connections: Threaded or solder.
  - 4. Stem: Bronze.

5. Disc: Solid wedge; bronze.
6. Packing: Asbestos free.
7. Handwheel Operator: Malleable iron.
8. Manufacturers:
  - a. Apollo Valves: [www.apollovalves.com/#sle](http://www.apollovalves.com/#sle).
  - b. FNW; 1221, Federal: [www.fnw.com/#sle](http://www.fnw.com/#sle).
  - c. Jomar Valves, a division of Jomar Group: [www.jomarvalve.com/#sle..](http://www.jomarvalve.com/#sle..)
  - d. Substitutions: See Section 016000 - Product Requirements.

C. Non-Rising Stem or NRS

1. Pressure-Temperature Range: MSS SP-80, Type I.
2. Class 125:
  - a. WSP Rating: 125 psi (861.8 kPa), saturated.
3. Class 150: CWP Rating; 300 psi (2070 kPa).
4. Body: ASTM B62, bronze with integral seat and screw-in bonnet.
5. Ends Connections: Threaded or solder.
6. Stem: Bronze.
7. Disc: Solid wedge; bronze.
8. Packing: Asbestos free.
9. Handwheel Operator: Malleable iron.
10. Manufacturers:
  - a. Apollo Valves: [www.apollovalves.com/#sle](http://www.apollovalves.com/#sle).
  - b. FNW; 1211, Federal: [www.fnw.com/#sle](http://www.fnw.com/#sle).
  - c. Substitutions: See Section 016000 - Product Requirements.

2.08 BRONZE, GLOBE VALVES

A. General:

1. Fabricate from dezincification resistant material.
2. Copper alloys containing more than 15 percent zinc are not permitted.

B. Class 125:

1. Class 125:
  - a. WOG Rating: 200 psi (1380 kPa).
  - b. WSP Rating: 125 psi (861.8 kPa), saturated.
2. Comply with MSS SP-80, Type 1.
3. Body: ASTM B62, bronze with integral seat and screw-in bonnet.
4. End Connections: Threaded or solder.
5. Bonnet: NRS; Non-rising Stem.
6. Non-Rising Stem: Bronze.
7. Disc: PTFE.
8. Packing: Asbestos free.
9. Handwheel Operator: Malleable iron.
10. Manufacturers:
  - a. Apollo Valves: [www.apollovalves.com/#sle](http://www.apollovalves.com/#sle).
  - b. FNW; 1231, Federal: [www.fnw.com/#sle](http://www.fnw.com/#sle).
  - c. Substitutions: See Section 016000 - Product Requirements.

### PART 3 EXECUTION

#### 3.01 EXAMINATION

- A. Discard all packing materials and verify that valve interior, including threads and flanges are completely clean without signs of damage or degradation that could result in leakage.
- B. Verify valve parts to be fully operational in all positions from closed to fully open.
- C. Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.
- D. Should valve is determined to be defective, replace with new valve.

#### 3.02 INSTALLATION

- A. Provide unions or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.
- B. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.
- C. Install check valves where necessary to maintain direction of flow as follows:
  - 1. Lift Check: Install with stem plumb and vertical.

END OF SECTION 220523

SECTION 220529  
HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

- 1.01 Section Includes
  - A. Strut systems for pipe or equipment support.
  - B. Beam clamps.
  - C. Pipe hangers.
  - D. Pipe supports, guides, shields, and saddles.
  - E. Anchors and fasteners.
  
- 1.02 Related Requirements
  - A. Section 033000 - Cast-in-Place Concrete: Concrete equipment pads.
  - B. Section 055000 - Metal Fabrications.
  - C. Section 220548 - Vibration and Seismic Controls for Plumbing Piping and Equipment.
  
- 1.03 Reference Standards
  - A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
  - B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
  - C. ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General-Purpose Piping; 2022.
  - D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
  - E. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2022).
  - F. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.
  - G. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures; 1999 (Reapproved 2022).
  - H. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2022.

- I. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2018a.
  - J. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.
  - K. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
  - L. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2022a, with Editorial Revision (2023).
  - M. FM (AG) - FM Approval Guide; Current Edition.
  - N. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018, with Amendment (2019).
  - O. UL (DIR) - Online Certifications Directory; Current Edition.
  - P. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.
- 1.04 Administrative Requirements
- A. Coordination:
    - 1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
    - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
    - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
    - 4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
    - 5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
  - B. Sequencing:
    - 1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 033000.
- 1.05 Submittals
- A. See Section 013000 - Administrative Requirements for submittal procedures.
  - B. Product Data: Provide manufacturer's standard catalog pages and data sheets for metal channel (strut) framing systems, post-installed concrete and masonry anchors, and thermal insulated pipe supports.

1.06 Quality Assurance

- A. Comply with applicable building code.

1.07 Delivery, Storage, and Handling

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 General Requirements

- A. Provide required hardware to hang or support piping, equipment, or fixtures with related accessories as necessary to complete installation of plumbing work.
- B. Provide hardware products listed, classified, and labeled as suitable for intended purpose.
- C. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
- D. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
- E. Fire Resistance: Provide hardware rated for 60 minutes resistance unless specifically indicated by the authority having jurisdiction.
- F. Materials for Metal Fabricated Supports: Comply with Section 055000.
  - 1. Zinc-Plated Steel: Electroplated in accordance with ASTM B633 unless stated otherwise.
  - 2. Galvanized Steel: Hot-dip galvanized in accordance with ASTM A123/A123M or ASTM A153/A153M unless stated otherwise.
- G. Corrosion Resistance: Use corrosion-resistant metal-based materials fully compatible with exposed piping materials and suitable for the environment where installed.
  - 1. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.

2.02 Strut Systems for Pipe or Equipment Support

- A. Strut Channels:
  - 1. Manufacturers:
    - a. ABB Installation Products: [electrification.us.abb.com/#sle](http://electrification.us.abb.com/#sle).
    - b. Gripple, Inc; Universal Bracket: [www.gripple.com/#sle](http://www.gripple.com/#sle).
    - c. Unistrut, a brand of Atkore International Inc: [www.unistrut.com/#sle](http://www.unistrut.com/#sle).
    - d. Substitutions: See Section 016000 - Product Requirements.
    - e. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.



2. ASTM A653/A653M galvanized steel bracket with clamps for surface mounting of piping or plumbing equipment support.
3. Channel or Bracket Kits: Include rods, brackets, end-fixed fittings, covers, clips, and other related hardware required to complete sectional trapeze section for piping or other support.

B. Hanger Rods:

1. Threaded zinc-plated steel unless otherwise indicated.

C. Channel Nuts:

1. Provide carbon steel channel nut with epoxy copper or zinc finish and long, regular, or short spring as indicated on drawings.

2.03 Beam Clamps

A. Manufacturers:

1. B-Line, a brand of Eaton Corporation: [www.eaton.com/#sle](http://www.eaton.com/#sle).
2. FNW; 7201: [www.fnw.com/#sle](http://www.fnw.com/#sle).
3. Unistrut, a brand of Atkore International, Inc: [www.unistrut.com/#sle](http://www.unistrut.com/#sle).
4. Substitutions: See Section 016000 - Product Requirements.
5. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

B. MSS SP-58 types 19 through 23, 25 or 27 through 30 based on required load.

C. C-Clamp: MSS SP-58 type 23, malleable iron and steel with plain, stainless steel, and zinc finish.

D. Small or Junior Beam Clamp: MSS SP-58 type 19, malleable iron with plain finish. For inverted usage provide manufacturer listed size(s).

E. Wide Mouth Beam Clamp: MSS SP-58 type 19, malleable iron with plain finish.

F. Centerload Beam Clamp with Extension Piece: MSS SP-58 type 30, malleable iron with plain finish.

G. FM (AG) and UL (DIR) Approved Beam Clamp: MSS SP-58 type 19, plain finish.

H. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.

I. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.

2.04 Pipe Hangers

A. J-Hangers, Adjustable:

1. Manufacturers:
  - a. B-Line, a brand of Eaton Corporation: [www.eaton.com/#sle](http://www.eaton.com/#sle).
  - b. FNW; 7025: [www.fnw.com/#sle](http://www.fnw.com/#sle).
  - c. Unistrut, a brand of Atkore International, Inc: [www.unistrut.com/#sle](http://www.unistrut.com/#sle).
  - d. Substitutions: See Section 016000 - Product Requirements.

- e. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
  - 2. MSS SP-58 type 5, zinc-plated ASTM A1011/A1011M steel or ASTM A653/A653M carbon steel.
- B. Clevis Hangers, Adjustable:
- 1. Manufacturers:
    - a. B-Line, a brand of Eaton Corporation: [www.eaton.com/#sle](http://www.eaton.com/#sle).
    - b. FNW; 7005: [www.fnw.com/#sle](http://www.fnw.com/#sle).
    - c. nVent Caddy, a brand of nVent: [www.erico.com/#sle](http://www.erico.com/#sle).
    - d. Substitutions: See Section 016000 - Product Requirements.
    - e. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
  - 2. Copper Tube: MSS SP-58 type 1, epoxy-plated copper.
  - 3. Felt-Lined: MSS SP-58 type 1, zinc-plated, silicone-free carbon steel.
  - 4. Light-Duty: MSS SP-58 type 1, zinc-colored, epoxy plated.
  - 5. Standard-Duty: MSS SP-58 type 1, zinc-colored, epoxy plated.
- C. Nonmetallic Pipe Hangers:
- 1. Manufacturers:
    - a. B-Line, a brand of Eaton Corporation: [www.eaton.com/#sle](http://www.eaton.com/#sle).
    - b. DecoShield Systems, Inc; Snap-2 Hangers: [www.decoshield.com/#sle](http://www.decoshield.com/#sle).
    - c. Gregory Industries, Inc: [www.gregorycorp.com/#sle](http://www.gregorycorp.com/#sle).
    - d. Substitutions: See Section 016000 - Product Requirements.
  - 2. CPVC fabricated, snap-action hanger for pendant or sidewall applications.
- 2.05 Pipe Clamps
- A. Riser Clamps:
- 1. Manufacturers:
    - a. B-Line, a brand of Eaton Corporation: [www.eaton.com/#sle](http://www.eaton.com/#sle).
    - b. FNW; 7020: [www.fnw.com/#sle](http://www.fnw.com/#sle).
    - c. nVent Caddy, a brand of nVent: [www.erico.com/#sle](http://www.erico.com/#sle).
    - d. Substitutions: See Section 016000 - Product Requirements.
    - e. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
  - 2. For insulated pipe runs, provide two bolt-type clamps designed for installation under insulation.
  - 3. MSS SP-58 type 1 or 8, carbon steel or steel with epoxy plated, plain, stainless steel, or zinc plated finish.
  - 4. UL (DIR) listed: Pipe sizes 1/2 to 8 inch (15 to 200 mm, DN).
- B. Strut Clamps:
- 1. Manufacturers:
    - a. B-Line, a brand of Eaton Corporation: [www.eaton.com/#sle](http://www.eaton.com/#sle).
    - b. Substitutions: See Section 016000 - Product Requirements.
    - c. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

2. Pipe Clamp: Two-piece rigid, universal, or outer diameter type, carbon steel with epoxy copper or zinc finish.
3. Cushioned Pipe or Tubing Strut Clamp: Provide strut clamp with thermoplastic elastomer cushion having dielectric strength of 670 V/mil (26,398,000 V/m).
4. Service Temperature Range: Minus 65 to 275 degrees F (Minus 53.8 to 135 degrees C).

## 2.06 Pipe Supports, Guides, Shields, and Saddles

- A. Dielectric Barriers: Provide between metallic supports and metallic piping and associated items of dissimilar type; acceptable dielectric barriers include rubber or plastic sheets or coatings attached securely to pipe or item.
- B. U-Bolts:
  1. MSS SP-58 type 24, carbon steel u-bolt for pipe support or anchoring.
- C. Pipe Shields for Insulated Piping:
  1. MSS SP-58 type 40, ASTM A1011/A1011M steel or ASTM A653/A653M carbon steel.
  2. General Construction and Requirements:
    - a. Surface Burning Characteristics: Comply with ASTM E84 or UL 723.
    - b. Shields Material: UV-resistant polypropylene with glass fill.
    - c. Maximum Insulated Pipe Outer Diameter: 12-5/8 inch (321 mm).
    - d. Service Temperature: Minus 40 to 178 degrees F (Minus 40 to 81 degrees C).
    - e. Pipe shields to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
- D. Pipe Supports:
  1. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
  2. Liquid Temperatures Up to 122 degrees F (50 degrees C):
    - a. Overhead Support: MSS SP-58 types 1, 3 through 12 clamps.
    - b. Support From Below: MSS SP-58 types 35 through 38.
- E. Pipe Supports, Thermal Insulated:
  1. General Requirements:
    - a. Insulated pipe supports to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
    - b. Surface Burning Characteristics: Flame spread index/smoke developed index of 5/30, maximum, when tested in accordance with ASTM E84 or UL 723.
    - c. Provide pipe supports for 1/2 to 30 inch (15 to 750 mm, DN) iron pipes.
    - d. Insulation inserts to consist of rigid phenolic foam insulation surrounded by 360 degree, PVC jacketing.
  2. PVC Jacket:
    - a. Pipe insulation protection shields to be provided with ball bearing hinge and locking seam.
    - b. Moisture Vapor Transmission: 0.0071 perm inch (0.0092 ng/Pa s m), when tested in accordance with ASTM E96/E96M.
    - c. Minimum Thickness: 60 mil, 0.06 inch (1.524 mm).

- F. Copper Pipe Supports:
  - 1. Manufacturers:
    - a. B-Line, a brand of Eaton Corporation: [www.eaton.com/#sle](http://www.eaton.com/#sle).
    - b. HoldRite, a brand of Reliance Worldwide Corporation: [www.holdrite.com/#sle](http://www.holdrite.com/#sle).
    - c. Substitutions: See Section 016000 - Product Requirements.
    - d. Source Limitations: Furnish supports, associated fittings, accessories, and hardware produced by single manufacturer.
  
- G. CPVC Pipe Supports:
  - 1. Manufacturers:
    - a. HoldRite, a brand of Reliance Worldwide Corporation: [www.holdrite.com/#sle](http://www.holdrite.com/#sle).
    - b. Substitutions: See Section 016000 - Product Requirements.
    - c. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
  
- H. Overhead Pipe Supports:
  - 1. Manufacturers:
    - a. HoldRite, a brand of Reliance Worldwide Corporation: [www.holdrite.com/#sle](http://www.holdrite.com/#sle).
    - b. nVent Caddy, a brand of nVent: [www.erico.com/#sle](http://www.erico.com/#sle).
    - c. Substitutions: See Section 016000 - Product Requirements.
    - d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

## 2.07 Anchors and Fasteners

- A. Manufacturers - Mechanical Anchors:
  - 1. FNW; 7502: [www.fnw.com/#sle](http://www.fnw.com/#sle).
  - 2. Hilti, Inc: [www.us.hilti.com/#sle](http://www.us.hilti.com/#sle).
  - 3. ITW Red Head, a division of Illinois Tool Works, Inc: [www.itwredhead.com/#sle](http://www.itwredhead.com/#sle).
  - 4. Powers Fasteners, Inc: [www.powers.com/#sle](http://www.powers.com/#sle).
  - 5. Simpson Strong-Tie Company Inc: [www.strongtie.com/#sle](http://www.strongtie.com/#sle).
  - 6. \_\_\_\_\_.
  - 7. Substitutions: See Section 016000 - Product Requirements.
  
- B. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
  
- C. Concrete: Use expansion anchors or screw anchors.
  
- D. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
  
- E. Steel: Use beam ceiling clamps, beam clamps, machine bolts, or welded threaded studs.
  
- F. Plastic and lead anchors are not permitted.
  
- G. Powder-actuated fasteners are not permitted.
  
- H. Hammer-driven anchors and fasteners are not permitted.

- I. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.

### PART 3 EXECUTION

#### 3.01 Examination

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

#### 3.02 Installation

- A. Install products in accordance with manufacturer's instructions.
- B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- C. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.
- D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- G. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.
- H. Equipment Support and Attachment:
  - 1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
  - 2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
  - 3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
  - 4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- I. Secure fasteners according to manufacturer's recommended torque settings.
- J. Remove temporary supports.

#### 3.03 Field Quality Control

- A. See Section 014000 - Quality Requirements for additional requirements.

- B. Inspect support and attachment components for damage and defects.
- C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION 220529

SECTION 220548  
VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

- 1.01 Section Includes
- A. Vibration isolation requirements.
  - B. Vibration-isolated equipment support bases.
  - C. Vibration isolators.
- 1.02 Related Requirements
- A. Section 033000 - Cast-in-Place Concrete.
  - B. Section 220529 - Hangers and Supports for Plumbing Piping and Equipment.
- 1.03 Reference Standards
- 1.04 Administrative Requirements
- A. Coordination:
    - 1. Coordinate selection and arrangement of vibration isolation and/or seismic control components with the actual equipment to be installed.
    - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
    - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
    - 4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
  - B. Sequencing:
    - 1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 033000.
- 1.05 Submittals
- A. See Section 013000 - Administrative Requirements for submittal procedures.
  - B. Design Documents: Prepare and submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, details, and calculations.
  - C. Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including materials, fabrication details, dimensions, and finishes.

1. Vibration Isolators: Include rated load capacities and deflections; include information on color coding or other identification methods for spring element load capacities.

1.06 Quality Assurance

- A. Comply with applicable building code.

1.07 Delivery, Storage, and Handling

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 Vibration Isolation Requirements

- A. Design and provide vibration isolation systems to reduce vibration transmission to supporting structure from vibration-producing plumbing equipment and/or plumbing connections to vibration-isolated equipment.
- B. Comply with applicable general recommendations of ASHRAE (HVACA), where not in conflict with other specified requirements:
- C. General Requirements:
  1. Select vibration isolators to provide required static deflection.
  2. Select vibration isolators for uniform deflection based on distributed operating weight of actual installed equipment.
  3. Select seismic type vibration isolators to comply with seismic design requirements, including conditions of equipment seismic certification where applicable.
  4. Select vibration isolators for outdoor equipment to comply with wind design requirements.
  5. Select vibration-isolated equipment support bases and associated vibration isolators to provide minimum 2-inch (50 mm) operating clearance beneath base unless otherwise indicated.
- D. Equipment Isolation: As indicated on drawings.
- E. Piping Isolation:
  1. Provide vibration isolators for piping supports:
    - a. Located in equipment rooms.
    - b. Located within 50 feet (15.2 m) of connected vibration-isolated equipment and pressure-regulating valve (PRV) stations.
  2. Minimum Static Deflection:
    - a. First Three Supports Closest to Isolated Equipment: Same as static deflection of equipment; maximum of 2 inch (50 mm) deflection required.
    - b. Remainder of Supports: 0.75 inch (19 mm) deflection unless otherwise indicated.
  3. Suspended Piping, Nonseismic Applications: Use resilient material isolator hangers, spring isolator hangers, or combination resilient material/spring isolator hangers.



## 2.02 Vibration Isolators

- A. Manufacturers:
  - 1. Vibration Isolators:
    - a. Kinetics Noise Control, Inc: [www.kineticsnoise.com/#sle](http://www.kineticsnoise.com/#sle).
    - b. Mason Industries: [www.mason-ind.com/#sle](http://www.mason-ind.com/#sle).
    - c. Vibration Eliminator Company, Inc: [www.veco-nyc.com/#sle](http://www.veco-nyc.com/#sle).
    - d. Substitutions: See Section 016000 - Product Requirements.
- B. General Requirements:
  - 1. Resilient Materials for Vibration Isolators: Oil, ozone, and oxidant resistant.
- C. Vibration Isolators for Nonseismic Applications:
  - 1. Resilient Material Isolator Pads:
    - a. Description: Single or multiple layer pads utilizing elastomeric (e.g., neoprene, rubber) or fiberglass isolator material.
    - b. Pad Thickness: As required for specified minimum static deflection; minimum 0.25 inch (6 mm) thickness.
    - c. Multiple Layer Pads: Provide bonded, galvanized sheet metal separation plate between each layer.

## PART 3 EXECUTION

### 3.01 Examination

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that mounting surfaces are ready to receive vibration isolation and/or seismic control components and associated attachments.
- C. Verify that conditions are satisfactory for installation prior to starting work.

### 3.02 Installation

- A. Install products in accordance with manufacturer's instructions.
- B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- C. Secure fasteners according to manufacturer's recommended torque settings.
- D. Install flexible piping connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.
- E. Vibration Isolation Systems:
  - 1. Clean debris from beneath vibration-isolated equipment that could cause short-circuiting of isolation.
  - 2. Use elastomeric grommets for attachments where required to prevent short-circuiting of isolation.

3. Adjust isolators to be free of isolation short circuits during normal operation.
4. Do not overtighten fasteners such that resilient material isolator pads are compressed beyond manufacturer's maximum recommended deflection.

3.03 Field Quality Control

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Inspect vibration isolation and/or seismic control components for damage and defects.
- C. Vibration Isolation Systems:
  1. Verify isolator static deflections.
  2. Verify vibration isolation performance during normal operation; investigate sources of isolation short circuits.
- D. Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.

END OF SECTION 220548

SECTION 220553  
IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Stencils.
- D. Pipe markers.
- E. Ceiling tacks.

1.02 RELATED REQUIREMENTS

- A. Section 099123 - Interior Painting: Identification painting.

1.03 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2020.
- B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2017.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide manufacturers catalog literature for each product required.
- C. Manufacturer's Installation Instructions: Indicate special procedures, and installation.

PART 2 PRODUCTS

2.01 PLUMBING COMPONENT IDENTIFICATION GUIDELINE

- A. Nameplates:
  - 1. Control panels, transducers, and other related control equipment products.
  - 2. Pumps, tanks, filters, water treatment devices, and other plumbing equipment products.
- B. Tags:
  - 1. Piping: 3/4 inch (20 mm) diameter and smaller.
  - 2. Instrumentation, relays, gauges, and other related control equipment products.
  - 3. Ceiling tacks placed on lay-in ceiling surface to reference plumbing components.

- C. Pipe Markers: 3/4 inch (20 mm) diameter and higher.

## 2.02 NAMEPLATES

- A. Manufacturers:
  - 1. Brimar Industries, Inc: [www.pipemarker.com/#sle](http://www.pipemarker.com/#sle).
  - 2. Kolbi Pipe Marker Co: [www.kolbipipemarkers.com/#sle](http://www.kolbipipemarkers.com/#sle).
  - 3. Seton Identification Products: [www.seton.com/#sle](http://www.seton.com/#sle).
  - 4. Substitutions: See Section 016000 - Product Requirements.
- B. Description: Laminated piece with up to three lines of text.
  - 1. Letter Color: White.
  - 2. Letter Height: 1/4 inch (6 mm).
  - 3. Nameplate Height: 3/4 inch (19 mm).
  - 4. Nameplate Material:
    - a. Flexible: Vinyl with adhesive backing per ASTM D709.
    - b. Metal: Brass with center-side holes for screw fastening.

## 2.03 TAGS

- A. Manufacturers:
  - 1. Advanced Graphic Engraving: [www.advancedgraphicengraving.com/#sle](http://www.advancedgraphicengraving.com/#sle).
  - 2. Brady Corporation: [www.bradycorp.com/#sle](http://www.bradycorp.com/#sle).
  - 3. Brimar Industries, Inc: [www.pipemarker.com/#sle](http://www.pipemarker.com/#sle).
  - 4. Craftmark Pipe Markers: [www.craftmarkid.com/#sle](http://www.craftmarkid.com/#sle).
  - 5. Kolbi Pipe Marker Co: [www.kolbipipemarkers.com/#sle](http://www.kolbipipemarkers.com/#sle).
  - 6. Seton Identification Products: [www.seton.com/#sle](http://www.seton.com/#sle).
  - 7. Substitutions: See Section 016000 - Product Requirements.
- B. Metal: Brass, 19 gauge 1-1/2 inch (40 mm) in diameter with smooth edges, blank, smooth edges, and corrosion-resistant ball chain. Up to three lines of text.
- C. Piping: 3/4 inch (20 mm) diameter and smaller. Include corrosion resistant chain. Identify service, flow direction, and pressure.

## 2.04 STENCILS

- A. Fluid Service Identification Scheme, ASME A13.1:
  - 1. Compressed Air: White text on blue background.
  - 2. Water; Potable, Cooling, Boiler Feed and Other: White text on green background.

## 2.05 PIPE MARKERS

- A. Manufacturers:
  - 1. Brady Corporation: [www.bradycorp.com/#sle](http://www.bradycorp.com/#sle).
  - 2. Brimar Industries, Inc: [www.pipemarker.com/#sle](http://www.pipemarker.com/#sle).
  - 3. Craftmark Pipe Markers: [www.craftmarkid.com/#sle](http://www.craftmarkid.com/#sle).

4. Kolbi Pipe Marker Co: [www.kolbipipemarkers.com/#sle](http://www.kolbipipemarkers.com/#sle).
5. Seton Identification Products: [www.seton.com/#sle](http://www.seton.com/#sle).
6. Substitutions: See Section 016000 - Product Requirements.

B. Comply with ASME A13.1.

C. Flexible Tape Marker: Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.

D. Identification Scheme, ASME A13.1:

1. Primary: External Pipe Diameter, Uninsulated or Insulated.
  - a. 3/4 to 1-1/4 inches (19 to 32 mm): Use 8 inch (203 mm) field-length with 1/2 inch (13 mm) text height.
  - b. 1-1/2 to 2 inches (38 to 51 mm): Use 8 inch (203 mm) field-length with 3/4 inch (19 mm) text height.
2. Secondary: Color scheme per fluid service.
  - a. Compressed Air: White text on blue background.
  - b. Water; Potable, Cooling, Boiler Feed, and Other: White text on green background.

## 2.06 CEILING TACKS

A. Manufacturers:

1. Craftmark Pipe Markers: [www.craftmarkid.com/#sle](http://www.craftmarkid.com/#sle).
2. Substitutions: See Section 016000 - Product Requirements.

B. Description: Steel with 3/4 inch (20 mm) diameter color coded head.

C. Color code as follows:

1. Plumbing Equipment: Yellow.
2. Plumbing Valves: Green.
3. Heating/Cooling Valves: Blue.

## PART 3 EXECUTION

### 3.01 PREPARATION

A. Degrease and clean surfaces to receive identification products.

### 3.02 INSTALLATION

A. Install tags in clear view and align with axis of piping

B. Install plastic tape pipe marker around pipe in accordance with manufacturer's instructions.

C. Apply ASME A13.1 Pipe Marking Rules:

1. Place pipe marker adjacent to changes in direction.
2. Place pipe marker adjacent each valve port and flange end.
3. Place pipe marker at both sides of floor and wall penetrations.

4. Place pipe marker every 25 to 50 feet (7.6 to 15.2 m) interval of straight run.
- D. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION 220553

SECTION 220719  
PLUMBING PIPING INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Glass fiber insulation.

1.02 RELATED REQUIREMENTS

- A. Section 078400 - Firestopping.

1.03 REFERENCE STANDARDS

- A. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019, with Editorial Revision (2023).
- B. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2019).
- C. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2022a.
- D. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2018).
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- F. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2022a, with Editorial Revision (2023).
- G. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
- C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.05 QUALITY ASSURANCE

- A. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.07 FIELD CONDITIONS

- A. Maintain ambient conditions required by manufacturers of each product.
- B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 GLASS FIBER INSULATION

- A. Manufacturers:
  - 1. CertainTeed Corporation: [www.certainteed.com/#sle](http://www.certainteed.com/#sle).
  - 2. Johns Manville Corporation: [www.jm.com/#sle](http://www.jm.com/#sle).
  - 3. Knauf Insulation; Earthwool 1000 Degree Pipe Insulation: [www.knaufinsulation.com/#sle](http://www.knaufinsulation.com/#sle).
  - 4. Owens Corning Corporation; Fiberglas Pipe Insulation ASJ: [www.ocbuildingspec.com/#sle](http://www.ocbuildingspec.com/#sle).
  - 5. Owens Corning Corporation; VaporWick Pipe Insulation: [www.ocbuildingspec.com/#sle](http://www.ocbuildingspec.com/#sle).
  - 6. Substitutions: See Section 016000 - Product Requirements.
- B. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.
  - 1. K (Ksi) Value: ASTM C177, 0.24 at 75 degrees F (0.035 at 24 degrees C).
  - 2. Maximum Service Temperature: 850 degrees F (454 degrees C).
  - 3. Maximum Moisture Absorption: 0.2 percent by volume.
- C. Vapor Barrier Jacket: White Kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm (0.029 ng/(Pa s m)).
- D. Tie Wire: 0.048 inch (1.22 mm) stainless steel with twisted ends on maximum 12 inch (300 mm) centers.



- E. Vapor Barrier Lap Adhesive: Compatible with insulation.
- F. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

### PART 3 EXECUTION

#### 3.01 EXAMINATION

- A. Verify that piping has been tested before applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

#### 3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with North American Insulation Manufacturers Association (NAIMA) National Insulation Standards.
- C. Exposed Piping: Locate insulation and cover seams in least visible locations.
- D. Glass fiber insulated pipes conveying fluids below ambient temperature:
  - 1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
  - 2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.
- E. For hot piping conveying fluids 140 degrees F (60 degrees C) or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
- F. Glass fiber insulated pipes conveying fluids above ambient temperature:
  - 1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples.
  - 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
- G. Inserts and Shields:
  - 1. Application: Piping 1-1/2 inches (40 mm) diameter or larger.
  - 2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
  - 3. Insert Location: Between support shield and piping and under the finish jacket.
  - 4. Insert Configuration: Minimum 6 inches (150 mm) long, of same thickness and contour as adjoining insulation; may be factory fabricated.
  - 5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
- H. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, see Section 078400.

- I. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet (3 meters) above finished floor): Finish with canvas jacket sized for finish painting.

### 3.03 SCHEDULES

- A. Insulation thickness for all piping shall be equal to or greater than that recommended in the latest edition of ASHRAE Standard 90.1.
- B. Plumbing Systems:
  - 1. Domestic Hot Water Supply:
    - a. Pipe Size Range: Less than 1-1/2 inch nominal
    - 1) Thickness: 1 inch (25 mm)
  - 2. Domestic Cold Water:
    - a. Pipe Size Range: Less than 1-1/2 inch nominal
    - b. Thi: 0.5 inch (13 mm)

END OF SECTION 220719

SECTION 221005  
PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Sanitary waste piping, above grade.
- B. Chemical-resistant sanitary waste piping.
- C. Domestic water piping, above grade.
- D. Natural gas piping, above grade.
- E. Vacuum piping, above grade.
- F. Pipe flanges, unions, and couplings.
- G. Pipe hangers and supports.
- H. Pressure reducing valves.
- I. Pressure relief valves.
- J. Strainers.

1.02 RELATED REQUIREMENTS

- A. Section 220516 - Expansion Fittings and Loops for Plumbing Piping.
- B. Section 220529 - Hangers and Supports for Plumbing Piping and Equipment.
- C. Section 220548 - Vibration and Seismic Controls for Plumbing Piping and Equipment.
- D. Section 220553 - Identification for Plumbing Piping and Equipment.
- E. Section 220719 - Plumbing Piping Insulation.

1.03 REFERENCE STANDARDS

- A. ANSI LC 1/CSA 6.26 - Fuel Gas Piping Systems Using Corrugated Stainless Steel Tubing; 2019.
- B. ANSI Z21.22 - American National Standard for Relief Valves for Hot Water Supply Systems; 2015 (Reaffirmed 2020).
- C. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2021.
- D. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.

- E. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2021.
- F. ASME B31.1 - Power Piping; 2022.
- G. ASME B31.3 - Process Piping; 2022, with Errata (2023).
- H. ASME B31.9 - Building Services Piping; 2020.
- I. ASSE 1003 - Water Pressure Reducing Valves for Potable Water Distribution Systems; 2023.
- J. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2022).
- K. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.
- L. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2023a.
- M. ASTM B32 - Standard Specification for Solder Metal; 2020.
- N. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2022.
- O. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.
- P. ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube; 2016.
- Q. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings; 2023.
- R. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings; 2020a.
- S. ASTM C1277 - Standard Specification for Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings; 2020.
- T. ASTM D2846/D2846M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems; 2019a.
- U. ASTM D2855 - Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets; 2020.
- V. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- W. ASTM F437 - Standard Specification for Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80; 2021.
- X. ASTM F438 - Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40; 2023.

- Y. ASTM F439 - Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80; 2019.
  - Z. ASTM F441/F441M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80; 2023.
  - AA. ASTM F442/F442M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR); 2023.
  - BB. ASTM F493 - Standard Specification for Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings; 2022.
  - CC. ASTM F876 - Standard Specification for Crosslinked Polyethylene (PEX) Tubing; 2024.
  - DD. ASTM F877 - Standard Specification for Crosslinked Polyethylene (PEX) Hot- and Cold-Water Distribution Systems; 2024.
  - EE. ASTM F1960 - Standard Specification for Cold Expansion Fittings with PEX Reinforcing Rings for Use with Cross-Linked Polyethylene (PEX) and Polyethylene of Raised Temperature (PE-RT) Tubing; 2023b.
  - FF. AWWA C606 - Grooved and Shouldered Joints; 2022.
  - GG. AWWA C651 - Disinfecting Water Mains; 2023.
  - HH. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2020.
  - II. IAPMO IGC 361 - Continuous Flexible Self-Plunging Waste Pipes; 2019.
  - JJ. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018, with Amendment (2019).
  - KK. NSF 61 - Drinking Water System Components - Health Effects; 2023, with Errata.
  - LL. NSF 372 - Drinking Water System Components - Lead Content; 2022.
  - MM. PPI TR-4 - PPI HSB Listing of Hydrostatic Design Basis (HDB), Hydrostatic Design Stress (HDS), Strength Design Basis (SDB), Pressure Design Basis (PDB) and Minimum Required Strength (MRS) Ratings for Thermoplastic Piping Materials or Pipe; 2024.
  - NN. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.
- 1.04 QUALITY ASSURANCE
- A. Perform work in accordance with applicable codes.
  - B. Valves: Manufacturer's name and pressure rating marked on valve body.
  - C. Regulatory requirements and approvals: Ensure the piping distribution system complies with all applicable codes and regulations.

- D. Certifications: Provide letters of certification indicating: Installer uses skilled workers holding a trade qualification license or equivalent or apprentices under the supervision of a licensed tradesperson.
- E. Pre-installation meetings:
  - 1. Verify project requirements, excavation conditions, system performance requirements, manufacturer's installation instructions and warranty requirements.
  - 2. Review project construction timeline to ensure compliance or discuss modifications as required.
  - 3. Interface with other trade representatives to verify areas of responsibility.
  - 4. Establish the frequency and construction phase the project engineer intends for site visits and inspections by the tubing manufacturer's representative.
- F. Installer Qualifications for PP-RCT: Installer shall have successfully completed a training course on fusion tool use and connections and carry a current certification or qualification from the fusion tool manufacturer or pipe and fittings manufacturer.
- G. If an approved alternate for piping applications is used, where metallic piping is the basis of design the manufacturer shall submit shop drawings clearly indicating that the design has been modified and approved, as required, to maintain pressure and flow. Any design resulting in reduced system pressure, flow or performance as a result of improper pipe sizing or design shall not be permitted.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. General: Comply with Division 1 Product Requirement Section.
- B. Ordering: Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.
- C. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- D. Storage and protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.
  - 1. Store PEX Do not expose white or blue PEX tubing to direct sunlight for more than one month or red PEX tubing to direct sunlight for more than six months. If construction delays are encountered, cover the tubing to prevent exposure to direct sunlight.
  - 2. Store piping on a flat surface to prevent unwated deformation.

### PART 2 PRODUCTS

#### 2.01 GENERAL REQUIREMENTS

- A. Potable Water Supply Systems: Provide piping, pipe fittings, and solder and flux (if used), that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.
- B. Plenum-Installed Acid Waste Piping: Flame-spread index equal or below 25 and smoke-spread index equal or below 50 according to ASTM E84 or UL 723 tests.

2.02 SANITARY WASTE PIPING, ABOVE GRADE

- A. Continuous Flexible Self-Plunging Waste Pipes: IAPMO IGC 361, provide to connect lavatories and sink tail piece to PVC sanitary waste piping.

2.03 CHEMICAL-RESISTANT SANITARY WASTE PIPING

- A. CPVC Pipe: ASTM D2846/D2846M, ASTM F441/F441M, or ASTM F442/F442M.
  - 1. Fittings: CPVC; ASTM D2846/D2846M, ASTM F437, ASTM F438, or ASTM F439.
  - 2. Joints: ASTM D2846/D2846M, solvent weld with ASTM F493 solvent cement.

2.04 DOMESTIC WATER PIPING, ABOVE GRADE

- A. Copper Pipe: ASTM B88 (ASTM B88M), Type K (A), Drawn (H).
  - 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
  - 2. Joints: ASTM B32, alloy Sn95 solder.
- B. Cross-Linked Polyethylene (PEX) Pipe: ASTM F876 or ASTM F877.
  - 1. PPI TR-4 Pressure Design Basis:
  - 2. Joints: ASTM F1960 cold-expansion fittings.

2.05 NATURAL GAS PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
  - 1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M, wrought steel welding type.
  - 2. Joints: Threaded or welded to ASME B31.1.
- B. Flexible Gas Piping:
  - 1. Corrugated Stainless Steel Tubing: Comply with ANSI LC 1/CSA 6.26.
  - 2. Comply with ASTM E84.
  - 3. Fittings: Provided by piping system manufacturer.
  - 4. Provide piping with integral lightning protection.
  - 5. Manufacturers:
    - a. Omega Flex, Inc; TracPipe CounterStrike: [www.omegaflex.com/#sle](http://www.omegaflex.com/#sle).
    - b. Substitutions: See Section 016000 - Product Requirements.

2.06 VACUUM PIPING, ABOVE GRADE

- A. Aluminum Tube: ASME B31.3, 6063 alloy, T5 temper.
  - 1. Manufacturers:
    - a. Applied System Technologies: [appliedsystemtech.com/#sle](http://appliedsystemtech.com/#sle).
    - b. Prevost Corporation; PPS: [www.prevostusa.com/#sle](http://www.prevostusa.com/#sle).
    - c. Substitutions: See Section 016000 - Product Requirements.
  - 2. Maximum Working Pressure: 230 psi (1585 kPa).
  - 3. Fittings and Joints 2-1/2 inch (65 mm, DN) and Smaller:

- a. Fittings: Comply with ASME B31.1 and ASME B31.3, aluminum or iron.
- b. Joints: Mechanical compression, coupling, push-connect bite ring coupling with stainless steel clamping washer, or threading.
- c. Gasket Material: High nitrile rubber seal suitable for operating temperature range from minus 4 to 176 degrees F (minus 20 to 80 degrees C).

## 2.07 PIPE FLANGES, UNIONS, AND COUPLINGS

- A. Unions for Pipe Sizes 3 inch (80 mm, DN) and Under:
  1. Ferrous Pipe: Class 150 malleable iron threaded unions.
  2. Copper Tube and Pipe: Class 150 bronze unions with soldered joints.
- B. Crosslinked-polyethylene PEX-a pipe: PEX-a to flange transition: Two-piece fitting with one steel flange conforming to ASME B 16.5 and one lead-free (LF) brass adapter conforming to ASTM F1960.
- C. Mechanical Couplings for Grooved and Shouldered Joints: Two or more curved housing segments with continuous key to engage pipe groove, circular C-profile gasket, and bolts to secure and compress gasket.
  1. Dimensions and Testing: In accordance with AWWA C606.
  2. Housing Material: Provide ASTM A47/A47M malleable iron, ductile iron, or \_\_\_\_\_, galvanized.
  3. Gasket Material: EPDM suitable for operating temperature range from minus 30 degrees F (minus 34 degrees C) to 230 degrees F (110 degrees C).
  4. Bolts and Nuts: Hot dipped galvanized or zinc-electroplated steel.
  5. When pipe is field grooved, provide coupling manufacturer's grooving tools.
  6. Manufacturers:
    - a. Anvil International: [www.anvilintl.com/#sle](http://www.anvilintl.com/#sle).
    - b. Apollo Valves: [www.apollovalves.com/#sle](http://www.apollovalves.com/#sle).
    - c. Grinnell Products: [www.grinnell.com/#sle](http://www.grinnell.com/#sle).
    - d. Substitutions: See Section 016000 - Product Requirements.
- D. No-Hub Couplings:
  1. Testing: In accordance with ASTM C1277 and CISPI 310.
  2. Gasket Material: Neoprene complying with ASTM C564.
  3. Band Material: Stainless steel.
  4. Eyelet Material: Stainless steel.
  5. Manufacturers:
    - a. Ideal Clamp Products, Inc; Standard: [www.idealtridon.com//#sle](http://www.idealtridon.com//#sle).
    - b. MIFAB, Inc; MI-QHUB: [www.mifab.com/#sle](http://www.mifab.com/#sle).
    - c. Substitutions: See Section 016000 - Product Requirements.
- E. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

## 2.08 PIPE HANGERS AND SUPPORTS

- A. See Section 220529 for additional requirements.



- B. Provide hangers and supports that comply with MSS SP-58.
  - 1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
  - 2. Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.
  - 3. Trapeze Hangers: Welded steel channel frames attached to structure.
  - 4. Vertical Pipe Support: Steel riser clamp.
- C. Plumbing Piping - Drain, Waste, and Vent:
  - 1. Hangers for Pipe Sizes 1/2 to 1-1/2 inch (15 to 40 mm, DN): Malleable iron, adjustable swivel, split ring.
  - 2. Hangers for Pipe Sizes 2 inch (50 mm, DN) and Over: Carbon steel, adjustable, clevis.
  - 3. Wall Support for Pipe Sizes to 3 inch (80 mm, DN): Cast iron hook.
  - 4. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- D. Plumbing Piping - Water:
  - 1. Hangers for Pipe Sizes 1/2 to 1-1/2 inch (15 to 40 mm, DN): Malleable iron, adjustable swivel, split ring.
  - 2. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

## 2.09 PRESSURE REDUCING VALVES

- A. Manufacturers:
  - 1. Amtrol Inc: [www.amtrol.com/#sle](http://www.amtrol.com/#sle).
  - 2. Apollo Valves: [www.apollovalves.com/#sle](http://www.apollovalves.com/#sle).
  - 3. Cash Acme, a brand of Reliance Worldwide Corporation: [www.cashacme.com/#sle](http://www.cashacme.com/#sle).
  - 4. Cla-Val Company: [www.cla-val.com/#sle](http://www.cla-val.com/#sle).
  - 5. Flomatic Valves: [www.flomatic.com/#sle](http://www.flomatic.com/#sle).
  - 6. Watts Regulator Company: [www.wattsregulator.com/#sle](http://www.wattsregulator.com/#sle).
  - 7. Zurn Industries, LLC; 500XL3: [www.zurn.com/#sle](http://www.zurn.com/#sle).
  - 8. Substitutions: See Section 016000 - Product Requirements.
- B. 2 inch (50 mm, DN) and Smaller:
  - 1. ASSE 1003, bronze body, stainless steel, and thermoplastic internal parts, fabric reinforced diaphragm, strainer, threaded single union ends.
  - 2. Pressure Reducing Pilot-Operator:
    - a. Operating Range: 5 to 50 psi (0.35 to 35 Bar).
    - b. Connected into brass or bronze pilot piping and fittings.
    - c. Fixed flow restrictor, pressure gauges, and isolation valves.

## 2.10 PRESSURE RELIEF VALVES

- A. Manufacturers:
  - 1. Cla-Val Co: [www.cla-val.com/#sle](http://www.cla-val.com/#sle).
  - 2. Watts Regulator Company: [www.wattsregulator.com/#sle](http://www.wattsregulator.com/#sle).
  - 3. Substitutions: See Section 016000 - Product Requirements.

- B. ANSI Z21.22, AGA certified, bronze body, teflon seat, steel stem and springs, automatic, direct pressure actuated.

## 2.11 STRAINERS

- A. Manufacturers:
  - 1. Armstrong International, Inc: [www.armstronginternational.com/#sle](http://www.armstronginternational.com/#sle).
  - 2. Green Country Filter Manufacturing: [www.greencountryfilter.com/#sle](http://www.greencountryfilter.com/#sle).
  - 3. WEAMCO: [www.weamco.com/#sle](http://www.weamco.com/#sle).
  - 4. Substitutions: See Section 016000 - Product Requirements.
- B. Size 1/2 inch (15 mm, DN) to 3 inch (80 mm, DN):
  - 1. Class 150, threaded forged bronze Y-pattern body, stainless steel perforated mesh screen with cap, and rated for 150 psi (1,034 kPa), 250 deg F (121.1 deg C) WOG service.

## PART 3 EXECUTION

### 3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

### 3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- D. Install piping to maintain headroom, conserve space, and not interfere with use of space.
- E. Group piping whenever practical at common elevations.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. See Section 220516.
- G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
  - 1. See Section 220719.
- H. Provide access where valves and fittings are not exposed.
- I. Install valves with stems upright or horizontal, not inverted. See Section 220523.
- J. Install water piping to ASME B31.9.

- K. Copper Pipe and Tube: Make soldered joints in accordance with ASTM B828, using specified solder, and flux meeting ASTM B813; in potable water systems use flux also complying with NSF 61 and NSF 372.
- L. PVC and CPVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.
  - 1. PVC and CPVC shall not be used in air plenums.
- M. Sleeve pipes passing through partitions, walls, and floors.
- N. Pipe Hangers and Supports:
  - 1. Install in accordance with ASME B31.9.
  - 2. Support horizontal piping as indicated.
  - 3. Place hangers within 12 inches (300 mm) of each horizontal elbow.
  - 4. Use hangers with 1-1/2 inch (40 mm) minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
  - 5. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
  - 6. Provide copper plated hangers and supports for copper piping.
  - 7. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
  - 8. Provide hangers adjacent to motor-driven equipment with vibration isolation; see Section 220548.
- O. Pipe Sleeve-Seal Systems:
  - 1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
  - 2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
  - 3. Locate piping in center of sleeve or penetration.
  - 4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
  - 5. Tighten bolting for a watertight seal.
  - 6. Install in accordance with manufacturer's recommendations.
- P. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

### 3.03 APPLICATION

- A. Install unions downstream of valves and at equipment or apparatus connections.
- B. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
- C. Install gate or ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- D. Install globe or ball valves for throttling, bypass, or manual flow control services.
- E. Provide spring-loaded check valves on discharge of water pumps.

- F. Limit Flexible Gas Piping to a maximum length of 24 inches (610 mm) for connections to vibrating equipment.

### 3.04 TOLERANCES

- A. Drainage Piping: Establish invert elevations within 1/2 inch (10 mm) vertically of location indicated and slope to drain at minimum of 1/4 inch per foot (1:50) slope.
- B. Water Piping: Slope at minimum of 1/32 inch per foot (1:400) and arrange to drain at low points.

### 3.05 FIELD TESTS AND INSPECTIONS

- A. Verify and inspect systems according to requirements by the Authority Having Jurisdiction. In the absence of specific test and inspection procedures proceed as indicated below.
- B. Domestic Water Systems:
  - 1. Perform hydrostatic testing for leakage prior to system disinfection.
  - 2. Test Preparation: Close each fixture valve or disconnect and cap each connected fixture.
  - 3. General:
    - a. Fill the system with water and raise static head to 10 psi (345 kPa) above service pressure. Minimum static head of 50 to 150 psi (345 to 1,034 kPa). As an exception, certain codes allow a maximum static pressure of 80 psi (551.6 kPa).
- C. Gas Distribution Systems:
  - 1. Test Preparation: Close each appliance valve or disconnect and cap each connected appliance.
  - 2. General Systems:
    - a. Inject a minimum of 10 psi (68.9 kPa) of compressed air into the piping system for a duration of 15 minutes and verify with a gauge that no perceptible pressure drop is measured.
    - b. Ensure test pressure gauge has a range of twice the specific pressure rate selected with an accuracy of 1/10 of 1 pound (0.45 kg).
- D. Test Results: Document and certify successful results, otherwise repair, document, and retest.

### 3.06 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Prior to starting work, verify system is complete, flushed, and clean.
- B. Ensure acidity (pH) of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).
- C. Inject disinfectant, free chlorine in liquid, powder, tablet, or gas form throughout system to obtain 50 to 80 mg/L residual.
- D. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.
- E. Maintain disinfectant in system for 24 hours.

- F. If final disinfectant residual tests less than 25 mg/L, repeat treatment.
- G. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.
- H. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

### 3.07 SCHEDULES

- A. Pipe Spacing:
  - 1. Copper Piping:
    - a. Pipe Size: 1/2 inch (15 mm, DN) to 1-1/4 inch (32 mm, DN):
      - 1) Maximum Hanger Spacing: ( ).
      - 2) Hanger Rod Diameter: 3/8 inches (9 mm).
    - b. Pipe Size: 1-1/2 inch (40 mm, DN) to 2 inch (50 mm, DN):
      - 1) Maximum Hanger Spacing: 10 ft (3 m).
      - 2) Hanger Rod Diameter: 3/8 inch (9 mm).
  - 2. PVC and CPVC Piping:
    - a. All Pipe Sizes:
      - 1) Maximum Hanger Spacing: 4 ft (1.33 m)
      - 2) Hanger Rod Diameter: 3/8 inch (9 mm).

END OF SECTION 221005

SECTION 221006  
PLUMBING PIPING SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Drains.
- B. Cleanouts.
- C. Backflow preventers.
- D. Water hammer arrestors.
- E. Mixing valves.
- F. Relief valves.
- G. Floor drain trap seals.
- H. Exterior penetration accessories.
- I. Fire-rated enclosures.

1.02 RELATED REQUIREMENTS

- A. Section 016000 - Product Requirements: Procedures for Owner-supplied products.
- B. Section 221005 - Plumbing Piping.
- C. Section 223000 - Plumbing Equipment.
- D. Section 224000 - Plumbing Fixtures.
- E. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

- A. ASSE 1013 - Performance Requirements for Reduced Pressure Principle Backflow Prevention Assemblies; 2021.
- B. NSF 61 - Drinking Water System Components - Health Effects; 2023, with Errata.
- C. NSF 372 - Drinking Water System Components - Lead Content; 2022.
- D. PDI-WH 201 - Water Hammer Arresters; 2017.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.
- C. Manufacturer's Instructions: Indicate Manufacturer's Installation Instructions: Indicate assembly and support requirements.
- D. Project Record Documents: Record actual locations of equipment, cleanouts, backflow preventers, and water hammer arrestors.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept specialties on site in original factory packaging. Inspect for damage.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Specialties in Potable Water Supply Systems: Provide products that comply with NSF 61 and NSF 372 for maximum lead content.

2.02 CLEANOUTS

- A. Manufacturers:
  - 1. Jay R. Smith Manufacturing Company: [www.jrsmith.com/#sle](http://www.jrsmith.com/#sle).
  - 2. Josam Company: [www.josam.com/#sle](http://www.josam.com/#sle).
  - 3. MIFAB, Inc; C1100-R: [www.mifab.com/#sle](http://www.mifab.com/#sle).
  - 4. Zurn Industries, LLC: [www.zurn.com/#sle](http://www.zurn.com/#sle).
  - 5. Substitutions: See Section 016000 - Product Requirements.
- B. Cleanouts at Interior Finished Wall Areas (CO-4):
  - 1. Line type with lacquered cast iron body and round epoxy coated gasketed cover, and round stainless steel access cover secured with machine screw.
- C. Cleanouts at Interior Unfinished Accessible Areas (CO-5): Calked or threaded type. Provide bolted stack cleanouts on vertical rainwater leaders.

2.03 BACKFLOW PREVENTERS

- A. Reduced Pressure Backflow Preventer Assembly:

1. ASSE 1013; cast bronze body and stainless steel springs; two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve that opens under back pressure in case of diaphragm failure, and non-threaded vent outlet.
2. Size: 3/4 to 2 inch (20 to 50 mm, DN) assembly with threaded gate valves.
3. Accessories: Provide air gap fitting, lead-free Y-strainer, and test cocks.

## 2.04 WATER HAMMER ARRESTORS

### A. Manufacturers:

1. Cash Acme, a brand of Reliance Worldwide Corporation: [www.cashacme.com/#sle](http://www.cashacme.com/#sle).
2. Jay R. Smith Manufacturing Company: [www.jrsmith.com/#sle](http://www.jrsmith.com/#sle).
3. Watts Regulator Company, a part of Watts Water Technologies: [www.wattsregulator.com/#sle](http://www.wattsregulator.com/#sle).
4. Zurn Industries, LLC: [www.zurn.com/#sle](http://www.zurn.com/#sle).
5. Substitutions: See Section 016000 - Product Requirements.

### B. Water Hammer Arrestors:

1. Stainless steel construction, bellows type sized in accordance with PDI-WH 201, precharged suitable for operation in temperature range minus 100 to 300 degrees F (minus 73 to 149 degrees C) and maximum 250 psi (1700 kPa) working pressure.

## 2.05 MIXING VALVES

### A. Thermostatic Mixing Valves:

1. Manufacturers:
  - a. Cash Acme, a brand of Reliance Worldwide Corporation: [www.cashacme.com/#sle](http://www.cashacme.com/#sle).
  - b. ESBE: [www.esbe.se/en](http://www.esbe.se/en).
  - c. Honeywell International Inc: [www.honeywellhome.com/#sle](http://www.honeywellhome.com/#sle).
  - d. Leonard Valve Company: [www.leonardvalve.com/#sle](http://www.leonardvalve.com/#sle).
  - e. Substitutions: See Section 016000 - Product Requirements.
2. Valve: Chrome-plated cast brass body, stainless steel or copper alloy bellows, integral temperature adjustment.
3. Accessories:
  - a. Check valve on inlets.
  - b. Volume control shut-off valve on outlet.
  - c. Stem thermometer on outlet.

## 2.06 RELIEF VALVES

### A. Manufacturers:

1. Cash Acme, a brand of Reliance Worldwide Corporation: [www.cashacme.com/#sle](http://www.cashacme.com/#sle).
2. ITT Bell & Gossett: [www.bellgossett.com/#sle](http://www.bellgossett.com/#sle).
3. Substitutions: See Section 016000 - Product Requirements.

### B. Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labelled.



## 2.07 FLOOR DRAIN TRAP SEALS

- A. Manufacturers:
  - 1. Green Drains; GD4: [www.greendrains.com/#sle](http://www.greendrains.com/#sle).
  - 2. MIFAB, Inc; MI-GARD: [www.mifab.com/#sle](http://www.mifab.com/#sle).
  - 3. Substitutions: See Section 016000 - Product Requirements.
- B. Description: Push-fit EPDM or silicone fitting with a one-way membrane.

## 2.08 EXTERIOR PENETRATION ACCESSORIES

- A. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for conduits and facade materials to be installed.
  - 1. Manufacturers:
    - a. Quickflash Weatherproofing Products, Inc: [www.quickflashproducts.com/#sle](http://www.quickflashproducts.com/#sle).
    - b. Substitutions: See Section 016000 - Product Requirements.

## 2.09 FIRE-RATED ENCLOSURES

- A. Manufacturers:
  - 1. Fire Rated Product Specialties Corp: [www.frpsonline.com/#sle](http://www.frpsonline.com/#sle).
  - 2. Substitutions: See Section 016000 - Product Requirements.
- B. Provide as required to preserve fire resistance rating of building elements.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.
- C. Install floor cleanouts at elevation to accommodate finished floor.
- D. Install approved potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibbs.
- E. Pipe relief from backflow preventer to nearest drain.
- F. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to sinks.

END OF SECTION 221006

SECTION 221500  
GENERAL-SERVICE COMPRESSED-AIR SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Pipe and fittings.
- B. Unions and couplings.
- C. Pressure reducing stations.
- D. Air outlets.

1.02 RELATED REQUIREMENTS

- A. Section 220513 - Common Motor Requirements for Plumbing Equipment.
- B. Section 220523 - General-Duty Valves for Plumbing Piping.
- C. Section 220548 - Vibration and Seismic Controls for Plumbing Piping and Equipment.
- D. Section 220553 - Identification for Plumbing Piping and Equipment.
- E. Section 260583 - Wiring Connections.

1.03 REFERENCE STANDARDS

- A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings; 2015 (Reaffirmed 2020).
- B. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.
- C. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2021.
- D. ASME B31.1 - Power Piping; 2022.
- E. ASME B31.3 - Process Piping; 2022, with Errata (2023).
- F. ASTM B32 - Standard Specification for Solder Metal; 2020.
- G. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2022.
- H. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.
- I. NEMA ICS 4 - Application Guideline for Terminal Blocks; 2015.
- J. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

#### 1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide manufacturers catalog literature with capacity, weight, and electrical characteristics and connection requirements.
- C. Shop Drawings: Indicate piping system schematic with electrical characteristics and connection requirements.
- D. Certificates: Provide certificate of compliance from Authority Having Jurisdiction indicating approval of air receiver.
- E. Test Reports: Submit inspector's certificate for air receiver for inclusion in Operating and Maintenance Manuals.
- F. Manufacturer's Instructions: Indicate manufacturer's installation instructions, hoisting and setting requirements, starting procedures.
- G. Operation Data: Submit for air compressor, air receiver, and accessories, aftercooler, refrigerated air dryer, and pressure reducing station.
- H. Maintenance Data: Submit for air compressor, air receiver, and accessories, aftercooler, refrigerated air dryer, and pressure reducing station.
- I. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
- J. Project Record Documents: Record actual locations of equipment and components. Modify shop drawings to indicate final locations.
- K. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 016000 - Product Requirements for additional provisions.
  - 2. Extra Compressor Oil: One container, quart (liter) size.

#### 1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. Pressure Vessels: Comply with applicable code for installation of pressure vessels.
- C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept air compressors, refrigerated air dryer on site in factory-fabricated containers with shipping skids and plastic pipe end protectors in place. Inspect for damage.
- B. Protect piping and equipment from weather and construction traffic.

## 1.07 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Provide five year manufacturer warranty for reciprocating air compressors.

## PART 2 PRODUCTS

### 2.01 PIPE AND FITTINGS

- A. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), drawn.
  - 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
  - 2. Joints: ASTM B32, solder, Grade Sn95.

### 2.02 UNIONS AND COUPLINGS

- A. Unions:
  - 1. Copper Tube and Pipe: 150 psi (1034 kPa) bronze unions with soldered joints.
- B. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.
- C. Flexible Connector: Neoprene with brass threaded connectors.

### 2.03 PRESSURE REDUCING STATIONS

- A. Pressure Reducing Station: Consisting of automatic reducing valve and bypass, and low pressure side relief valve and gauge. Provide oil separator where indicated.
- B. Valve Capacity: Reduce pressure from 200 psi (1379 kPa) to 30 psi (207 kPa), adjustable upwards from reduced pressure.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Install equipment in accordance with manufacturer's instructions.
- B. Install compressor unit on vibration isolators. Level and bolt in place. See Section 220548.
- C. Install line size gate valve and check valve on compressor discharge. See Section 220523.
- D. Connect condensate drains to oil/water separator with discharge. see section 220523
- E. Install valved drip connections at low points of piping system. See Section 220523.
- F. Install takeoffs to outlets from top of main, with shut off valve after takeoff. Slope takeoff piping to outlets.

- G. Install compressed air couplings, female quick connectors, and pressure gauges where outlets are indicated.
- H. Identify piping system and components. See Section 220553.

3.02 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Compressed Air Piping Leak Test: Prior to initial operation, clean and test compressed air piping in accordance with ASME B31.1.
- C. Repair or replace compressed air piping as required to eliminate leaks, and retest to demonstrate compliance.
- D. Cap and seal ends of piping when not connected to mechanical equipment.

END OF SECTION 221500

SECTION 226600  
CHEMICAL-WASTE SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Single-wall piping.
- B. Joints for acid-waste systems.
- C. Traps, drains, and cleanouts.

1.02 RELATED REQUIREMENTS

- A. Section 003100 - Available Project Information.
- B. Section 220529 - Hangers and Supports for Plumbing Piping and Equipment.

1.03 REFERENCE STANDARDS

- A. ASTM D2846/D2846M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems; 2019a.
- B. ASTM F441/F441M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80; 2023.
- C. ASTM F493 - Standard Specification for Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings; 2022.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
- B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.
- C. Scheduling: Coordinate downtime duration to transfer existing service to temporary or replacement system.

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.

1.06 QUALITY ASSURANCE

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

- B. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

#### 1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store piping and specialties with sealing plugs in ends or with end protection.
- B. Do not store plastic pipe or fittings in direct sunlight.
- C. Protect pipe, fittings, and seals from dirt and damage.

#### 1.08 FIELD CONDITIONS

- A. Existing Conditions: See subsurface investigation report; see Section 003100.

#### 1.09 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

### PART 2 PRODUCTS

#### 2.01 SINGLE-WALL PIPE

- A. CPVC (Chlorinated Polyvinyl Chloride) Piping:
  - 1. Manufacturers:
    - a. Aetna Plastics Corp: [www.aetnaplastics.com/#sle](http://www.aetnaplastics.com/#sle).
    - b. GF Piping Systems: [www.gfps.com/#sle](http://www.gfps.com/#sle).
    - c. IPEX USA, LLC: [www.ipexna.com/#sle](http://www.ipexna.com/#sle).
    - d. Substitutions: See Section 016000 - Product Requirements.
  - 2. Fabrication: ASTM F441/F441M, schedule 40 pipe and fittings with minimum cell classification of 24448.
  - 3. Join Method: ASTM D2846/D2846M, solvent weld with ASTM F493 solvent cement.
  - 4. Sizes: 1/2 to 16 inch (15 to 450 DN in mm), schedule 40.
  - 5. Required Pipe Segment Length: 10 feet (3 m).
  - 6. Transition Fittings: Provide combinations of clamps, couplings, adapters, and gaskets; compatible with installed products and service fluids when joining different piping materials.

#### 2.02 JOINTS FOR ACID-WASTE SYSTEMS

- A. Manufacturers:
  - 1. Asahi/America: [www.asahi-america.com/#sle](http://www.asahi-america.com/#sle).
  - 2. GF Piping Systems: [www.gfps.com/#sle](http://www.gfps.com/#sle).
  - 3. Substitutions: See Section 016000 - Product Requirements.
- B. Solvent-Weld Joints:

1. CPVC (Chlorinated Polyvinyl Chloride): ASTM F441/F441M, solvent weld with ASTM F493 solvent cement.
  - a. Solvent cement volatile organic chemical (VOC) indoor emissions are not to exceed 510 grams/L.
- C. Dissimilar Pipe Material Joints: Provide adapters, transition fittings including combination assemblies with clamps, couplings, adapters, gaskets, threaded, flanged, socket, and others.

## 2.03 TRAPS, DRAINS, AND CLEANOUTS

- A. Manufacturers:
  1. Aetna Plastics Corp: [www.aetnaplastics.com/#sle](http://www.aetnaplastics.com/#sle).
  2. IPEX USA, LLC: [www.ipexna.com/#sle](http://www.ipexna.com/#sle).
  3. Substitutions: See Section 016000 - Product Requirements.
- B. Corrosion-Resistant Traps:
  1. Type: P-trap or drum trap.
  2. Size: As indicated on drawings matching inlet and outlet connections.
  3. CPVC: Solvent weld with ASTM F493 solvent cement.
    - a. Solvent cement volatile organic chemical (VOC) indoor emissions are not to exceed 510 grams/L.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Review plans and details to confirm general aboveground and specific belowground location and arrangement of system piping and equipment.
- B. Verify that excavations are to required grade, dry, and not over-excavated.

### 3.02 PREPARATION

- A. Remove scale and dirt, on inside and outside, before assembly.
- B. Prepare piping connections to equipment with flanges or unions.

### 3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions beginning at low point, true to grades and alignment indicated with unbroken continuity of invert.
- B. Group piping whenever practical at common elevations, especially for buried piping.
- C. Drainage Piping: Establish invert elevations within 1/2 inch (10 mm) vertically of location indicated and slope to drain at minimum of 1/4 inch per foot (1:50) slope.
- D. Provide nonconducting dielectric connections wherever jointing dissimilar metals.



- E. Route piping in orderly manner and maintain gradients while running parallel and perpendicular to walls.
- F. Provide sleeves for pipes passing through partitions, walls, and floors.
- G. Provide hangers and supports for aboveground piping according to Section 220529.

3.04 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Carefully inspect and replace installed products found incompatible, crushed, broken, cracked, leaking, or otherwise damaged.

END OF SECTION 226600

SECTION 230130.51  
HVAC AIR-DISTRIBUTION SYSTEM CLEANING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Cleaning of HVAC duct system, equipment, and related components.
- B. Testing and inspection agency employed by Owner.

1.02 RELATED REQUIREMENTS

- A. Section 014000 - Quality Requirements: Additional requirements for testing and inspection agencies.
- B. Section 015719 - Temporary Environmental Controls.
- C. Section 019113 - General Commissioning Requirements: Commissioning requirements that apply to all types of work.

1.03 DEFINITIONS

- A. HVAC System: For purposes of this section, the surfaces to be cleaned include all interior surfaces of the heating, air-conditioning and ventilation system from the points where the air enters the system to the points where the air is discharged from the system, including the inside of air distribution equipment, coils, and condensate drain pans; see NADCA ACR for more details.
  - 1. Above-ceiling plenum for supply air is required to be cleaned.
  - 2. Exhaust-only system is required to be cleaned.

1.04 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- B. NADCA ACR - The NADCA Standard for Assessment, Cleaning, and Restoration of HVAC System; 2021.
- C. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; Current Edition, Including All Revisions.
- D. UL 181A - Closure Systems for Use with Rigid Air Ducts; Current Edition, Including All Revisions.

1.05 QUALITY ASSURANCE

- A. Information Available to Contractor: Upon request, Owner will provide the following:  
iDesign Solutions, LLC 1217-1 | Synergy Consulting Engineers

1. One copy of original construction drawings of HVAC system.
- B. Cleaning Contractor Qualifications: Company specializing in the cleaning and restoration of HVAC systems as specified in this section.
  1. Certified by one of the following:
    - a. NADCA, National Air Duct Cleaners Association: [www.nadca.com](http://www.nadca.com).
  2. Having minimum of three years documented experience.
  3. Employing for this project a supervisor certified as an Air Systems Cleaning Specialist by NADCA.
- C. Testing and Inspection Agency Qualifications: Experienced in inspection and testing using methods defined in NADCA ACR.

## PART 2 PRODUCTS

### 2.01 TOOLS AND EQUIPMENT

- A. Vacuum Devices and Other Tools: Exceptionally clean, in good working order, and sealed when brought into the facility.
- B. Vacuum Devices That Exhaust Air Inside Building, Including Hand-Held and Wet Vacuums: Equipped with HEPA filtration with 99.97 percent collection efficiency for minimum 0.3-micron size particles and DOP test number.
- C. Vacuum Devices That Exhaust Air Outside Building, Including Truck- and Trailer-Mounted Types: Equipped with particulate collection including adequate filtration to contain debris removed from the HVAC system; exhausted in manner that prevents contaminant re-entry to building; compliant with applicable regulations as to outdoor environmental contamination.

### 2.02 REPLACEMENT PRODUCTS

- A. Fibrous Glass Insulation: Provide material complying with UL 181 equivalent to existing material in quality and thickness.

### 2.03 SURFACE TREATMENTS

- A. Anti-Microbial Materials: EPA registered specifically for use on non-porous HVAC system surfaces and applied per manufacturer's instructions.
- B. Surface Coating for Fibrous Glass Materials: Water-based, zero VOC; flame spread index less than 25, smoke developed index less than 450, Class A, when tested in accordance with ASTM E84.

## PART 3 EXECUTION

### 3.01 PROJECT CONDITIONS

- A. Comply with applicable federal, state, and local requirements.

- B. Perform cleaning, inspection, and remediation in accordance with the recommendations of NADCA "Assessment, Cleaning and Restoration of HVAC Systems" (ACR) and as specified herein.
- C. Where NADCA ACR uses the terms "recommended", "highly recommended", or "ideally" in regard to a certain procedure or activity, do that unless it is clearly inapplicable to the project.
- D. Take precautions to prevent introduction of additional hazards into occupied spaces.
- E. Comply with requirements of Section 015719.
- F. Obtain Owner's approval of proposed temporary locations for large equipment.
- G. Designate a decontamination area and obtain Owner's approval.
- H. When portions of the facility are to remain occupied or in operation during cleaning activities, provide adequate controls or containment to prevent access to spaces being cleaned by unauthorized persons and provide detailed instructions to Owner as to these controls or containment.
- I. If unforeseen mold or other biological contamination is encountered, notify Architect immediately, identifying areas affected and extent and type of contamination.

### 3.02 EXAMINATION

- A. Prior to the commencement of any cleaning work, prepare and submit to Architect a project evaluation and plan for this project, including considerations recommended in NADCA ACR.
- B. Coordinate cleaning plan with indoor air quality control plan specified in Section 015719.
- C. Inspect the system as required to determine appropriate methods, tools, equipment, and protection.
- D. Start of cleaning work constitutes acceptance of existing conditions.
- E. When concealed spaces are later made accessible, examine and document interior conditions prior to beginning cleaning.
- F. Document all instances of mold growth, rodent droppings, other biological hazards, and damaged system components.

### 3.03 PREPARATION

- A. When cleaning work might adversely affect life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with authorities having jurisdiction.
- B. Ensure that electrical components that might be adversely affected by cleaning are de-energized, locked out, and protected prior to beginning work.
- C. Prepare written report listing conditions detrimental to the performance of work.

- D. Proceed with work only after unsatisfactory conditions have been corrected.
- E. Air-Volume Control Devices: Mark the original position of dampers and other air-directional mechanical devices inside the HVAC system prior to starting cleaning.
- F. Access to Concealed Spaces: Use existing service openings and make additional service openings as required to accomplish cleaning and inspection.
  - 1. Do not cut openings in non-HVAC components without obtaining the prior approval of Owner.
  - 2. Make new openings in HVAC components in accordance with NADCA Standard 05; do not compromise the structural integrity of the system.
  - 3. Do not cut service openings into flexible duct; disconnect at ends for cleaning and inspection.
- G. Ceiling Tile: Lay-in ceiling tile may be removed to gain access to HVAC systems during the cleaning process; protect tile from damage and reinstall upon completion; replace damaged tile.

### 3.04 CLEANING

- A. Use any cleaning method recommended by NADCA ACR unless otherwise specified; do not use methods prohibited by NADCA ACR, or that will damage HVAC components or other work, or that will significantly alter the integrity of the system.
- B. Obtain Owner's approval before using wet cleaning methods; ensure that drainage is adequate before beginning.
- C. Ducts: Mechanically clean all portions of ducts.
- D. Hoses, Cables, and Extension Rods: Clean using suitable sanitary damp wipes at the time they are being removed or withdrawn from their normal position.
- E. Registers, Diffusers, and Grilles: When removing, take care to prevent containment exposure due to accumulated debris.
- F. Coils: Follow NADCA ACR completely including measuring static pressure drop before and after cleaning; do not remove refrigeration coils from system to clean; report coils that are permanently impacted.
- G. Fibrous Glass Material: Use HEPA vacuuming equipment, under constant negative pressure, do not permit to get wet, and do not damage surfaces; replace material damaged by cleaning operations.
- H. Existing Damaged Fibrous Glass Material: Report to Architect all evidence of damage, deterioration, delaminating, friable material, mold or fungus growth, or moisture that cannot be remedied by cleaning or resurfacing with an acceptable insulation repair coating.
  - 1. Remove unremediable material and clean underlying surfaces.
  - 2. Where surface damage can be repaired by applying a coating, do so at no extra cost to Owner.
  - 3. Replace unremediable material.

- I. Collect debris removed during cleaning; ensure that debris is not dispersed outside the HVAC system during the cleaning process.
- J. Store contaminated tools and equipment in polyethylene bags until cleaned in the designated decontamination area.

### 3.05 DUCT ACCESSORIES 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. Provide 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 duct-mounting access doors where access doors do not currently exist to allow for the cleaning of ducts, accessories, and terminal units as follows:
  - 1. On both sides of duct coils.
  - 2. Downstream from volume dampers, turning vanes, and equipment.
  - 3. Adjacent to fire or smoke dampers; reset or install new fusible links.
  - 4. Before and after each change in direction, at maximum 50-foot (15-m) spacing.
  - 5. On sides of ducts where adequate clearance is available.
- D. Install the following sizes for duct-mounting, rectangular access doors:
  - 1. One-Hand or Inspection Access: 8 by 5 inches (200 by 125 mm).
  - 2. Two-Hand Access: 12 by 6 inches (300 by 150 mm).
  - 3. Head and Hand Access: 18 by 10 inches (460 by 250 mm).
  - 4. Head and Shoulders Access: 21 by 14 inches (530 by 355 mm).
  - 5. Body Access: 25 by 14 inches (635 by 355 mm).
  - 6. Body Plus Ladder Access: 25 by 17 inches (635 by 430 mm).
- E. Install the following sizes for duct-mounting, round access doors:
  - 1. One-Hand or Inspection Access: 8 inches (200 mm) in diameter.
  - 2. Two-Hand Access: 10 inches (250 mm) in diameter.
  - 3. Head and Hand Access: 12 inches (300 mm) in diameter.
  - 4. Head and Shoulders Access: 18 inches (460 mm) in diameter.
  - 5. Body Access: 24 inches (600 mm) in diameter.
- F. Install the following sizes for duct-mounting, pressure relief access doors:
  - 1. One-Hand or Inspection Access: 5 inches (125 mm) in diameter.
  - 2. Two-Hand Access: 10 inches (250 mm) in diameter.
  - 3. Head and Hand Access: 13 inches (330 mm) in diameter.
  - 4. Head and Shoulders Access: 19 inches (480 mm) in diameter.

### 3.06 CONNECTIONS

- A. Reconnect ducts to fans and air-handling units with existing flexible connectors after cleaning ducts and flexible connectors. Replace existing damaged and deteriorated flexible connectors.

- B. For fans developing static pressures of 5-inch wg (1250 Pa) and higher, cover replacement flexible connectors with loaded vinyl sheet held in place with metal straps.
- C. Reconnect terminal units to supply ducts with existing flexible ducts or replace damaged and deteriorated existing flexible ducts with maximum 12-inch (300-mm) lengths of new flexible duct.
- D. Reconnect existing and new flexible ducts to metal ducts.

### 3.07 REPAIR

- A. Repair openings cut in the ventilation system so that they do not significantly alter the airflow or adversely impact the facility's indoor air quality.
- B. At insulated ducts and components, accomplish repairs in such a manner as to achieve the equivalent thermal value.
- C. Reseal new openings in accordance with NADCA Standard 05.
- D. Reseal rigid fiber glass duct systems using closure techniques that comply with UL 181 or UL 181A.
- E. When new openings are intended to be capable of being re-opened in the future, clearly mark them and report their locations to Owner in project report documents.

### 3.08 FIELD QUALITY CONTROL

- A. Ensure that the following field quality control activities are completed prior to application of any treatments or coatings and prior to returning HVAC system to normal operation.
- B. Visually inspect all portions of the cleaned components; if not visibly clean as defined in NADCA ACR, re-clean and reinspect.
- C. Coils: Cleaning must restore the coil pressure drop to within 10 percent of the coil's original installed pressure drop; if original pressure drop is not known, coil will be considered clean if free of foreign matter and chemical residue based on visual inspection.
- D. Notify Architect when cleaned components are ready for inspection.
- E. Notify Owner's testing and inspection agency when cleaned components are ready for inspection.
- F. Owner reserves the right to verify cleanliness using NADCA ACR Surface Comparison Testing or NADCA Vacuum Test.
- G. When directed, re-clean components until they pass.
- H. Contractor shall bear the costs of retesting due to inadequate cleaning.
- I. Submit evidence that all portions of the system required to be cleaned have been cleaned satisfactorily.

3.09 ANTI-MICROBIAL TREATMENT

- A. When directed, apply anti-microbial treatment to internal surfaces.
- B. Apply anti-microbial agent after removal of surface deposits and debris.
- C. Apply anti-microbial treatments and coatings in strict accordance with the manufacturer's written recommendations and EPA registration listing.
- D. Spray coatings directly onto interior ductwork surfaces; do not "fog" into air stream.

3.10 ADJUSTING

- A. After satisfactory completion of field quality control activities, restore adjustable devices to original settings, including, but not limited to, dampers, air directional devices, valves, fuses, and circuit breakers.

3.11 WASTE MANAGEMENT

- A. Double-bag waste and debris in 6 mil, 0.006 inch (0.1524 mm) thick polyethylene plastic bags.
- B. Dispose of debris off-site in accordance with applicable federal, state and local requirements.

END OF SECTION 230130.51



SECTION 230516  
EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Flexible pipe connectors.

1.02 RELATED REQUIREMENTS

- A. Section 232113 - Hydronic Piping.

1.03 REFERENCE STANDARDS

- A. UL (DIR) - Online Certifications Directory; Current Edition.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data:
  - 1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot (meter) and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
- C. Manufacturer's Instructions: Indicate manufacturer's installation instructions, special procedures, and external controls.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Comply with UL (DIR) requirements.

2.02 FLEXIBLE PIPE CONNECTORS - COPPER PIPING

- A. Manufacturers:
  - 1. Mercer Rubber Company: [www.mercer-rubber.com/#sle](http://www.mercer-rubber.com/#sle).
  - 2. The Metraflex Company: [www.metraflex.com/#sle](http://www.metraflex.com/#sle).
  - 3. Unisource Manufacturing, Inc; Series 411, Bronze Braided Flex Connectors: [www.unisource-mfg.com/#sle](http://www.unisource-mfg.com/#sle).
  - 4. Substitutions: See Section 016000 - Product Requirements.
- B. Inner Hose: Bronze.

- C. Exterior Sleeve: Braided bronze.
- D. Pressure Rating: 125 psi up to 2 inch (862 kPa up to 50 mm, DN).
- E. Maximum Service Temperature: 450 degrees F (232 degrees C).
- F. End Connections: As specified for pipe joints.
- G. Size: Use pipe sized units.
- H. Application: Copper piping.

### PART 3 EXECUTION

#### 3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install flexible pipe connectors on pipes connected to vibration isolated equipment. Provide line size flexible connectors.
- C. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.

END OF SECTION 230516

SECTION 230517  
SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Pipe sleeves.
- B. Pipe-sleeve seals.

1.02 RELATED REQUIREMENTS

- A. Section 078400 - Firestopping.

1.03 REFERENCE STANDARDS

- A. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2022a.
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a (Reapproved 2017).

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified this section.
  - 1. Minimum three years experience.
- C. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store sleeve and sleeve seals in shipping containers, with labeling in place.
- B. Provide temporary protective coating on cast iron and steel sleeves if shipped loose.

1.07 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 PIPE SLEEVES

- A. Manufacturers:
  - 1. Flexicraft Industries; Pipe Wall Sleeve: [www.flexicraft.com/#sle](http://www.flexicraft.com/#sle).
  - 2. Substitutions: See Section 016000 - Product Requirements.
- B. Plastic or Sheet Metal: Pipe passing through interior walls, partitions, and floors, unless steel or brass sleeves are specified below.
- C. Clearances:
  - 1. Provide allowance for insulated piping.
  - 2. Wall, Floor, Partitions, and Beam Flanges: 1 inch (25 mm) greater than external pipe diameter.
  - 3. All Rated Openings: Caulked tight with fire stopping material in compliance with ASTM E814 in accordance with Section 078400 to prevent the spread of fire, smoke, and gases.

2.02 PIPE-SLEEVE SEALS

- A. Manufacturers:
  - 1. Advance Products & Systems, LLC; Innerlynx: [www.apsonline.com/#sle](http://www.apsonline.com/#sle).
  - 2. American Polywater Corporation; PGKD Modular Seals: [www.polywater-haufftechnik.com/#sle](http://www.polywater-haufftechnik.com/#sle).
  - 3. Flexicraft Industries; PipeSeal: [www.flexicraft.com/#sle](http://www.flexicraft.com/#sle).
  - 4. Substitutions: See Section 016000 - Product Requirements.
- B. Modular Mechanical Sleeve-Seal:
  - 1. Elastomer-based interlocking links continuously fill annular space between pipe and wall-sleeve, wall or casing opening.
  - 2. Watertight seal between pipe and wall-sleeve, wall or casing opening.
  - 3. Size and select seal component materials in accordance with service requirements.
  - 4. Service Requirements:
  - 5. Glass-reinforced plastic pressure end plates.
- C. Sealing Compounds:
  - 1. Provide packing and sealing compound to fill pipe to sleeve thickness.
  - 2. Combined packing and seal compound is to match partition fire-resistance hourly rating.
- D. Wall Sleeve: Steel material with waterstop collar, and nailer end-caps.

## PART 3 EXECUTION

### 3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and foreign material, from inside and outside, before assembly.

### 3.02 INSTALLATION

- A. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- B. Install piping to conserve building space, to not interfere with use of space and other work.
- C. Install piping and pipe sleeves to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- D. Provide sleeves when penetrating walls and partitions. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.
  - 1. Aboveground Piping:
    - a. Pack solid using mineral fiber in compliance with ASTM C592.
    - b. Fill space with an elastomer caulk to a depth of 0.50 inch (15 mm) where penetrations occur between conditioned and unconditioned spaces.
  - 2. All Rated Openings: Caulk tight with fire stopping material in compliance with ASTM E814 in accordance with Section 078400 to prevent the spread of fire, smoke, and gases.
- E. Manufactured Sleeve-Seal Systems:
  - 1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
  - 2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
  - 3. Locate piping in center of sleeve or penetration.
  - 4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
  - 5. Tighten bolting for a water-tight seal.
  - 6. Install in accordance with manufacturer's recommendations.
- F. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

### 3.03 CLEANING

- A. Upon completion of work, clean all parts of the installation.

- B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

END OF SECTION 230517

SECTION 230519  
METERS AND GAUGES FOR HVAC PIPING

PART 1 GENERAL

SECTION INCLUDES

- A. Test Plugs.

1.01 RELATED REQUIREMENTS

- A. Section 232113 - Hydronic Piping.

1.02 REFERENCE STANDARDS

- A. ASME B40.100 - Pressure Gauges and Gauge Attachments; 2022.
- B. ASME MFC-3M - Measurement of Fluid Flow in Pipes Using Orifice, Nozzle, and Venturi; 2004 (Reaffirmed 2017).
- C. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers; 2014 (Reapproved 2020).
- D. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers; 2014 (Reapproved 2021).
- E. AWWA C700 - Cold-Water Meters -- Displacement Type, Metal Alloy Main Case; 2020.
- F. AWWA C701 - Cold-Water Meters -- Turbine Type, for Customer Service; 2019.
- G. AWWA C702 - Cold-Water Meters -- Compound Type; 2019.
- H. AWWA M6 - Water Meters -- Selection, Installation, Testing, and Maintenance; 2012, with Addendum (2018).
- I. UL 393 - Indicating Pressure Gauges for Fire-Protection Service; Current Edition, Including All Revisions.
- J. UL 404 - Gauges, Indicating Pressure, for Compressed Gas Service; Current Edition, Including All Revisions.

1.03 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: For each type of product indicated; include performance curves.

PART 2 PRODUCTS

2.01 TEST PLUGS

- A. Test Plug: 1/4 inch (6 mm) or 1/2 inch (13 mm) brass fitting and cap for receiving 1/8 inch (3 mm) outside diameter pressure or temperature probe with neoprene core for temperatures up to 200 degrees F (93 degrees C).

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Locate test plugs where indicated.

END OF SECTION 230519



SECTION 230523  
GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

1.02 ABBREVIATIONS AND ACRONYMS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. PTFE: Polytetrafluoroethylene.
- G. RS: Rising stem.
- H. TFE: Tetrafluoroethylene.
- I. WOG: Water, oil, and gas.

1.03 REFERENCE STANDARDS

- A. ASME B1.20.1 - Pipe Threads, General Purpose, Inch; 2013 (Reaffirmed 2018).
- B. ASME B16.10 - Face-to-Face and End-to-End Dimensions of Valves; 2022.
- C. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.
- D. ASME B16.34 - Valves — Flanged, Threaded, and Welding End; 2020.
- E. ASME B31.9 - Building Services Piping; 2020.
- F. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures; 1999 (Reapproved 2022).
- G. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings; 2017.
- H. AWWA C606 - Grooved and Shouldered Joints; 2022.
- I. MSS SP-45 - Drain and Bypass Connections; 2020.
- J. MSS SP-80 - Bronze Gate, Globe, Angle, and Check Valves; 2019.

- K. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010, with Errata .

#### 1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- C. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

#### 1.05 QUALITY ASSURANCE

- A. Manufacturer:
  - 1. Obtain valves for each valve type from single manufacturer.
  - 2. Company must specialize in manufacturing products specified in this section, with not less than three years of documented experience.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Use the following precautions during storage:
  - 1. Maintain valve end protection and protect flanges and specialties from dirt.
    - a. Provide temporary inlet and outlet caps.
    - b. Maintain caps in place until installation.
  - 2. Store valves in shipping containers and maintain in place until installation.
    - a. Store valves indoors in dry environment.
    - b. Store valves off the ground in watertight enclosures when indoor storage is not an option.

### PART 2 PRODUCTS

#### 2.01 APPLICATIONS

- A. Listed pipe sizes shown using nominal pipe sizes (NPS) and nominal diameter (DN).
- B. Provide the following valves for the applications if not indicated on drawings:
  - 1. Throttling (Hydronic): Butterfly, Ball, and Globe
  - 2. Isolation (Shutoff): Ball.
- C. Substitutions of valves with higher CWP classes or WSP ratings for same valve types are permitted when specified CWP ratings or WSP classes are not available.
- D. Heating Hot Water Valves:
  - 1. Size 2 inch (50 mm, DN) and Smaller, Brass and Bronze Valves:
    - a. Threaded ends.
    - b. Ball: Full port, two piece, brass trim.

- c. Swing Check: Bronze disc, Class 125.
- d. Globe: Bronze disc, Class 125.

## 2.02 GENERAL REQUIREMENTS

- A. Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.
- B. Valve Sizes: Match upstream piping unless otherwise indicated.
- C. Valve Actuator Types:
  - 1. Handwheel: Valves other than quarter-turn types.
  - 2. Hand Lever: Quarter-turn valves 6 inch (150 mm, DN) and smaller.
- D. Valves in Insulated Piping: Provide 2 inch (50 mm, DN) stem extensions and the following features:
  - 1. Ball Valves: Extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
  - 2. Butterfly Valves: Extended neck.
  - 3. Memory Stops: Fully adjustable after insulation is installed.
- E. Memory Stops: Fully adjustable after insulation is installed.
- F. Valve-End Connections:
  - 1. Threaded End Valves: ASME B1.20.1.
  - 2. Solder Joint Connections: ASME B16.18.
  - 3. Grooved End Connections: AWWA C606.
- G. General ASME Compliance:
  - 1. Ferrous Valve Dimensions and Design Criteria: ASME B16.10 and ASME B16.34.
  - 2. Building Services Piping Valves: ASME B31.9.
- H. Bronze Valves:
  - 1. Fabricate from dezincification resistant material.
  - 2. Copper alloys containing more than 15 percent zinc are not permitted.
- I. Valve Bypass and Drain Connections: MSS SP-45.
- J. Source Limitations: Obtain each valve type from a single manufacturer.

## 2.03 BRONZE, GLOBE VALVES

- A. CWP Rating: Class 125: 200 psi (1,380 kPa):
  - 1. Comply with MSS SP-80, Type 1.
  - 2. Body: Bronze; ASTM B62, with integral seat and screw in bonnet.
  - 3. Ends: Threaded or solder joint.
  - 4. Stem and Disc: Bronze or PTFE.
  - 5. Packing: Asbestos free.
    - a. Handwheel: Malleable iron.

- b. Manufacturers:
  - 1) Apollo Valves: [www.apollovalves.com/#sle](http://www.apollovalves.com/#sle).
  - 2) Substitutions: See Section 016000 - Product Requirements.

## 2.04 BRONZE, BALL VALVES

- A. General:
  - 1. Fabricate from dezincification resistant material.
  - 2. Copper alloys containing more than 15 percent zinc are not permitted.
- B. Two Piece, Full Port with Bronze or Brass Trim:
  - 1. Comply with MSS SP-110.
  - 2. WSP Rating: 150 psi (1,035 kPa).
  - 3. WOG Rating: 400 psi (2,758 kPa).
  - 4. Body: Forged bronze or dezincified-brass alloy.
  - 5. End Connections: Pipe thread or solder.
  - 6. Seats: PTFE.
  - 7. Stem: Bronze or brass.
  - 8. Ball: Chrome plated brass.
  - 9. Operator: Provide lockable handle and stem extension.
  - 10. Manufacturers:
    - a. Apollo Valves: [www.apollovalves.com/#sle](http://www.apollovalves.com/#sle).
    - b. FNW; X450: [www.fnw.com/#sle](http://www.fnw.com/#sle).
    - c. Jomar Valves, a division of Jomar Group: [www.jomarvalve.com/#sle](http://www.jomarvalve.com/#sle).
    - d. Substitutions: See Section 016000 - Product Requirements.

## 2.05 BRONZE, SWING CHECK VALVES

- A. Class 125:
  - 1. Pressure and Temperature Rating: MSS SP-80, Type 3.
  - 2. Design: Y-pattern, horizontal or vertical flow.
  - 3. WSP Rating: 200 psi (1,380 kPa).
  - 4. Body: Bronze, ASTM B62.
  - 5. End Connections: Threaded or soldered.
  - 6. Disc: Bronze.
  - 7. Manufacturers:
    - a. Apollo Valves: [www.apollovalves.com/#sle](http://www.apollovalves.com/#sle).
    - b. Kitz Corporation of America; #22: [www.kitzus-kca.com/#sle](http://www.kitzus-kca.com/#sle).
    - c. Substitutions: See Section 016000 - Product Requirements.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Discard all packing materials and verify that valve interior, including threads and flanges, are completely clean without signs of damage or degradation that could result in leakage.

- B. Verify valve parts to be fully operational in all positions from closed to fully open.
- C. Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.
- D. Should valve is determined to be defective, replace with new valve.

### 3.02 INSTALLATION

- A. Provide unions or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.
- B. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.
- C. Install check valves where necessary to maintain direction of flow as follows:
  - 1. Swing Check: Install horizontal maintaining hinge pin level.

END OF SECTION 230523

SECTION 230529  
HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

- 1.01 Section Includes
- A. Support and attachment components.
- 1.02 Reference Standards
- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
  - B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
  - C. ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General-Purpose Piping; 2022.
  - D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
  - E. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2022).
  - F. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.
  - G. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures; 1999 (Reapproved 2022).
  - H. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2022.
  - I. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2018a.
  - J. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.
  - K. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
  - L. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2022a, with Editorial Revision (2023).
  - M. FM (AG) - FM Approval Guide; Current Edition.
  - N. MFMA-4 - Metal Framing Standards Publication; 2004.

- O. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018, with Amendment (2019).
- P. UL (DIR) - Online Certifications Directory; Current Edition.
- Q. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.03 Administrative Requirements

- A. Coordination:
  - 1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
  - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
  - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
  - 4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
  - 5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
  - 1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 033000.

1.04 Submittals

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for channel (strut) framing systems, post-installed concrete and masonry anchors, and thermal insulated pipe supports.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.05 Quality Assurance

- A. Comply with applicable building code.

1.06 Delivery, Storage, and Handling

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

## PART 2 PRODUCTS

### 2.01 Support and Attachment Components

#### A. General Requirements:

1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of plumbing work.
2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
4. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
5. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
  - a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
  - b. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
  - c. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

#### B. Prefabricated Trapeze-Framed Metal Strut Systems:

1. Manufacturers:
  - a. ABB Installation Products: [electrification.us.abb.com/#sle](http://electrification.us.abb.com/#sle).
  - b. B-Line, a brand of Eaton Corporation: [www.eaton.com/#sle](http://www.eaton.com/#sle).
  - c. Unistrut, a brand of Atkore International Inc: [www.unistrut.com/#sle](http://www.unistrut.com/#sle).
  - d. Substitutions: See Section 016000 - Product Requirements.
  - e. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. MFMA-4 compliant, pre-fabricated, MSS SP-58 type 59 continuous-slot metal strut channel with associated tracks, fittings, and related accessories.
3. Strut Channel or Bracket Material:
  - a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
4. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch (2.66 mm).
5. Minimum Channel Dimensions: 1-5/8 inch (41 mm) width by 13/16 inch (21 mm) height.
6. Accessories: Provide bracket covers, cable basket clips, cable tray clips, clamps, conduit clamps, fire-retarding brackets, j-hooks, protectors, and vibration dampeners.

#### C. Strut Channels:

1. Manufacturers:
  - a. B-Line, a brand of Eaton Corporation: [www.eaton.com/#sle](http://www.eaton.com/#sle).
  - b. Gripple, Inc; Universal Bracket: [www.gripple.com/#sle](http://www.gripple.com/#sle).
  - c. Unistrut, a brand of Atkore International Inc: [www.unistrut.com/#sle](http://www.unistrut.com/#sle).
  - d. Substitutions: See Section 016000 - Product Requirements.



- e. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
  2. ASTM A653/A653M galvanized steel bracket with clamps for surface mounting of piping or plumbing equipment support.
  3. Channel or Bracket Kits: Include rods, brackets, end-fixed fittings, covers, clips, and other related hardware required to complete sectional trapeze section for piping or other support.
- D. Hanger Rods:
1. Threaded zinc-plated steel unless otherwise indicated.
  2. Minimum Size, Unless Otherwise Indicated or Required:
    - a. Piping up to 1 inch (25 mm, DN): 1/4 inch (6 mm) diameter.
    - b. Piping larger than 1 inch (25 mm, DN): 3/8 inch (10 mm) diameter.
    - c. Trapeze Support for Multiple Pipes: 3/8 inch (10 mm) diameter.
- E. Thermal Insulated Pipe Supports:
1. Manufacturers:
    - a. Buckaroos, Inc: [www.buckaroos.com/#sle](http://www.buckaroos.com/#sle).
    - b. KB Enterprises: [www.snappitz.com/#sle](http://www.snappitz.com/#sle).
    - c. Substitutions: See Section 016000 - Product Requirements.
  2. General Requirements:
    - a. Insulated pipe supports to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
    - b. Surface Burning Characteristics: Flame spread index/smoke developed index of 5/30, maximum, when tested in accordance with ASTM E84 or UL 723.
    - c. Pipe supports to be provided for nominally sized, 1/2 to 30 inch (15 to 750 mm, DN) iron pipes.
    - d. Insulation inserts to consist of rigid polyisocyanurate (urethane) insulation surrounded by a 360 degree, PVC jacketing.
  3. PVC Jacket:
    - a. Pipe insulation protection shields to be provided with a ball bearing hinge and locking seam.
    - b. Moisture Vapor Transmission: 0.0071 perm inch (0.0092 ng/Pa s m), when tested in accordance with ASTM E96/E96M.
    - c. Thickness: 60 mil (1.524 mm).
  4. Pipe insulation protection shields to be provided at the hanger points and guide locations on pipes requiring insulation as indicated on drawings.
- F. Pipe Supports:
1. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
  2. Liquid Temperatures Up To 122 degrees F (50 degrees C):
    - a. Overhead Support: MSS SP-58 Types 1, 3 through 12.
    - b. Support From Below: MSS SP-58 Types 35 through 38.
  3. Operating Temperatures from 122 to 446 degrees F (50 to 230 degrees C):
    - a. Overhead Support: MSS SP-58 Type 1 or 3 through 12, with appropriate saddle of MSS SP-58 Type 40 for insulated pipe.

- b. Roller Support: MSS SP-58 Types 41 or 43 through 46, with appropriate saddle of MSS SP-58 Type 39 for insulated pipe.
- c. Sliding Support: MSS SP-58 Types 35 through 38.

G. Roller Chairs:

- 1. Manufacturers:
  - a. ASC Engineered Solutions: [www.asc-es.com/#sle](http://www.asc-es.com/#sle).
  - b. FNW; 7901: [www.fnw.com/#sle](http://www.fnw.com/#sle).
  - c. Substitutions: See Section 016000 - Product Requirements.
  - d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
- 2. MSS SP-58 type 43 based on required load, nonconductive and corrosion resistant.
- 3. Steel Yoke Type: MSS SP-58 type 44, vertically adjustable, nonconductive, and corrosion resistant.
- 4. Material: Zinc plated ASTM A36/A36M carbon steel or ASTM A47/A47M malleable iron.

H. Beam Clamps:

- 1. Manufacturers:
  - a. FNW; 7201: [www.fnw.com/#sle](http://www.fnw.com/#sle).
  - b. Substitutions: See Section 016000 - Product Requirements.
  - c. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
- 2. MSS SP-58 types 19 through 23, 25 or 27 through 30 based on required load.
- 3. Beam C-Clamp: MSS SP-58 type 23, malleable iron and steel with plain, stainless steel, and zinc finish.
- 4. Small or Junior Beam Clamp: MSS SP-58 type 19, malleable iron with plain finish. For inverted usage provide manufacturer listed size(s).
- 5. Wide Mouth Beam Clamp: MSS SP-58 type 19, malleable iron with plain finish.
- 6. Centerload Beam Clamp with Extension Piece: MSS SP-58 type 30, malleable iron with plain finish.
- 7. FM (AG) and UL (DIR) Approved Beam Clamp: MSS SP-58 type 19, plain finish,
- 8. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.
- 9. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.

I. Pipe Hangers:

- 1. Split Ring Hangers:
  - a. Manufacturers:
    - 1) FNW; 7001: [www.fnw.com/#sle](http://www.fnw.com/#sle).
    - 2) Substitutions: See Section 016000 - Product Requirements.
    - 3) Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
  - b. Provide hinged split ring and yoke roller hanger with epoxy copper or plain finish.
  - c. Material: ASTM A47/A47M malleable iron or ASTM A36/A36M carbon steel.
  - d. Provide hanger rod and nuts of the same type and material for a given pipe run.

- e. Provide coated or plated hangers to isolate steel hangers from dissimilar metal tube or pipe.
- 2. Swivel Ring Hangers, Adjustable:
  - a. Manufacturers:
    - 1) FNW; 7010: [www.fnw.com/#sle](http://www.fnw.com/#sle).
    - 2) Substitutions: See Section 016000 - Product Requirements.
    - 3) Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
  - b. MSS SP-58 Type 10, epoxy-painted, zinc-colored.
  - c. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
  - d. FM (AG) and UL (DIR) listed for specific pipe size runs and loads.
- 3. Clevis Hangers, Adjustable:
  - a. Manufacturers:
    - 1) FNW; 7005: [www.fnw.com/#sle](http://www.fnw.com/#sle).
    - 2) Substitutions: See Section 016000 - Product Requirements.
    - 3) Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
  - b. Copper Tube: MSS SP-58 Type 1, epoxy-plated copper.
  - c. Felt-Lined: MSS SP-58 Type 1, zinc-plated, silicone-free carbon steel.
  - d. Light-Duty: MSS SP-58 Type 1, zinc-colored, epoxy plated.
  - e. Standard-Duty: MSS SP-58 Type 1, zinc-colored, epoxy plated.
  - f. UL (DIR) listed: Pipe sizes 2-1/2 to 8 inch (65 to 200 mm, DN).
- J. Dielectric Barriers: Provide between metallic supports and metallic piping and associated items of dissimilar type; acceptable dielectric barriers include rubber or plastic sheets or coatings attached securely to pipe or item.
- K. Pipe Shields for Insulated Piping:
  - 1. Manufacturers:
    - a. Anvil International: [www.anvilintl.com/#sle](http://www.anvilintl.com/#sle).
    - b. FNW; 7750: [www.fnw.com/#sle](http://www.fnw.com/#sle).
    - c. Substitutions: See Section 016000 - Product Requirements.
    - d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
  - 2. MSS SP-58 Type 40, ASTM A1011/A1011M steel or ASTM A653/A653M carbon steel
  - 3. General Construction and Requirements:
    - a. Surface Burning Characteristics: Comply with ASTM E84 or UL 723.
    - b. Shields Material: UV-resistant polypropylene with glass fill.
    - c. Maximum Insulated Pipe Outer Diameter: 12-5/8 inch (321 mm).
    - d. Minimum Service Temperature: Minus 40 degrees F (Minus 40 degrees C).
    - e. Maximum Service Temperature: 178 degrees F (81 degrees C).
    - f. Pipe shields to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
- L. Anchors and Fasteners:
  - 1. Manufacturers - Mechanical Anchors:

- a. FNW; 7502: [www.fnw.com/#sle](http://www.fnw.com/#sle).
  - b. Hilti, Inc: [www.us.hilti.com/#sle](http://www.us.hilti.com/#sle).
  - c. ITW Red Head, a division of Illinois Tool Works, Inc: [www.itwredhead.com/#sle](http://www.itwredhead.com/#sle).
  - d. Powers Fasteners, Inc: [www.powers.com/#sle](http://www.powers.com/#sle).
  - e. Simpson Strong-Tie Company Inc: [www.strongtie.com/#sle](http://www.strongtie.com/#sle).
  - f. Substitutions: See Section 016000 - Product Requirements.
2. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
  3. Concrete: Use expansion anchors or screw anchors.
  4. Steel: Use beam-ceiling clamps or beam clamps.
  5. Plastic and lead anchors are not permitted.
  6. Powder-actuated fasteners are not permitted.
  7. Hammer-driven anchors and fasteners are not permitted.
- M. Pipe Installation Accessories:
1. Overhead Pipe Supports:
    - a. Manufacturers:
      - 1) HoldRite, a brand of Reliance Worldwide Corporation: [www.holdrite.com/#sle](http://www.holdrite.com/#sle).
      - 2) Substitutions: See Section 016000 - Product Requirements.
      - 3) Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
  2. Plenum Pipe Supports:
    - a. Manufacturers:
      - 1) HoldRite, a brand of Reliance Worldwide Corporation: [www.holdrite.com/#sle](http://www.holdrite.com/#sle).
      - 2) Substitutions: See Section 016000 - Product Requirements.
      - 3) Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

## PART 3 EXECUTION

### 3.01 Examination

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

### 3.02 Installation

- A. Install products in accordance with manufacturer's instructions.
- B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- C. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.

- D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
  - E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
  - F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
  - G. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.
  - H. Equipment Support and Attachment:
    - 1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
    - 2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
    - 3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
    - 4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
  - I. Secure fasteners according to manufacturer's recommended torque settings.
  - J. Remove temporary supports.
- 3.03 Field Quality Control
- A. See Section 014000 - Quality Requirements for additional requirements.
  - B. Inspect support and attachment components for damage and defects.
  - C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
  - D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION 230529

SECTION 230548  
VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 GENERAL

- 1.01 Section Includes
  - A. Vibration isolation requirements.
  - B. Vibration isolators.
- 1.02 Related Requirements
  - A. Section 033000 - Cast-in-Place Concrete.
  - B. Section 230529 - Hangers and Supports for HVAC Piping and Equipment.
- 1.03 Reference Standards
  - A. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications; Most Recent Edition Cited by Referring Code or Reference Standard.
- 1.04 Administrative Requirements
  - A. Coordination:
    - 1. Coordinate selection and arrangement of vibration isolation and/or seismic control components with the actual equipment to be installed.
    - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
    - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
    - 4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
  - B. Sequencing:
    - 1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 033000.
- 1.05 Submittals
  - A. See Section 013000 - Administrative Requirements for submittal procedures.
  - B. Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including materials, fabrication details, dimensions, and finishes.
    - 1. Vibration Isolators: Include rated load capacities and deflections; include information on color coding or other identification methods for spring element load capacities.

1.06 Quality Assurance

- A. Comply with applicable building code.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

1.07 Delivery, Storage, and Handling

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 Vibration Isolation Requirements

- A. Design and provide vibration isolation systems to reduce vibration transmission to supporting structure from vibration-producing HVAC equipment and/or HVAC connections to vibration-isolated equipment.
- B. Comply with applicable general recommendations of ASHRAE (HVACA), where not in conflict with other specified requirements:
- C. General Requirements:
  - 1. Select vibration isolators to provide required static deflection.
  - 2. Select vibration isolators for uniform deflection based on distributed operating weight of actual installed equipment.
- D. Piping Isolation:
  - 1. Provide vibration isolators for piping supports:
    - a. Located within 50 feet (15.2 m) of connected vibration-isolated equipment and pressure-regulating valve (PRV) stations.
  - 2. Minimum Static Deflection:
    - a. First Three Supports Closest to Isolated Equipment: Same as static deflection of equipment; maximum of 2 inch (50 mm) deflection required.
    - b. Remainder of Supports: 0.75 inch (19 mm) deflection unless otherwise indicated.
  - 3. Suspended Piping, Nonseismic Applications: Use resilient material isolator hangers, spring isolator hangers, or combination resilient material/spring isolator hangers.

2.02 Vibration Isolators

- A. General Requirements:
  - 1. Resilient Materials for Vibration Isolators: Oil, ozone, and oxidant resistant.

2.03 Acoustical and Vibration Isolators

- A. Manufacturers:
  - 1. Acoustical and Vibration Isolators:
    - a. HoldRite, a brand of Reliance Worldwide Corporation: [www.holdrite.com/#sle](http://www.holdrite.com/#sle).

- b. Substitutions: See Section 016000 - Product Requirements.
- 2. Source Limitations: Furnish isolators and associated accessories produced by a single manufacturer and obtained from a single supplier.

B. General Requirements:

- 1. Acoustical Isolation System: Through-stud isolators, pipe clamps, riser clamp pads, neoprene and felt lining material and associated support brackets.

### PART 3 EXECUTION

#### 3.01 Examination

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that mounting surfaces are ready to receive vibration isolation and/or seismic control components and associated attachments.
- C. Verify that conditions are satisfactory for installation prior to starting work.

#### 3.02 Installation

- A. Install products in accordance with manufacturer's instructions.
- B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- C. Secure fasteners according to manufacturer's recommended torque settings.
- D. Install flexible piping connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.
- E. Vibration Isolation Systems:
  - 1. Isolator Hangers:
    - a. Use precompressed isolator hangers where required to facilitate installation and prevent damage to equipment utility connection provisions.
    - b. Locate isolator hangers at top of hanger rods in accordance with manufacturer's instructions.
  - 2. Clean debris from beneath vibration-isolated equipment that could cause short-circuiting of isolation.
  - 3. Use elastomeric grommets for attachments where required to prevent short-circuiting of isolation.
  - 4. Adjust isolators to be free of isolation short circuits during normal operation.
  - 5. Do not overtighten fasteners such that resilient material isolator pads are compressed beyond manufacturer's maximum recommended deflection.

#### 3.03 Field Quality Control

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Inspect vibration isolation and/or seismic control components for damage and defects.



- C. Vibration Isolation Systems:
  - 1. Verify isolator static deflections.
  - 2. Verify vibration isolation performance during normal operation; investigate sources of isolation short circuits.
  
- D. Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.

END OF SECTION 230548

SECTION 230553  
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Adhesive-backed duct markers.
- D. Pipe markers.
- E. Ceiling tacks.

1.02 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2020.
- B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2017.

1.03 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- C. Product Data: Provide manufacturers catalog literature for each product required.
- D. Manufacturer's Installation Instructions: Indicate special procedures, and installation.

PART 2 PRODUCTS

2.01 IDENTIFICATION APPLICATIONS

- A. Air Terminal Units: Tags.
- B. Automatic Controls: Tags. Key to control schematic.
- C. Control Panels: Nameplates.
- D. Dampers: Ceiling tacks, where located above lay-in ceiling.
- E. Ductwork: Adhesive-backed duct markers.
- F. Piping: Pipe markers.

- G. Valves: Tags and ceiling tacks where located above lay-in ceiling.

## 2.02 NAMEPLATES

- A. Manufacturers:
  - 1. Advanced Graphic Engraving, LLC: [www.advancedgraphicengraving.com/#sle](http://www.advancedgraphicengraving.com/#sle).
  - 2. Brimar Industries, Inc: [www.pipemarker.com/#sle](http://www.pipemarker.com/#sle).
  - 3. Craftmark Pipe Markers: [www.craftmarkid.com/#sle](http://www.craftmarkid.com/#sle).
  - 4. Kolbi Pipe Marker Co: [www.kolbipipemarkers.com/#sle](http://www.kolbipipemarkers.com/#sle).
  - 5. Seton Identification Products, a Tricor Direct Company: [www.seton.com/#sle](http://www.seton.com/#sle).
  - 6. Substitutions: See Section 016000 - Product Requirements.
- B. Letter Color: White.
- C. Letter Height: 1/4 inch (6 mm).
- D. Background Color: Black.
- E. Plastic: Comply with ASTM D709.

## 2.03 TAGS

- A. Manufacturers:
  - 1. Advanced Graphic Engraving: [www.advancedgraphicengraving.com/#sle](http://www.advancedgraphicengraving.com/#sle).
  - 2. Brady Corporation: [www.bradycorp.com/#sle](http://www.bradycorp.com/#sle).
  - 3. Brimar Industries, Inc: [www.pipemarker.com/#sle](http://www.pipemarker.com/#sle).
  - 4. Craftmark Pipe Markers: [www.craftmarkid.com/#sle](http://www.craftmarkid.com/#sle).
  - 5. Kolbi Pipe Marker Co: [www.kolbipipemarkers.com/#sle](http://www.kolbipipemarkers.com/#sle).
  - 6. Seton Identification Products, a Tricor Company: [www.seton.com/#sle](http://www.seton.com/#sle).
- B. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch (40 mm) diameter with smooth edges.

## 2.04 ADHESIVE-BACKED DUCT MARKERS

- A. Manufacturers:
  - 1. Brimar Industries, Inc: [www.pipemarker.com/#sle](http://www.pipemarker.com/#sle).
  - 2. Craftmark Pipe Markers: [www.craftmarkid.com/#sle](http://www.craftmarkid.com/#sle).
  - 3. Kolbi Pipe Marker Co: [www.kolbipipemarkers.com/#sle](http://www.kolbipipemarkers.com/#sle).
  - 4. Substitutions: See Section 016000 - Product Requirements.
- B. Material: High gloss acrylic adhesive-backed vinyl film 0.0032 inch (0.76 mm); printed with UV and chemical resistant inks.
- C. Style: Individual Label.
- D. Color: Green/White.

## 2.05 PIPE MARKERS

- A. Manufacturers:
  - 1. Brady Corporation: [www.bradycorp.com/#sle](http://www.bradycorp.com/#sle).
  - 2. Brimar Industries, Inc: [www.pipemarker.com/#sle](http://www.pipemarker.com/#sle).
  - 3. Craftmark Pipe Markers: [www.craftmarkid.com/#sle](http://www.craftmarkid.com/#sle).
  - 4. Kolbi Pipe Marker Co: [www.kolbipipemarkers.com/#sle](http://www.kolbipipemarkers.com/#sle).
  - 5. Seton Identification Products, a Tricor Company: [www.seton.com/#sle](http://www.seton.com/#sle).
  - 6. Substitutions: See Section 016000 - Product Requirements.
- B. Color: Comply with ASME A13.1.
- C. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- D. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.

## 2.06 CEILING TACKS

- A. Manufacturers:
  - 1. Craftmark Pipe Markers: [www.craftmarkid.com/#sle](http://www.craftmarkid.com/#sle).
  - 2. Substitutions: See Section 016000 - Product Requirements.
- B. Description: Steel with 3/4 inch (20 mm) diameter color coded head.
- C. Color code as follows:
  - 1. HVAC Equipment: Yellow.
  - 2. Fire Dampers and Smoke Dampers: Red.
  - 3. Heating/Cooling Valves: Blue.

## PART 3 EXECUTION

### 3.01 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

### 3.02 INSTALLATION

- A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags with corrosion resistant chain.
- C. Install plastic pipe markers in accordance with manufacturer's instructions.
- D. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

- E. Use tags on piping 3/4 inch (20 mm) diameter and smaller.
  - 1. Install in clear view and align with axis of piping.
  - 2. Locate identification not to exceed 20 feet (6 m) on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.
  
- F. Install ductwork with Adhesive-backed duct markers. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.
  
- G. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION 230553

SECTION 230593  
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Testing, adjustment, and balancing of air systems.
- B. Testing, adjustment, and balancing of hydronic systems.
- C. Field quality-control testing of Laboratory fume hoods.
- D. Measurement of final operating condition of HVAC systems.
- E. Commissioning activities.

1.02 RELATED REQUIREMENTS

Section 014000 - Quality Requirements: Employment of testing agency and payment for services.

- A. Section 019113 - General Commissioning Requirements: Commissioning requirements that apply to all types of work.
- B. Section 230800 - Commissioning of HVAC.

1.03 REFERENCE STANDARDS

- A. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems; 2008, with Errata (2019).

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.

TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.

1. Submit to the Commissioning Authority.
2. Include certification that the plan developer has reviewed Contract Documents, the equipment and systems, and the control system with the Architect and other installers to sufficiently understand the design intent for each system.
3. Include at least the following in the plan:
  - a. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
  - b. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.

- c. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
  - d. Final test report forms to be used.
  - e. Details of how TOTAL flow will be determined; for example:
    - 1) Air: Sum of terminal flows via control system calibrated readings or via hood readings of all terminals, supply (SA) and return air (RA) pitot traverse, SA or RA flow stations.
    - 2) Water: Pump curves, circuit setter, flow station, ultrasonic, etc.
  - f. Method of checking building static and exhaust fan and/or relief damper capacity.
  - g. Time schedule for TAB work to be done in phases (by floor, etc.).
  - h. Exhaust fan balancing and capacity verifications, including any required room pressure differentials.
  - i. Procedures for formal deficiency reports, including scope, frequency and distribution.
- B. Field Quality-control Testing of Laboratory Fume Hoods:
- 1. Product Data sheets for all equipment proposed for use in on-site as-installed testing.
  - 2. Sample Test Report.
  - 3. List of laboratory fume hoods to be tested. Submit a minimum of one week prior to commencement of testing.
  - 4. Test data demonstrating that each type of fume hood provided for the project has been successfully tested in the factory as per requirements of Section 115313.
- C. Field Logs: Submit at least twice a week to the Commissioning Authority.
- D. Control System Coordination Reports: Communicate in writing to the controls installer all setpoint and parameter changes made or problems and discrepancies identified during TAB that affect, or could affect, the control system setup and operation.
- E. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
- 1. Submit under provisions of Section 014000.
  - 2. Revise TAB plan to reflect actual procedures and submit as part of final report.
  - 3. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect and for inclusion in operating and maintenance manuals.
  - 4. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
  - 5. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
  - 6. Units of Measure: Report data in both I-P (inch-pound) and SI (metric) units.
  - 7. Include the following on the title page of each report:
    - a. Name of Testing, Adjusting, and Balancing Agency.
    - b. Address of Testing, Adjusting, and Balancing Agency.
    - c. Telephone number of Testing, Adjusting, and Balancing Agency.
    - d. Project name.
    - e. Project location.
    - f. Project Contractor.
    - g. Report date.

- F. Project Record Documents: Record actual locations of flow measuring stations and balancing valves and rough setting.

## PART 2 PRODUCTS - NOT USED

## PART 3 EXECUTION

### 3.01 GENERAL REQUIREMENTS

- A. Perform total system balance in accordance with one of the following:
- B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.
- C. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.
- D. TAB Agency Qualifications:
  - 1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
  - 2. Having minimum of three years documented experience.
  - 3. Certified by one of the following:
    - a. AABC, Associated Air Balance Council: [www.aabc.com/#sle](http://www.aabc.com/#sle); upon completion submit AABC National Performance Guaranty.
    - b. NEBB, National Environmental Balancing Bureau: [www.nebb.org/#sle](http://www.nebb.org/#sle).
- E. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

### 3.02 EXAMINATION

- A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
  - 1. Systems are started and operating in a safe and normal condition.
  - 2. Temperature control systems are installed complete and operable.
  - 3. Proper thermal overload protection is in place for electrical equipment.
  - 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
  - 5. Duct systems are clean of debris.
  - 6. Fans are rotating correctly.
  - 7. Fire and volume dampers are in place and open.
  - 8. Air coil fins are cleaned and combed.
  - 9. Access doors are closed and duct end caps are in place.
  - 10. Air outlets are installed and connected.
  - 11. Duct system leakage is minimized.
  - 12. Hydronic systems are flushed, filled, and vented.



13. Pumps are rotating correctly.
14. Proper strainer baskets are clean and in place.
15. Service and balance valves are open.

- B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.
- C. Beginning of work means acceptance of existing conditions.

### 3.03 PREPARATION

- A. Hold a pre-balancing meeting at least one week prior to starting TAB work.
- B. Provide additional balancing devices as required.

### 3.04 ADJUSTMENT TOLERANCES

- A. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.
- B. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

### 3.05 RECORDING AND ADJUSTING

- A. Field Logs: Maintain written logs including:
  1. Running log of events and issues.
  2. Discrepancies, deficient or uncompleted work by others.
  3. Contract interpretation requests.
  4. Lists of completed tests.
- B. Ensure recorded data represents actual measured or observed conditions.
- C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- D. Mark on drawings the locations where traverse and other critical measurements were taken and cross reference the location in the final report.
- E. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

### 3.06 FUME HOOD TESTING (ON SITE)

- A. General: Test fume hoods as installed to assess airflow velocity, airflow visualization, and level of containment. Perform tests with static mode (set sash position) conditions. Conduct testing as outlined below for 100% of the hoods provided in the Project.

- B. Testing to be performed by firm certified by National Environmental Balancing Bureau - NEBB (FHT).
- C. Preparation: Visit the project site to confirm that construction activities related to the fume hood system(s) and equipment are complete. Review design documents and Contractor's submittals. Verify that mechanical ventilation systems serving the space are functioning and operating in the normal mode. Notify Owner in writing, if conditions exist which preclude proper fume hood testing. Starting of testing constitutes acceptance of site conditions.
- D. Testing Requirements:
  - 1. Perform the following tests, in order:
    - a. Airflow Velocity Test.
    - b. Airflow Visualization Test.
    - c. Tracer Gas Containment Test.
  - 2. If more than one test procedure is selected, proceed to the next test only if any unsafe condition discovered during current test has been successfully rectified.
  - 3. Airflow Velocity Test: Comply with Section 9 of NEBB (FHT) Fume Hood Testing Standard - current edition.
  - 4. Airflow Visualization Test: Comply with Section 10 of NEBB (FHT) Fume Hood Testing Standard - current edition.
  - 5. Tracer Gas Containment Test:
    - a. Comply with Section 11 of NEBB Fume Hood Testing Standard - current edition.
  - 6. Reporting Requirements: Comply with Section 5 of NEBB (FHT) Fume Hood Testing Standard - current edition. Organize and include, at a minimum, the following information:
    - a. Report Title.
    - b. Report Certification.
    - c. Table of Contents.
    - d. Report Summary/ Remarks.
    - e. Appropriate Forms.
    - f. Instrument Calibration.
    - g. List of Abbreviations Used.
    - h. A room layout drawing for each tested item. Identify: walls; doors; fume hood(s); other present environmental enclosures (e.g. biological safety cabinet(s), laminar flow hood(s), canopy hood(s), etc.); location and airflow pattern of all air supply, return, and exhaust grilles, registers and diffusers.

### 3.07 AIR SYSTEM PROCEDURE

- A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities.
- B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
- C. Measure air quantities at air inlets and outlets.

- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
- E. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.
- F. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.
- G. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.
- H. For variable air volume system powered units set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.

### 3.08 WATER SYSTEM PROCEDURE

- A. Adjust water systems to provide required or design quantities.
- B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.
- C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
- D. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.
- E. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

### 3.09 COMMISSIONING

- A. See Sections 019113 - General Commissioning Requirements and 230800 for additional requirements.
- B. Perform prerequisites prior to starting commissioning activities.
- C. Fill out Prefunctional Checklists for:
  - 1. Air side systems.
  - 2. Water side systems.
- D. Furnish to the Commissioning Authority, upon request, any data gathered but not shown in the final TAB report.

- E. Re-check a random sample equivalent to 25 percent of the final TAB report data as directed by Commissioning Authority.
1. Original TAB agency shall execute the re-checks, witnessed by the Commissioning Authority.
  2. Use the same test instruments as used in the original TAB work.
  3. Failure of more than 10 percent of the re-checked items of a given system shall result in the rejection of the system TAB report; rebalance the system, provide a new system TAB report, and repeat random re-checks.
  4. For purposes of re-check, failure is defined as follows:
    - a. Air Flow of Supply and Return: Deviation of more than 10 percent of instrument reading.
    - b. Minimum Outside Air Flow: Deviation of more than 20 percent of instrument reading; for inlet vane or VFD OSA compensation system using linear proportional control, deviation of more than 30 percent at intermediate supply flow.
    - c. Temperatures: Deviation of more than one degree F (0.5 degree C).
    - d. Air and Water Pressures: Deviation of more than 10 percent of full scale of test instrument reading.
    - e. Sound Pressures: Deviation of more than 3 decibels, with consideration for variations in background noise.
  5. For purposes of re-check, a whole system is defined as one in which inaccuracies will have little or no impact on connected systems; for example, the air distribution system served by one air handler or the hydronic chilled water supply system served by a chiller or the condenser water system.
- F. In the presence of the Commissioning Authority, verify that:
1. Final settings of all valves, splitters, dampers and other adjustment devices have been permanently marked.
  2. The air system is being controlled to the lowest possible static pressure while still meeting design loads, less diversity; this shall include a review of TAB methods, established control setpoints, and physical verification of at least one leg from fan to diffuser having all balancing dampers wide open and that during full cooling of all terminal units taking off downstream of the static pressure sensor, the terminal unit on the critical leg has its damper 90 percent or more open.
  3. The water system is being controlled to the lowest possible pressure while still meeting design loads, less diversity; this shall include a review of TAB methods, established control setpoints, and physical verification of at least one leg from the pump to the coil having all balancing valves wide open and that during full cooling the cooling coil valve of that leg is 90 percent or more open.

### 3.10 SCOPE

- A. Test, adjust, and balance the following:
1. Air Coils.
  2. Air Handling Units.
  3. Fans.
  4. Air Terminal Units.

5. Air Inlets and Outlets.

3.11 MINIMUM DATA TO BE REPORTED

A. Electric Motors:

1. Manufacturer.
2. Model/Frame.
3. HP/BHP.
4. Phase, voltage, amperage; nameplate, actual, no load.
5. RPM.
6. Service factor.
7. Starter size, rating, heater elements.
8. Sheave Make/Size/Bore.

B. V-Belt Drives:

1. Identification/location.
2. Required driven RPM.
3. Driven sheave, diameter and RPM.
4. Belt, size and quantity.
5. Motor sheave diameter and RPM.
6. Center to center distance, maximum, minimum, and actual.

C. Heating Coils:

1. Identification/number.
2. Location.
3. Service.
4. Manufacturer.
5. Air flow, design and actual.
6. Water flow, design and actual.
7. Water pressure drop, design and actual.
8. Entering water temperature, design and actual.
9. Leaving water temperature, design and actual.
10. Entering air temperature, design and actual.
11. Leaving air temperature, design and actual.
12. Air pressure drop, design and actual.

D. Exhaust Fans:

1. Location.
2. Manufacturer.
3. Model number.
4. Serial number.
5. Air flow, specified and actual.
6. Total static pressure (total external), specified and actual.
7. Inlet pressure.
8. Discharge pressure.
9. Sheave Make/Size/Bore.
10. Number of Belts/Make/Size.
11. Fan RPM.

- E. Duct Leak Tests:
  - 1. Description of ductwork under test.
  - 2. Duct design operating pressure.
  - 3. Duct design test static pressure.
  - 4. Maximum allowable leakage duct capacity times leak factor.
  - 5. Test static pressure.
  - 6. Leakage.
  
- F. Terminal Unit Data:
  - 1. Manufacturer.
  - 2. Type, constant, variable, single, dual duct.
  - 3. Identification/number.
  - 4. Location.
  - 5. Model number.
  - 6. Size.
  - 7. Minimum design air flow.
  - 8. Maximum design air flow.
  - 9. Maximum actual air flow.
  - 10. Inlet static pressure.
  
- G. Air Distribution Tests:
  - 1. Air terminal number.
  - 2. Room number/location.
  - 3. Terminal type.
  - 4. Terminal size.
  - 5. Area factor.
  - 6. Design air flow.
  - 7. Test (final) air flow.

END OF SECTION 230593

SECTION 230713  
DUCT INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Duct insulation.
- B. Jacketing and accessories.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

- A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
- B. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013 (Reapproved 2019).
- C. ASTM C1423 - Standard Guide for Selecting Jacketing Materials for Thermal Insulation; 2021.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- E. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2022a, with Editorial Revision (2023).
- F. SAE AMS3779 - Tape, Adhesive, Pressure-Sensitive Thermal Radiation Resistant, Aluminum Coated Glass Cloth; 2016b.
- G. UL 181A - Closure Systems for Use with Rigid Air Ducts; Current Edition, Including All Revisions.
- H. UL 181B - Closure Systems for Use with Flexible Air Ducts and Air Connectors; Current Edition, Including All Revisions.
- I. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

- C. Manufacturer's Instructions: Indicate installation procedures necessary to ensure acceptable workmanship and that installation standards will be achieved.

#### 1.05 QUALITY ASSURANCE

- A. Applicator Qualifications: Company specializing in performing the type of work specified in this section, documented experience and approved by manufacturer.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.
- B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

#### 1.07 FIELD CONDITIONS

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- B. Maintain temperature during and after installation for minimum period of 24 hours.

### PART 2 PRODUCTS

#### 2.01 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

#### 2.02 GLASS FIBER, FLEXIBLE

- A. Manufacturer:
  1. CertainTeed Corporation: [www.certainteed.com/#sle](http://www.certainteed.com/#sle).
  2. Johns Manville: [www.jm.com/#sle](http://www.jm.com/#sle).
  3. JP Lamborn Co; Thermal Sleeve MT: [www.jpflex.com/#sle](http://www.jpflex.com/#sle).
  4. Knauf Insulation; Atmosphere Duct Wrap: [www.knaufinsulation.com/#sle](http://www.knaufinsulation.com/#sle).
  5. Owens Corning Corporation: [www.ocbuildingspec.com/#sle](http://www.ocbuildingspec.com/#sle).
- B. Insulation: ASTM C553; flexible, noncombustible blanket.
  1. K (Ksi) value: 0.36 at 75 degrees F (0.052 at 24 degrees C), when tested in accordance with ASTM C518.
  2. Maximum Service Temperature: 1,200 degrees F (649 degrees C).
  3. Maximum Water Vapor Absorption: 5.0 percent by weight.
- C. Vapor Barrier Jacket:
  1. Kraft paper with glass fiber yarn and bonded to aluminized film.



2. Moisture Vapor Permeability: 0.02 perm inch (0.029 ng/(Pa s m)), when tested in accordance with ASTM E96/E96M.
  3. Secure with pressure-sensitive tape.
- D. Vapor Barrier Tape:
1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure-sensitive rubber-based adhesive.
- E. Indoor Vapor Barrier Mastic:
1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

## 2.03 JACKETING AND ACCESSORIES

- A. Reinforced Tape:
1. Manufacturers:
    - a. Ideal Tape Co., Inc: [www.idealtape.com/#sle](http://www.idealtape.com/#sle).
    - b. Substitutions: See Section 016000 - Product Requirements.
  2. FSK tape suitable for sealing seams between insulation, insulated elbows, and fittings resulting in a tight, smooth surface without wrinkles.
  3. Comply with UL 723 or ASTM E84.
  4. Moisture Vapor Permeability: 0.00 perm inch (0.00 ng/(Pa s m)), when tested in accordance with ASTM E96/E96M.
  5. Finish: Match insulation.
- B. Plain Foil Tape:
1. Manufacturers:
    - a. Ideal Tape Co., Inc: [www.idealtape.com/#sle](http://www.idealtape.com/#sle).
    - b. Substitutions: See Section 016000 - Product Requirements.
  2. Aluminum foil with pressure-sensitive adhesive on paper release liner.
  3. Finish: Plain foil.
- C. UL181 Tape for Rigid and Flexible Ductwork:
1. Manufacturers:
    - a. Ideal Tape Co., Inc: [www.idealtape.com/#sle](http://www.idealtape.com/#sle).
    - b. Substitutions: See Section 016000 - Product Requirements.
  2. Comply with UL 181A for rigid ductwork.
  3. Comply with UL 181B for flexible ductwork.
  4. Aluminum foil coated with pressure-sensitive adhesive on paper release liner.
  5. Foil tape suitable for sealing seams between insulation, insulated elbows, and fittings resulting in a tight, smooth surface without wrinkles.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Test ductwork for design pressure prior to applying insulation materials.
- B. Verify that surfaces are clean, foreign material removed, and dry.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Insulated Ducts Conveying Air Below Ambient Temperature:
  - 1. Provide insulation with vapor barrier jackets.
  - 2. Finish with tape and vapor barrier jacket.
  - 3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
  - 4. Insulate entire system, including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.

3.03 SCHEDULES

- A. Supply Ducts: Minimum R-3.5 1-1/2 inches (38 mm) thick.

END OF SECTION 230713

SECTION 230719  
HVAC PIPING INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Piping insulation.

1.02 RELATED REQUIREMENTS

- A. Section 078400 - Firestopping.
- B. Section 232113 - Hydronic Piping: Placement of hangers and hanger inserts.

1.03 REFERENCE STANDARDS

- A. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2019.
- B. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019, with Editorial Revision (2023).
- C. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2019).
- D. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2022a.
- E. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2018).
- F. ASTM D610 - Standard Practice for Evaluating Degree of Rusting on Painted Steel Surfaces; 2008 (Reapproved 2019).
- G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- H. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2022a, with Editorial Revision (2023).
- I. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

- C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

#### 1.05 QUALITY ASSURANCE

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

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

#### 1.07 FIELD CONDITIONS

- A. Maintain ambient conditions required by manufacturers of each product.
- B. Maintain temperature before, during, and after installation for minimum of 24 hours.

### PART 2 PRODUCTS

#### 2.01 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

#### 2.02 GLASS FIBER, RIGID

- A. Manufacturers:
  1. CertainTeed Corporation: [www.certainteed.com/#sle](http://www.certainteed.com/#sle).
  2. Johns Manville Corporation: [www.jm.com/#sle](http://www.jm.com/#sle).
  3. Knauf Insulation; Earthwool 1000 Degree Pipe Insulation: [www.knaufinsulation.com/#sle](http://www.knaufinsulation.com/#sle).
  4. Owens Corning Corporation; Fiberglas Pipe Insulation ASJ: [www.ocbuildingspec.com/#sle](http://www.ocbuildingspec.com/#sle).
  5. Owens Corning Corporation; VaporWick Pipe Insulation: [www.ocbuildingspec.com/#sle](http://www.ocbuildingspec.com/#sle).
  6. Substitutions: See Section 016000 - Product Requirements.
- B. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.
  1. K (Ksi) Value: ASTM C177, 0.24 at 75 degrees F (0.035 at 24 degrees C).
  2. Maximum Service Temperature: 850 degrees F (454 degrees C).
  3. Maximum Moisture Absorption: 0.2 percent by volume.

- C. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible, with wicking material to transport condensed water to the outside of the system for evaporation to the atmosphere.
  - 1. K (Ksi) Value: ASTM C177, 0.23 at 75 degrees F (0.034 at 24 degrees C).
  - 2. Maximum Service Temperature: 220 degrees F (104 degrees C).
  - 3. Maximum Moisture Absorption: 0.2 percent by volume.
- D. Vapor Barrier Jacket: White kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches (0.029 ng/(Pa s m)).
- E. Tie Wire: 0.048 inch (1.22 mm) stainless steel with twisted ends on maximum 12 inch (300 mm) centers.
- F. Vapor Barrier Lap Adhesive: Compatible with insulation.
- G. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

## 2.03 ACCESSORIES

- A. General Requirements:
  - 1. Provide required accessories in accordance with and subject to the recommendations of the insulation manufacturer.
  - 2. Furnish compatible materials which do not contribute to corrosion, soften, or otherwise attack surfaces to which applied, in either the wet or dry state.
  - 3. Comply with ASTM C795 requirements for materials to be used on stainless steel surfaces.
  - 4. Supply materials that are asbestos free.
- B. Corrosion Inhibitors:
  - 1. Corrosion Control Gel:
    - a. Manufacturers:
      - 1) Polyguard Products; RG2400LT: [www.polyguardproducts.com/#sle](http://www.polyguardproducts.com/#sle).
      - 2) Substitutions: See Section 016000 - Product Requirements.
    - b. Corrosion Protection: Comply with ASTM B117 and ASTM D610.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Test piping for design pressure, liquid tightness, and continuity prior to applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

### 3.02 INSTALLATION

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

- B. Install in accordance with NAIMA National Insulation Standards.
- C. For hot piping conveying fluids over 140 degrees F (60 degrees C), insulate flanges and unions at equipment.
- D. Inserts and Shields:
  - 1. Application: Piping 1-1/2 inches (40 mm) diameter or larger.
  - 2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
  - 3. Insert location: Between support shield and piping and under the finish jacket.
  - 4. Insert Configuration: Minimum 6 inches (150 mm) long, of same thickness and contour as adjoining insulation; may be factory fabricated.
  - 5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
- E. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, see Section 078400.

### 3.03 SCHEDULE

- A. Heating Systems:
  - 1. Heating Water Supply and Return:
    - a. Pipe Size Range: Less than 1-1/2 inch nominal:
      - 1) Thickness: 1.5 inch (38 mm)

END OF SECTION 230719

SECTION 230800  
COMMISSIONING OF HVAC

PART 1 GENERAL

1.01 SUMMARY

- A. See Section 019113 - General Commissioning Requirements for overall objectives; comply with the requirements of Section 019113.
- B. This section covers the Contractor's responsibilities for commissioning; each subcontractor or installer responsible for the installation of a particular system or equipment item to be commissioned is responsible for the commissioning activities relating to that system or equipment item.
- C. The Commissioning Authority (CA) directs and coordinates all commissioning activities and provides Prefunctional Checklists and Functional Test Procedures for Contractor's use.
- D. The following HVAC equipment is to be commissioned, including commissioning activities for the following specific items:
  - 1. Control system.
  - 2. Terminal units.
  - 3. Special Ventilation:
    - a. Fume hoods.
    - b. Laboratory pressurization.
  - 4. Other equipment and systems explicitly identified elsewhere in Contract Documents as requiring commissioning.
- E. The Prefunctional Checklist and Functional Test requirements specified in this section are in addition to, not a substitute for, inspection or testing specified in other sections.

1.02 RELATED REQUIREMENTS

- A. Section 230593 - Testing, Adjusting, and Balancing for HVAC.
- B. Section 230913 - Instrumentation and Control Devices for HVAC.

1.03 REFERENCE STANDARDS

- A. ASHRAE Guideline 1.1 - HVAC&R Technical Requirements for the Commissioning Process; 2007, with Errata (2012).

1.04 SUBMITTALS

- A. Updated Submittals: Keep the Commissioning Authority informed of all changes to control system documentation made during programming and setup; revise and resubmit when substantial changes are made.

- B. Draft Prefunctional Checklists and Functional Test Procedures for Control System: Detailed written plan indicating the procedures to be followed to test, checkout and adjust the control system prior to full system Functional Testing; include at least the following for each type of equipment controlled:
1. System name.
  2. List of devices.
  3. Step-by-step procedures for testing each controller after installation, including:
    - a. Process of verifying proper hardware and wiring installation.
    - b. Process of downloading programs to local controllers and verifying that they are addressed correctly.
    - c. Process of performing operational checks of each controlled component.
    - d. Plan and process for calibrating valve and damper actuators and all sensors.
    - e. Description of the expected field adjustments for transmitters, controllers and control actuators should control responses fall outside of expected values.
  4. Copy of proposed log and field checkout sheets to be used to document the process; include space for initial and final read values during calibration of each point and space to specifically indicate when a sensor or controller has “passed” and is operating within the contract parameters.
  5. Description of the instrumentation required for testing.
  6. Indicate what tests on what systems should be completed prior to TAB using the control system for TAB work. Coordinate with the Commissioning Authority and TAB contractor for this determination.
- C. Startup Reports, Prefunctional Checklists, and Trend Logs: Submit for approval of Commissioning Authority.
- D. HVAC Control System O&M Manual Requirements. In addition to documentation specified elsewhere, compile and organize at minimum the following data on the control system:
1. Specific step-by-step instructions on how to perform and apply all functions, features, modes, etc. mentioned in the controls training sections of this specification and other features of this system. Provide an index and clear table of contents. Include the detailed technical manual for programming and customizing control loops and algorithms.
  2. Full as-built set of control drawings.
  3. Full as-built sequence of operations for each piece of equipment.
  4. Full points list; in addition to the information on the original points list submittal, include a listing of all rooms with the following information for each room:
    - a. Floor.
    - b. Room number.
    - c. Room name.
    - d. Air handler unit ID.
    - e. Reference drawing number.
    - f. Air terminal unit tag ID.
    - g. Heating and/or cooling valve tag ID.
    - h. Minimum air flow rate.
    - i. Maximum air flow rate.
  5. Full print out of all schedules and set points after testing and acceptance of the system.
  6. Full as-built print out of software program.



7. Electronic copy on disk of the entire program for this facility.
  8. Marking of all system sensors and thermostats on the as-built floor plan and HVAC drawings with their control system designations.
  9. Maintenance instructions, including sensor calibration requirements and methods by sensor type, etc.
  10. Control equipment component submittals, parts lists, etc.
  11. Warranty requirements.
  12. Copies of all checkout tests and calibrations performed by the Contractor (not commissioning tests).
  13. Organize and subdivide the manual with permanently labeled tabs for each of the following data in the given order:
    - a. Sequences of operation.
    - b. Control drawings.
    - c. Points lists.
    - d. Controller and/or module data.
    - e. Thermostats and timers.
    - f. Sensors and DP switches.
    - g. Valves and valve actuators.
    - h. Dampers and damper actuators.
    - i. Program setups (software program printouts).
- E. Project Record Documents: See Section 017800 for additional requirements.
1. Submit updated version of control system documentation, for inclusion with operation and maintenance data.
  2. Show actual locations of all static and differential pressure sensors (air, water and building pressure) and air-flow stations on project record drawings.
- F. Draft Training Plan: In addition to requirements specified in Section 017900, include:
1. Follow the recommendations of ASHRAE Guideline 1.1.
  2. Control system manufacturer's recommended training.
  3. Demonstration and instruction on function and overrides of any local packaged controls not controlled by the HVAC control system.
- G. Training Manuals: See Section 017900 for additional requirements.
1. Provide three extra copies of the controls training manuals in a separate manual from the O&M manuals.

## PART 2 PRODUCTS

### 2.01 TEST EQUIPMENT

- A. Provide all standard testing equipment required to perform startup and initial checkout and required functional performance testing; unless otherwise noted such testing equipment will NOT become the property of Owner.
- B. Equipment-Specific Tools: Where special testing equipment, tools and instruments are specific to a piece of equipment, are only available from the vendor, and are required in order to accomplish startup or Functional Testing, provide such equipment, tools, and instruments as

part of the work at no extra cost to Owner; such equipment, tools, and instruments are to become the property of Owner.

### PART 3 EXECUTION

#### 3.01 PREPARATION

- A. Cooperate with the Commissioning Authority in development of the Prefunctional Checklists and Functional Test Procedures.
- B. Furnish additional information requested by the Commissioning Authority.
- C. Prepare a preliminary schedule for HVAC pipe and duct system testing, flushing and cleaning, equipment start-up and testing, adjusting, and balancing start and completion for use by the Commissioning Authority; update the schedule as appropriate.
- D. Notify the Commissioning Authority when pipe and duct system testing, flushing, cleaning, startup of each piece of equipment and testing, adjusting, and balancing will occur; when commissioning activities not yet performed or not yet scheduled will delay construction notify ahead of time and be proactive in seeing that the Commissioning Authority has the scheduling information needed to efficiently execute the commissioning process.
- E. Put all HVAC equipment and systems into operation and continue operation during each working day of testing, adjusting, and balancing and commissioning, as required.
- F. Provide test holes in ducts and plenums where directed to allow air measurements and air balancing; close with an approved plug.
- G. Provide temperature and pressure taps in accordance with Contract Documents.
  - 1. Provide a pressure/temperature plug at each water sensor that is an input point to the control system.

#### 3.02 INSPECTING AND TESTING - GENERAL

- A. Submit startup plans, startup reports, and Prefunctional Checklists for each item of equipment or other assembly to be commissioned.
- B. Perform the Functional Tests directed by the Commissioning Authority for each item of equipment or other assembly to be commissioned.
- C. Provide two-way radios for use during the testing.
- D. Valve/Damper Stroke Setup and Check:
  - 1. For all valve/damper actuator positions checked, verify the actual position against the control system readout.
  - 2. Set pump/fan to normal operating mode.
  - 3. Command valve/damper closed; visually verify that valve/damper is closed and adjust output zero signal as required.
  - 4. Command valve/damper open; verify position is full open and adjust output signal as required.
  - 5. Command valve/damper to a few intermediate positions.

6. If actual valve/damper position does not reasonably correspond, replace actuator or add pilot positioner (for pneumatics).
7. Closure for Heating Coil Valves - Normally Open:
  - a. Set heating setpoint 20 degrees F (11 degrees C) above room temperature.
  - b. Observe valve open.
  - c. Remove control air or power from the valve and verify that the valve stem and actuator position do not change.
  - d. Restore to normal.
  - e. Set heating setpoint to 20 degrees F (11 degrees C) below room temperature.
  - f. Observe the valve close.
  - g. Restore to normal.
- E. Coil Valve Leak Check:
  1. Method 1 - Water Temperature With 2-Way Valve:
    - a. Calibrate water temperature sensors on each side of coil to be within 0.2 degree F (0.1 degree C ) of each other.
    - b. Turn off air handler fans, close outside air dampers. Keep pump running. Make sure appropriate coil dampers are open.
    - c. Normally closed valves will close.
    - d. Override normally open valves to the closed position.
    - e. After 10 minutes observe water delta T across coil. If it is greater than 2 degrees F ( (one degree C ), leakage is probably occurring.
    - f. Reset valve stroke to close tighter.
    - g. Repeat test until compliance is achieved.
- F. Isolation Valve or System Valve Leak Check: For valves not by coils.
  1. With full pressure in the system, command valve closed.
  2. Use an ultra-sonic flow meter to detect flow or leakage.
- G. Deficiencies: Correct deficiencies and re-inspect or re-test, as applicable, at no extra cost to Owner.

### 3.03 TAB COORDINATION

- A. TAB: Testing, adjusting, and balancing of HVAC.
- B. Coordinate commissioning schedule with TAB schedule.
- C. Review the TAB plan to determine the capabilities of the control system toward completing TAB.
- D. Provide all necessary unique instruments and instruct the TAB technicians in their use; such as handheld control system interface for setting terminal unit boxes, etc.
- E. Have all required Prefunctional Checklists, calibrations, startup and component Functional Tests of the system completed and approved by the Commissioning Authority prior to starting TAB.
- F. Provide a qualified control system technician to operate the controls to assist the TAB technicians or provide sufficient training for the TAB technicians to operate the system without

assistance.

### 3.04 CONTROL SYSTEM FUNCTIONAL TESTING

- A. Prefunctional Checklists for control system components will require a signed and dated certification that all system programming is complete as required to accomplish the requirements of Contract Documents and the detailed Sequences of Operation documentation submittal.
- B. Do not start Functional Testing until all controlled components have themselves been successfully Functionally Tested in accordance with Contract Documents.
- C. Using a skilled technician who is familiar with this building, execute the Functional Testing of the control system as required by the Commissioning Authority.
- D. Functional Testing of the control system constitutes demonstration and trend logging of control points monitored by the control system.
  - 1. The scope of trend logging is partially specified; trend log up to 50 percent more points than specified at no extra cost to Owner.
  - 2. Perform all trend logging specified in Prefunctional Checklists and Functional Test procedures.
- E. Functionally Test integral or stand-alone controls in conjunction with the Functional Tests of the equipment they are attached to, including any interlocks with other equipment or systems; further testing during control system Functional Test is not required unless specifically indicated below.
- F. Demonstrate the following to the Commissioning Authority during testing of controlled equipment; coordinate with commissioning of equipment.
  - 1. Setpoint changing features and functions.
  - 2. Sensor calibrations.
- G. Demonstrate to the Commissioning Authority:
  - 1. That all specified functions and features are set up, debugged and fully operable.
  - 2. That scheduling features are fully functional and setup, including holidays.
  - 3. That all graphic screens and value readouts are completed.
  - 4. Correct date and time setting in central computer.
  - 5. That field panels read the same time as the central computer; sample 10 percent of field panels; if any of those fail, sample another 10 percent; if any of those fail test all remaining units at no extra cost to Owner.
  - 6. Functionality of field panels using local operator keypads and local ports (plug-ins) using portable computer/keypad; demonstrate 100 percent of panels and 10 percent of ports; if any ports fail, sample another 10 percent; if any of those fail, test all remaining units at no extra cost to Owner.
  - 7. Power failure and battery backup and power-up restart functions.
  - 8. Global commands features.
  - 9. Security and access codes.
  - 10. Occupant over-rides (manual, telephone, key, keypad, etc.).
  - 11. O&M schedules and alarms.
  - 12. Occupancy sensors and controls.

13. All control strategies and sequences not tested during controlled equipment testing.
14. Trend logging and graphing features that are specified.

H. If the control system, integral control components, or related equipment do not respond to changing conditions and parameters appropriately as expected, as specified and according to acceptable operating practice, under any of the conditions, sequences, or modes tested, correct all systems, equipment, components, and software required at no additional cost to Owner.

### 3.05 OPERATION AND MAINTENANCE MANUALS

- A. See Section 017800 for additional requirements.
- B. Add design intent documentation furnished by Architect to manuals prior to submission to Owner.
- C. Submit manuals related to items that were commissioned to Commissioning Authority for review; make changes recommended by Commissioning Authority.
- D. Commissioning Authority will add commissioning records to manuals after submission to Owner.

### 3.06 DEMONSTRATION AND TRAINING

- A. See Section 017900 for additional requirements.
- B. Demonstrate operation and maintenance of HVAC system to Owner' personnel; if during any demonstration, the system fails to perform in accordance with the information included in the O&M manual, stop demonstration, repair or adjust, and repeat demonstration. Demonstrations may be combined with training sessions if appropriate.
- C. These demonstrations are in addition to, and not a substitute for, Prefunctional Checklists and demonstrations to the Commissioning Authority during Functional Testing.
- D. Provide classroom and hands-on training of Owner's designated personnel on operation and maintenance of the HVAC system, control system, and all equipment items indicated to be commissioned.
- E. TAB Review: Instruct Owner's personnel for minimum two hours, after completion of TAB, on the following:
  1. Review final TAB report, explaining the layout and meanings of each data type.
  2. Discuss any outstanding deficient items in control, ducting or design that may affect the proper delivery of air or water.
  3. Identify and discuss any terminal units, duct runs, diffusers, coils, fans and pumps that are close to or are not meeting their design capacity.
  4. Discuss any temporary settings and steps to finalize them for any areas that are not finished.
  5. Other salient information that may be useful for facility operations, relative to TAB.
- F. HVAC Control System Training: Perform training in at least three phases:
  1. Phase 1 - Basic Control System: Provide minimum of 4 hours of actual training on the control system itself. Upon completion of training, each attendee, using appropriate

documentation, should be able to perform elementary operations and describe general hardware architecture and functionality of the system.

- a. This training may be held on-site or at the manufacturer's facility.
  - b. If held off-site, the training may occur prior to final completion of the system installation.
  - c. For off-site training, Contractor shall pay expenses of up to two attendees.
2. Phase 2 - Integrating with HVAC Systems: Provide minimum of 8 hours of on-site, hands-on training after completion of Functional Testing. Include instruction on:
- a. The specific hardware configuration of installed systems in this facility and specific instruction for operating the installed system, including interfaces with other systems, if any.
  - b. Security levels, alarms, system start-up, shut-down, power outage and restart routines, changing setpoints and alarms and other typical changed parameters, overrides, freeze protection, manual operation of equipment, optional control strategies that can be considered, energy savings strategies and set points that if changed will adversely affect energy consumption, energy accounting, procedures for obtaining vendor assistance, etc.
  - c. Trend logging and monitoring features (values, change of state, totalization, etc.), including setting up, executing, downloading, viewing both tabular and graphically and printing trends; provide practice in setting up trend logging and monitoring during training session.
  - d. Every display screen, allowing time for questions.
  - e. Graphics generation.
  - f. Point database entry and modifications.
3. Phase 3 - Post-Occupancy: Six months after occupancy conduct minimum of four hours of training. Tailor training session to questions and topics solicited beforehand from Owner. Also be prepared to address topics brought up and answer questions concerning operation of the system.
- G. Provide the services of manufacturer representatives to assist instructors where necessary.
- H. Provide the services of the HVAC controls instructor at other training sessions, when requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.

END OF SECTION 230800

SECTION 230913  
INSTRUMENTATION AND CONTROL DEVICES FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Control panels.
- B. Control Valves:
  - 1. Ball valves and actuators.
- C. HVAC&R Sensors:
  - 1. Temperature sensors.
  - 2. Humidity sensors.
- D. Sensors with transmitters:
  - 1. Pressure transmitters.
  - 2. Room pressure monitor.
  - 3. Temperature transmitters.
  - 4. Humidity transmitters.

1.02 RELATED REQUIREMENTS

- A. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.
- B. Section 262726 - Wiring Devices: Elevation of exposed components.

1.03 REFERENCE STANDARDS

- A. ANSI/FCI 70-2 - Control Valve Seat Leakage; 2021.
- B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.

1.04 ADMINISTRATIVE REQUIREMENTS

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

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide description and engineering data for each control system component. Include sizing as requested. Provide data for each system component and software module.
- C. Project Record Documents: Record actual location of control components, including panels, thermostats, and sensors.

- D. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 016000 - Product Requirements for additional provisions.
  - 2. Extra Thermostats and Other Exposed Sensors: One of each type.

#### 1.06 QUALITY ASSURANCE

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

#### 1.07 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Correct defective work within a five year period after Substantial Completion.

### PART 2 PRODUCTS

#### 2.01 EQUIPMENT - GENERAL

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

#### 2.02 CONTROL PANELS

- A. NEMA 250, general purpose utility enclosures with enameled finished face panel.
- B. Provide common keying for all panels.

#### 2.03 CONTROL VALVES

- A. Ball Valves and Actuators:
  - 1. Manufacturers:
    - a. Belimo Aircontrols (USA), Inc: [www.belimo.com/#sle](http://www.belimo.com/#sle).
    - b. Johnson Controls International, PLC: [www.johnsoncontrols.com/#sle](http://www.johnsoncontrols.com/#sle).
    - c. KMC Controls: [www.kmcccontrols.com/#sle](http://www.kmcccontrols.com/#sle).
    - d. Schneider Electric: [www.schneider-electric.us/#sle](http://www.schneider-electric.us/#sle).
    - e. Substitutions: See Section 016000 - Product Requirements.
  - 2. Service: Use for hot water.
  - 3. Flow Characteristic: Include 2-way operation configured to fail normally open (NO).
  - 4. Replacements in Kind: Provide pressure-independent type.
  - 5. Rangeability: 500 to 1.
  - 6. ANSI Rating: Class 150.



7. Leakage: Class IV (0.1 percent of rated capacity) per ANSI/FCI 70-2.
8. Body Size:
  - a. Under 2-1/2 inches (64 mm):
    - 1) Connection: NPT.
    - 2) Materials:
      - a) Body: Brass.
      - b) Flanges: Ductile iron.
      - c) Ball: Chrome-plated brass.
      - d) Stem: Nickel-plated brass.
      - e) Seat: Graphite-reinforced PTFE with EPDM O-Ring backing.
      - f) Stem Seal: EPDM O-Rings.
      - g) Flow Control Disk: Thermoplastic synthetic-resin.
  - b. Service Temperature:
    - 1) Fluid Side: 0 to 284 degrees F (0 to 140 degrees C) liquid or 25 psig (172.4 kPa) steam.
    - 2) Ambient Side: From minus 4 to 122 degrees F (minus 20 to 50 degrees C).
9. Actuator Requirements:
  - a. Assembly: Factory-mounted.
  - b. Input: 0 to 5 VDC configured for proportional control.
  - c. Accessories: Provide with valve position indicator and manual override.

## 2.04 HVAC&R SENSORS

### A. Temperature Sensors:

1. Manufacturers:
  - a. Veris Industries: [www.veris.com/#sle](http://www.veris.com/#sle).
  - b. Automation Components, Inc.; [www.workaci.com/#sle](http://www.workaci.com/#sle).
  - c. Johnson Controls International, PLC; [www.johnsoncontrols.com/#sle](http://www.johnsoncontrols.com/#sle).
  - d. Honeywell, Inc.; <https://buildings.honeywell.com/us/en/brands/our-brands/bms>
  - e. Substitutions: See Section 016000 - Product Requirements.
2. Use thermistor or RTD type temperature sensing elements with characteristics resistant to moisture, vibration, and other conditions consistent with the application without affecting accuracy and life expectancy.
3. Construct RTD of nickel or platinum with base resistance of 1000 ohms at 70 degrees F (26 degrees C).
4. 100 ohm platinum RTD is acceptable if used with project DDC controllers.
5. Temperature Sensing Device: Compatible with project DDC controllers.
6. Performance Characteristics:
  - a. RTD:
    - 1) Room Sensor Accuracy: Plus/minus 0.50 degrees F (0.28 degrees C) minimum.
    - 2) Duct Averaging Accuracy: Plus/minus 0.50 degrees F (0.28 degrees C) minimum.
    - 3) All Other Accuracy: Plus/minus 0.75 degrees F (0.42 degrees C) minimum.
    - 4) Range: Minus 40 degrees F (Minus 40 degrees C) through 220 degrees F (104.4 degrees C) minimum.
  - b. Thermistor:

- 1) Accuracy (All): Plus/minus 0.36 degrees F (0.20 degrees C) minimum.
  - 2) Range: Minus 25 degrees F (Minus 13 degrees C) through 122 degrees F (50 degrees C) minimum.
  - 3) Heat Dissipation Constant: 2.7 mW per degree C.
  - c. Temperature Transmitter:
    - 1) Accuracy: 0.10 degree F (0.06 degrees C) minimum or plus/minus 0.20 percent of span.
  - d. Sensing Range:
    - 1) Provide limited range sensors if required to sense the range expected for a respective point.
    - 2) Use RTD type sensors for extended ranges beyond minus 30 to 230 degrees F (minus 34.4 to 114.4 degrees).
    - 3) Use temperature transmitters in conjunction with RTD's when RTD's are incompatible with DDC controller direct temperature input.
  - e. Wire Resistance:
    - 1) Use appropriate wire size to limit temperature offset due to wire resistance to 1.0 degree F (0.56 degrees C) or use temperature transmitter when offset is greater than 1.0 degree F (0.56 degrees C) due to wire resistance.
    - 2) Compensate for wire resistance in software input definition when feature is available in the DDC controller.
  - f. Room Sensors: Locking cover.
  - g. Room Temperature Sensors with Integral Digital Display:
    - 1) Construct for wall box.
    - 2) Provide a four button keypad with the following capabilities:
      - a) Indication of space and outdoor temperatures.
      - b) Setpoint adjustment to accommodate room setpoint.
      - c) Manual occupancy override and indication of occupancy status.
      - d) Controller mode status.
      - e) Password enabled setpoint and override modes.
  - h. Temperature Averaging Elements:
    - 1) Use on duct sensors for ductwork 10 sq ft (0.93 sq m) or larger.
    - 2) Use averaging elements where prone to stratification with sensor length 8 ft (2.5 m) or 16 ft (5 m).
    - 3) Provide for all mixed air and heating and reheat coil discharge sensors regardless of duct size.
- B. Humidity Sensors:
1. Manufacturers:
    - a. Veris Industries: [www.veris.com/#sle](http://www.veris.com/#sle).
    - b. Automation Components, Inc.; [www.workaci.com/#sle](http://www.workaci.com/#sle).
    - c. Johnson Controls International, PLC; [www.johnsoncontrols.com/#sle](http://www.johnsoncontrols.com/#sle).
    - d. Honeywell, Inc.; <https://buildings.honeywell.com/us/en/brands/our-brands/bms>
    - e. Substitutions: See Section 016000 - Product Requirements.

## 2.05 SENSORS WITH TRANSMITTERS

### A. Room Pressure Monitor:

1. Manufacturers:
  - a. Dwyer Instruments Inc: [www.dwyer-inst.com/#sle](http://www.dwyer-inst.com/#sle).
  - b. Ebtron, Inc: [www.ebtron.com/#sle](http://www.ebtron.com/#sle).
  - c. Setra Systems, Inc: [www.setra.com/#sle](http://www.setra.com/#sle).
  - d. Antec Controls, a brand of Price Industries, Inc: [www.anteccontrols.com/sle#](http://www.anteccontrols.com/sle#).
  - e. Substitutions: See Section 016000 - Product Requirements.
2. Type: Externally-powered, remote differential pressure transmitter interconnected via tubing or cables to pick-up sensors located inside wall-section fitted module(s).
3. Transmitter: Five percent accuracy, adjustable zero and span, 100 to 1 turndown, 0.1 percent of calibrated span linearity, 30 to 50 millisecond response time, minimum overpressure of 150 percent over highest range value, alphanumeric indicating display, wired or wireless connectivity for configuration, and terminal strip within enclosed electronic components.
4. Differential Pressure Monitoring Range: 0 to 0.05 in-wc (0 to 12.4 Pa), bidirectional.
5. BAS, SCADA, or other Integrated Automation System Output: Two-wire, 4 to 20 mA.
6. Room pressure monitor shall use 24 VAC power  $\pm$  15% the industry standard.

### PART 3 EXECUTION

#### 3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that systems are ready to receive work.
- C. Beginning of installation means installer accepts existing conditions.
- D. Sequence work to ensure installation of components is complementary to installation of similar components in other systems.
- E. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.
- F. Ensure installation of components is complementary to installation of similar components.
- G. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.

#### 3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Check and verify location of exposed control sensors with plans and room details before installation. Locate 48 inches (1200 mm) above floor. Align with lighting switches; see Section 262726.
- C. Provide valves with position indicators and with pilot positioners where sequenced with other controls.

- D. Provide conduit and electrical wiring in accordance with Section 260583. Electrical material and installation shall be in accordance with appropriate requirements of Division 26.

END OF SECTION 230913

SECTION 230923  
DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. System description.
- B. Controllers.
- C. Power supplies and line filtering.
- D. Controller software.

1.02 RELATED REQUIREMENTS

- A. Section 230913 - Instrumentation and Control Devices for HVAC.
- B. Section 230993 - Sequence of Operations for HVAC Controls.
- C. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

- A. MIL-STD-810 - Environmental Engineering Considerations and Laboratory Tests; 2019h.
- B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. UL (DIR) - Online Certifications Directory; Current Edition.

1.04 ADMINISTRATIVE REQUIREMENTS

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data for each system component and software module.
- C. Shop Drawings:
  - 1. Indicate trunk cable schematic showing programmable control unit locations, and trunk data conductors.
  - 2. Indicate system graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations. Provide demonstration digital media containing graphics.
  - 3. Show system configuration with peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.

- 4. Indicate description and sequence of operation of operating, user, and application software.
  - D. Manufacturer's Instructions: Indicate manufacturer's installation instructions for all manufactured components.
  - E. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors.
  - F. Operation and Maintenance Data:
    - 1. Include interconnection wiring diagrams complete field installed systems with identified and numbered, system components and devices.
    - 2. Include keyboard illustrations and step-by-step procedures indexed for each operator function.
    - 3. Include inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
  - G. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.
- 1.06 QUALITY ASSURANCE
- A. Perform work in accordance with NFPA 70.
  - 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 and with minimum three years of documented experience.
  - D. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for purpose specified and indicated.
- 1.07 WARRANTY
- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
  - B. Correct defective Work within a five year period after Substantial Completion.
  - C. Provide five year manufacturer's warranty for field programmable micro-processor based units.
- 1.08 PROTECTION OF SOFTWARE RIGHTS
- A. Prior to delivery of software, the Owner and the party providing the software will enter into a software license agreement with provisions for the following:
    - 1. Limiting use of software to equipment provided under these specifications.
    - 2. Limiting copying.
    - 3. Preserving confidentiality.
    - 4. Prohibiting transfer to a third party.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

- A. Siemens AG, Building Technologies Division; \_\_\_\_\_: [www.siemens.com/#sle](http://www.siemens.com/#sle).
- B. Antec Controls, a brand of Price Industries, Inc<>: [www.antecontrols.com/sle#](http://www.antecontrols.com/sle#).
- C. Substitutions: See Section 016000 - Product Requirements.

### 2.02 SYSTEM DESCRIPTION

- A. Automatic temperature control field monitoring and control system using field programmable micro-processor based units.
- B. Base system on distributed system of fully intelligent, stand-alone controllers, operating in a multi-tasking, multi-user environment on token passing network, with central and remote hardware, software, and interconnecting wire and conduit.
- C. Include computer software and hardware, operator input/output devices, control units, local area networks (LAN), sensors, control devices, actuators.
- D. Controls for variable air volume terminals, radiation, reheat coils, unit heaters, fan coils, and the like when directly connected to the control units. Individual terminal unit control is specified in Section 230913.
- E. Provide control systems consisting of thermostats, control valves, dampers and operators, indicating devices, interface equipment and other apparatus and accessories required to operate mechanical systems, and to perform functions specified.
- F. Include installation and calibration, supervision, adjustments, and fine tuning necessary for complete and fully operational system.

### 2.03 CONTROLLERS

- A. Building Controllers:
  - 1. General:
    - a. Manage global strategies by one or more, independent, standalone, microprocessor based controllers.
    - b. Provide sufficient memory to support controller's operating system, database, and programming requirements.
    - c. Share data between networked controllers.
    - d. Controller operating system manages input and output communication signals allowing distributed controllers to share real and virtual object information and allowing for central monitoring and alarms.
    - e. Utilize real-time clock for scheduling.
    - f. Continuously check processor status and memory circuits for abnormal operation.
    - g. Controller to assume predetermined failure mode and generate alarm notification upon detection of abnormal operation.

- h. Communication with other network devices to be based on assigned protocol.
  2. Communication:
    - a. Controller to reside on a BACnet network using ISO 8802-3 (ETHERNET) Data Link/Physical layer protocol.
    - b. Perform routing when connected to a network of custom application and application specific controllers.
    - c. Provide service communication port for connection to a portable operator's terminal or hand held device with compatible protocol.
  3. Anticipated Environmental Ambient Conditions:
    - a. Outdoors and/or in Wet Ambient Conditions:
      - 1) Mount within waterproof enclosures.
      - 2) Rated for operation at 40 to 150 degrees F (4 to 65 degrees C).
    - b. Conditioned Space:
      - 1) Mount within dustproof enclosures.
      - 2) Rated for operation at 32 to 120 degrees F (0 to 50 degrees C).
  4. Provisions for Serviceability:
    - a. Diagnostic LEDs for power, communication, and processor.
    - b. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.
  5. Memory: In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.
  6. Power and Noise Immunity:
    - a. Maintain operation at 90 to 110 percent of nominal voltage rating.
    - b. Perform orderly shutdown below 80 percent of nominal voltage.
    - c. Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W. at 3 feet (1 m).
- B. Application Specific Controllers:
  1. General:
    - a. Not fully user programmable, microprocessor based controllers dedicated to control specific equipment.
    - b. Customized for operation within the confines of equipment served.
    - c. Communication with other network devices to be based on assigned protocol.
    - d. Controller shall use 24 VAC power  $\pm$  15% the industry standard.
  2. Communication:
    - a. Controller to reside on a BACnet network using MS/TP Data Link/Physical layer protocol.
    - b. Provide service communication port for connection to a portable operator's terminal or hand held device with compatible protocol.
  3. Anticipated Environmental Ambient Conditions:
    - a. Outdoors and/or in Wet Ambient Conditions:
      - 1) Mount within waterproof enclosures.
      - 2) Rated for operation at 40 to 150 degrees F (4 to 65 degrees C).
    - b. Conditioned Space:
      - 1) Mount within dustproof enclosures.
      - 2) Rated for operation at 32 to 120 degrees F (0 to 50 degrees C).
  4. Provisions for Serviceability:



- a. Diagnostic LEDs for power, communication, and processor.
  - b. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.
  5. Memory: In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.
  6. Power and Noise Immunity:
    - a. Maintain operation at 90 to 110 percent of nominal voltage rating.
    - b. Perform orderly shutdown below 80 percent of nominal voltage.
    - c. Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 3 feet (1 m).
- C. Input/Output Interface:
1. Hardwired inputs and outputs tie into the DDC system through building, custom application, or application specific controllers.
  2. All Input/Output Points:
    - a. Protect controller from damage resulting from any point short-circuiting or grounding and from voltage up to 24 volts of any duration.
    - b. Provide universal type for building and custom application controllers where input or output is software designated as either binary or analog type with appropriate properties.
  3. Binary Inputs:
    - a. Allow monitoring of On/Off signals from remote devices.
    - b. Provide wetting current of 12 mA minimum, compatible with commonly available control devices and protected against the effects of contact bounce and noise.
    - c. Sense dry contact closure with power provided only by the controller.
  4. Pulse Accumulation Input Objects: Comply with all requirements of binary input objects and accept up to 10 pulses per second.
  5. Analog Inputs:
    - a. Allow for monitoring of low voltage 0 to 10 VDC, 4 to 20 mA current, or resistance signals (thermistor, RTD).
    - b. Compatible with and field configurable to commonly available sensing devices.
  6. Binary Outputs:
    - a. Used for On/Off operation or a pulsed low-voltage signal for pulse width modulation control.
    - b. Outputs provided with three position (On/Off/Auto) override switches.
    - c. Status lights for building and custom application controllers to be selectable for normally open or normally closed operation.
  7. Analog Outputs:
    - a. Monitoring signal provides a 0 to 10 VDC or a 4 to 20 mA output signal for end device control.
    - b. Provide status lights and two position (AUTO/MANUAL) switch for building and custom application controllers with manually adjustable potentiometer for manual override on building and custom application controllers.
    - c. Drift to not exceed 0.4 percent of range per year.
  8. Tri State Outputs:
    - a. Coordinate two binary outputs to control three point, floating type, electronic actuators without feedback.

- b. Limit the use of three point, floating devices to the following zone and terminal unit control applications:
  - c. Control algorithms run the zone actuator to one end of its stroke once every 24 hours for verification of operator tracking.
9. System Object Capacity:
- a. System size to be expandable to twice the number of input output objects required by providing additional controllers, including associated devices and wiring.
  - b. Hardware additions or software revisions for the installed operator interfaces are not to be required for future, system expansions.

## 2.04 POWER SUPPLIES AND LINE FILTERING

### A. Power Supplies:

1. Provide UL listed control transformers with Class 2 current limiting type or over-current protection in both primary and secondary circuits for Class 2 service as required by the NEC.
2. Limit connected loads to 80 percent of rated capacity.
3. Match power supply to current output and voltage requirements.
4. Unit to be full wave rectifier type with output ripple of 5.0 mV maximum peak to peak.
5. Regulation to be 1 percent combined line and load with 100 microsecond response time for 50 percent load changes.
6. Provide over-voltage and over-current protection to withstand a 150 percent current overload for 3 seconds minimum without trip-out or failure.
7. Operational Ambient Conditions: 32 to 120 degrees F (0 to 50 degrees C).
8. EM/RF meets FCC Class B and VDE 0871 for Class B and MIL-STD-810 for shock and vibration.
9. Line voltage units UL recognized and CSA approved.

### B. Power Line Filtering:

1. Provide external or internal transient voltage and surge suppression component for all workstations and controllers.
2. Minimum surge protection attributes:
  - a. Dielectric strength of 1000 volts minimum.
  - b. Response time of 10 nanoseconds or less.
  - c. Transverse mode noise attenuation of 65 dB or greater.
  - d. Common mode noise attenuation of 150 dB or greater at 40 to 100 Hz.

## 2.05 LOCAL AREA NETWORK (LAN)

- A. Provide communication between control units over local area network (LAN).
- B. LAN Capacity: Not less than 60 stations or nodes.
- C. Break in Communication Path: Alarm and automatically initiate LAN reconfiguration.
- D. LAN Data Speed: Minimum 19.2 Kb.
- E. Communication Techniques: Allow interface into network by multiple operation stations and by auto-answer/auto-dial modems. Support communication over telephone lines utilizing

modems.

- F. Transmission Median: Fiber optic or single pair of solid 24 gauge twisted, shielded copper cable.
- G. Network Support: Time for global point to be received by any station, shall be less than 3 seconds. Provide automatic reconfiguration if any station is added or lost. If transmission cable is cut, reconfigure two sections with no disruption to system's operation, without operator intervention.

## 2.06 CONTROLLER SOFTWARE

- A. All applications reside and operate in the system controllers and editing of all applications occurs at the operator workstation.
- B. System Security:
  - 1. User access secured via user passwords and user names.
  - 2. Passwords restrict user to the objects, applications, and system functions as assigned by the system manager.
  - 3. User Log On/Log Off attempts are recorded.
  - 4. Automatic Log Off occurs following the last keystroke after a user defined delay time.
- C. Object or Object Group Scheduling:
  - 1. Weekly Schedules Based on Separate, Daily Schedules:
    - a. Include start, stop, optimal stop, and night economizer.
    - b. 10 events maximum per schedule.
    - c. Start/stop times adjustable for each group object.
  - 2. Exception Schedules:
    - a. Based on any day of the year.
    - b. Defined up to one year in advance.
    - c. Automatically discarded and replaced with standard schedule for that day of the week upon execution.
  - 3. Holiday or Special Schedules:
    - a. Capability to define up to 99 schedules.
    - b. Repeated annually.
    - c. Length of each period is operator defined.
- D. Provide standard application for equipment coordination and grouping based on function and location to be used for scheduling and other applications.
- E. Alarms:
  - 1. Binary object is set to alarm based on the operator specified state.
  - 2. Analog object to have high/low alarm limits.
  - 3. All alarming is capable of being automatically and manually disabled.
  - 4. Alarm Reporting:
    - a. Operator determines action to be taken for alarm event.
    - b. Alarms to be routed to appropriate workstation.
    - c. Reporting Options:
      - 1) Start programs.

- 2) Logged.
  - 3) Custom messaging.
  - 4) Graphical displays.
- F. Maintenance Management: System monitors equipment status and generates maintenance messages based upon user-designated run-time limits.
- G. Sequencing: Application software based upon specified sequences of operation on the drawings.
- H. PID Control Characteristics:
1. Direct or reverse action.
  2. Anti-windup.
  3. Calculated, time-varying, analog value, positions an output or stages a series of outputs.
  4. User selectable controlled variable, set-point, and PED gains.
- I. Staggered Start Application:
1. Prevents all controlled equipment from simultaneously restarting after power outage.
  2. Order of equipment startup is user selectable.
- J. Energy Calculations:
1. Accumulated instantaneous power or flow rates are converted to energy use data.
  2. Algorithm calculates a rolling average and allows window of time to be user specified in minute intervals.
  3. Algorithm calculates a fixed window average with a digital input signal from a utility meter defining the start of the window period that in turn synchronizes the fixed-window average with that used by the power company.
- K. Anti-Short Cycling:
1. All binary output objects protected from short-cycling.
  2. Allows minimum on-time and off-time to be selected.
- L. On-Off Control with Differential:
1. Algorithm allows binary output to be cycled based on a controlled variable and set-point.
  2. Algorithm to be direct-acting or reverse-acting incorporating an adjustable differential.
- M. Run-Time Totalization:
1. Totalize run-times for all binary input objects.
  2. Provides operator with capability to assign high run-time alarm.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that conditioned power supply is available to the control units and to the operator work station. Verify that field end devices, wiring, and pneumatic tubing is installed prior to installation proceeding.

3.02 INSTALLATION

- A. Install control units and other hardware in position on permanent walls where not subject to excessive vibration.
- B. Install software in control units and in operator work station. Implement all features of programs to specified requirements and appropriate to sequence of operation..
- C. Provide conduit and electrical wiring in accordance with Section 260583. Electrical material and installation shall be in accordance with appropriate requirements of Division 26.

3.03 MANUFACTURER'S FIELD SERVICES

- A. Start and commission systems. Allow sufficient time for start-up and commissioning prior to placing control systems in permanent operation.
- B. Provide service engineer to instruct Owner's representative in operation of systems plant and equipment for 3 day period.

3.04 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate complete and operating system to Owner.

3.05 MAINTENANCE

- A. See Section 017000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.
- B. Provide service and maintenance of energy management and control systems for one years from Date of Substantial Completion.

END OF SECTION 230923

SECTION 232113  
HYDRONIC PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Hydronic system requirements.
- B. Heating water piping, above grade.
- C. Chilled water piping, buried.
- D. Chilled water piping, above grade.
- E. Condenser water piping, buried.
- F. Condenser water piping, above grade.
- G. Radiant heating piping system.
- H. Pipe hangers and supports.
- I. Unions, flanges, mechanical couplings, and dielectric connections.
- J. Valves:
- K. Flow controls.

1.02 RELATED REQUIREMENTS

- A. Section 083100 - Access Doors and Panels.
- B. Section 230719 - HVAC Piping Insulation.
- C. Section 232500 - HVAC Water Treatment: Pipe cleaning.

1.03 REFERENCE STANDARDS

- A. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2023.
- B. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2021.
- C. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.
- D. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2021.
- E. ASME B31.9 - Building Services Piping; 2020.

- F. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.
  - G. ASTM A106/A106M - Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service; 2019a.
  - H. ASTM A183 - Standard Specification for Carbon Steel Track Bolts and Nuts; 2014 (Reapproved 2020).
  - I. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2023a.
  - J. ASTM B32 - Standard Specification for Solder Metal; 2020.
  - K. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2022.
  - L. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.
  - M. ASTM D2000 - Standard Classification System for Rubber Products in Automotive Applications; 2018.
  - N. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers; 2024.
  - O. ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications; 2007 (Reapproved 2019).
  - P. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2019.
  - Q. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2022).
  - R. AWWA C606 - Grooved and Shouldered Joints; 2022.
  - S. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018, with Amendment (2019).
- 1.04 ADMINISTRATIVE REQUIREMENTS
- A. Coordination: Coordinate the installation of hydronic piping with size, location and installation of service utilities.
  - B. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
  - C. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.
- 1.05 SUBMITTALS
- A. See Section 013000 - Administrative Requirements for submittal procedures.
  - B. Welders Certificate: Include welders certification of compliance with ASME BPVC-IX.
  - C. Product Data:
    - 1. Include data on pipe materials, pipe fittings, valves, and accessories.

2. Provide manufacturers catalog information.
3. Indicate valve data and ratings.

- D. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 016000 - Product Requirements, for additional provisions.
  2. Valve Repacking Kits: One for each type and size of valve.

#### 1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with documented experience.
- C. Provide all grooved joint couplings, fittings, valves, specialties, and grooving tools from a single manufacturer.
- D. Welder Qualifications: Certify in accordance with ASME BPVC-IX.
1. Provide certificate of compliance from authority having jurisdiction, indicating approval of welders.

#### 1.07 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- C. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

### PART 2 PRODUCTS

#### 2.01 HYDRONIC SYSTEM REQUIREMENTS

- A. Comply with ASME B31.9 and applicable federal, state, and local regulations.
- B. Piping: Provide piping, fittings, hangers, and supports as required, as indicated, and as follows:
1. Where more than one piping system material is specified, provide joining fittings that are compatible with piping materials and ensure that the integrity of the system is not jeopardized.
  2. Use non-conducting dielectric connections whenever jointing dissimilar metals.
  3. Grooved mechanical joints may be used in accessible locations only.
    - a. Accessible locations include those exposed on interior of building, in pipe chases, and in mechanical rooms, aboveground outdoors, and as approved by Architect.
    - b. Grooved mechanical connections and joints comply with AWWA C606.



- 1) Steel: Comply with ASTM A106/A106M, Grade B or ASTM A53/A53M.
  - c. Use rigid joints unless otherwise indicated.
  - d. Use gaskets of molded synthetic rubber with central cavity, pressure-responsive configuration, and complying with ASTM D2000, Grade 2CA615A15B44F17Z for circulating medium up to maximum 230 degrees F (110 degrees C) or Grade M3BA610A15B44Z for circulating medium up to maximum 200 degrees F (93 degrees C).
  - e. Provide steel coupling nuts and bolts complying with ASTM A183.
4. Provide pipe hangers and supports in accordance with ASME B31.9 or MSS SP-58 unless indicated otherwise.
- C. Pipe-to-Valve and Pipe-to-Equipment Connections: Use flanges, unions, or grooved couplings to allow disconnection of components for servicing; do not use direct welded, soldered, or threaded connections.
- D. Valves: Provide valves where indicated:
1. Provide drain valves where indicated, and if not indicated, provide at least at main shut-off, low points of piping, bases of vertical risers, and at equipment. Use 3/4 inch (20 mm) gate valves with cap; pipe to nearest floor drain.
  2. Isolate equipment using butterfly valves with lug end flanges or grooved mechanical couplings.
  3. For throttling, bypass, or manual flow control services, use globe, ball, or butterfly valves.
  4. In heating water systems, butterfly valves may be used interchangeably with gate and globe valves.
  5. For shut-off and to isolate parts of systems or vertical risers, use ball or butterfly valves.
  6. For throttling service, use plug cocks. Use non-lubricated plug cocks only when shut-off or isolating valves are also provided.
- E. Welding Materials and Procedures: Comply with ASME BPVC-IX.

## 2.02 HEATING WATER PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A53/A53M, Schedule 40, black, using one of the following joint types:
1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D1.1/D1.1M welded.
  2. Threaded Joints: ASME B16.3, malleable iron fittings.
  3. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.
- B. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), drawn, using one of the following joint types:
1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings.
    - a. Solder: ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
    - b. Braze: AWS A5.8M/A5.8 BCuP copper/silver alloy.
  2. Mechanical Press Sealed Fittings: Double pressed type complying with ASME B16.22, utilizing EPDM, nontoxic synthetic rubber sealing elements.

- a. Manufacturers:
  - 1) Apollo Valves: [www.apollovalves.com/#sle](http://www.apollovalves.com/#sle).
  - 2) FNW; Copper Press: [www.fnw.com/#sle](http://www.fnw.com/#sle).
  - 3) Grinnell Products: [www.grinnell.com/#sle](http://www.grinnell.com/#sle).
  - 4) Substitutions: See Section 016000 - Product Requirements.

2.03 CHILLED WATER PIPING, BURIED

2.04 CHILLED WATER PIPING, ABOVE GRADE

2.05 CONDENSER WATER PIPING, BURIED

2.06 CONDENSER WATER PIPING, ABOVE GRADE

2.07 RADIANT HEATING PIPING

2.08 PIPE HANGERS AND SUPPORTS

- A. Provide hangers and supports that comply with MSS SP-58.
  - 1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
  - 2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inches (13 to 38 mm): Malleable iron, adjustable swivel, split ring.
  - 3. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
  - 4. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
- B. In grooved installations, use rigid couplings with offsetting angle-pattern bolt pads or with wedge-shaped grooves in header piping to permit support and hanging in accordance with ASME B31.9.

2.09 UNIONS, FLANGES, MECHANICAL COUPLINGS, AND DIELECTRIC CONNECTIONS

- A. Unions for Pipe of 2 Inches (50 mm, DN) and Less:
  - 1. Ferrous Piping: 150 psi (1034 kPa) brass or malleable iron, threaded.
  - 2. Copper Pipe: Bronze, soldered joints.
  - 3. Manufacturers:
    - a. Nexus Valve, Inc: [www.nexusvalve.com/#sle](http://www.nexusvalve.com/#sle).
- B. Mechanical Couplings for Grooved and Shouldered Joints: Two or more curved housing segments with continuous key to engage pipe groove, circular C-profile gasket, and bolts to secure and compress gasket.
  - 1. Dimensions and Testing: In accordance with AWWA C606.
  - 2. Mechanical Couplings: Comply with ASTM F1476.
  - 3. Gasket Material: EPDM suitable for operating temperature range from minus 30 degrees F (minus 34 degrees C) to 230 degrees F (110 degrees C).
  - 4. Bolts and Nuts: Hot dipped galvanized or zinc-electroplated steel.

5. When pipe is field grooved, provide coupling manufacturer's grooving tools.

6. Manufacturers:

- a. Anvil International: [www.anvilintl.com/#sle](http://www.anvilintl.com/#sle).
- b. Apollo Valves: [www.apollovalves.com/#sle](http://www.apollovalves.com/#sle).
- c. Grinnell Products: [www.grinnell.com/#sle](http://www.grinnell.com/#sle).
- d. Shurjoint Piping Products, Inc: [www.shurjoint.com/#sle](http://www.shurjoint.com/#sle).
- e. Victaulic Company: [www.victaulic.com/#sle](http://www.victaulic.com/#sle).
- f. Substitutions: See Section 016000 - Product Requirements.

C. Dielectric Connections:

1. Unions:

- a. 1/2 to 1 Inches (15 to 25 mm): Brass solder to galvanized FPT.
- b. 1/2 to 2 Inches (15 to 50 mm): Brass solder to galvanized FPT.
- c. 1/2 to 1 Inches (15 to 25 mm): Brass to galvanized FPT or FIP (Female Iron Pipe).
- d. 3/4 to 1/2 Inch (20 to 15 mm) Reducer: Brass solder to galvanized FPT.
- e. Service: 250 psi (1,723.6 kPa), minus 20 to 180 deg F (minus 28.9 to 82.2 deg F).
- f. Manufacturers:
  - 1) Jomar Valves, a division of Jomar Group: [www.jomarvalve.com/#sle](http://www.jomarvalve.com/#sle).
  - 2) Substitutions: See Section 016000 - Product Requirements.

## 2.10 FLOW CONTROLS

A. Manufacturers:

1. Anvil International: [www.anvilintl.com/#sle](http://www.anvilintl.com/#sle).
2. Bell & Gossett, a brand of Xylem, Inc: [www.bellgossett.com/#sle](http://www.bellgossett.com/#sle).
3. Griswold Controls: [www.griswoldcontrols.com/#sle](http://www.griswoldcontrols.com/#sle).
4. Hays Fluid Controls: [www.haysfluidcontrols.com/#sle](http://www.haysfluidcontrols.com/#sle).
5. ITT Bell & Gossett: [www.bellgossett.com/#sle](http://www.bellgossett.com/#sle).
6. Shurjoint Piping Products, Inc: [www.shurjoint.com/#sle](http://www.shurjoint.com/#sle).
7. Taco, Inc: [www.taco-hvac.com/#sle](http://www.taco-hvac.com/#sle).
8. Victaulic Company: [www.victaulic.com/#sle](http://www.victaulic.com/#sle).
9. Substitutions: See Section 016000 - Product Requirements.

B. Construction: Class 125, Brass or bronze body with union on inlet and outlet, temperature and pressure test plug on inlet and outlet, blowdown/backflush drain.

C. Calibration: Control flow within 10 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, minimum pressure 2 psi (13.7 kPa).

## PART 3 EXECUTION

### 3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Prepare pipe for grooved mechanical joints as required by coupling manufacturer.

C. Remove scale and dirt on inside and outside before assembly.

- D. Prepare piping connections to equipment using jointing system specified.
- E. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.
- F. After completion, fill, clean, and treat systems. See Section 232500 for additional requirements.

### 3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install heating water, glycol, chilled water, condenser water, and engine exhaust piping to ASME B31.9 requirements.
- C. Route piping in orderly manner, parallel to building structure, and maintain gradient.
- D. Install piping to conserve building space and to avoid interference with use of space.
- E. Group piping whenever practical at common elevations.
- F. Sleeve pipe passing through partitions, walls, and floors.
- G. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified.
- H. Slope piping and arrange to drain at low points.
- I. Pipe Hangers and Supports:
  - 1. Install in accordance with ASME B31.9, ASTM F708, or MSS SP-58.
  - 2. Install hangers to provide minimum 1/2-inch (13 mm) space between finished covering and adjacent work.
  - 3. Place hangers within 12 inches (300 mm) of each horizontal elbow.
  - 4. Use hangers with 1-1/2 inches (38 mm) minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
  - 5. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
  - 6. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- J. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. See Section 230719.
- K. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Section 083100 .
- L. Use eccentric reducers to maintain top of pipe level.
- M. Install valves with stems upright or horizontal, not inverted.

### 3.03 SCHEDULES

- A. Hanger Spacing for Copper Tubing.

1. 1/2 Inch (15 mm) and 3/4 inch (20 mm): Maximum span, 5 feet (1500 mm); minimum rod size, 1/4 inch (6 mm).
  2. 1 Inch (25 mm): Maximum span, 6 feet (1800 mm); minimum rod size, 1/4 inch (6 mm).
  3. 1-1/2 Inches (40 mm) and 2 Inches (50 mm): Maximum span, 8 feet (2400 mm); minimum rod size, 3/8 inch (9 mm).
- B. Hanger Spacing for Steel Piping.
1. 1/2 Inch (15 mm), 3/4 Inch (20 mm), and 1 Inch (25 mm): Maximum span, 7 feet (2100 mm); minimum rod size, 1/4 inch (6 mm).
  2. 1-1/4 Inches (32 mm): Maximum span, 8 feet (2400 mm); minimum rod size, 3/8 inch (9 mm).
  3. 1-1/2 Inches (40 mm): Maximum span, 9 feet (2700 mm); minimum rod size, 3/8 inch (9 mm).

END OF SECTION 232113

SECTION 232114  
HYDRONIC SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Air vents.
- B. Strainers.
- C. Pressure-temperature test plugs.
- D. Balancing valves.

1.02 RELATED REQUIREMENTS

- A. Section 232113 - Hydronic Piping.

1.03 REFERENCE STANDARDS

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate the installation of equipment, piping, and accessories with size, location and installation of service utilities.

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description and model.
- C. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.
- D. Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 016000 - Product Requirements for additional provisions.

1.06 QUALITY ASSURANCE

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

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- C. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

2.01 AIR VENTS

- A. Manufacturers:
  - 1. Armstrong International, Inc: [www.armstronginternational.com/#sle](http://www.armstronginternational.com/#sle).
  - 2. Bell & Gossett, a brand of Xylem, Inc: [www.bellgossett.com/#sle](http://www.bellgossett.com/#sle).
  - 3. Nexus Valve, Inc: [www.nexusvalve.com/#sle](http://www.nexusvalve.com/#sle).
  - 4. Taco, Inc: [www.taco-hvac.com/#sle](http://www.taco-hvac.com/#sle).
  - 5. Substitutions: See Section 016000 - Product Requirements.
- B. Manual Air Vent: Short vertical sections of 2-inch (50 mm, DN) diameter pipe to form air chamber, with 1/8 inch (6 mm, DN) brass needle valve at top of chamber.
- C. Maximum Fluid Pressure: 150 psi (1,034 kPa).
- D. Maximum Fluid Temperature: 250 degrees F (121.1 degrees C).

2.02 STRAINERS

- A. Manufacturers:
  - 1. American Wheatley, a company of Global Flow Products, LLC: [www.wheatleyhvac.com/#sle](http://www.wheatleyhvac.com/#sle).
  - 2. Armstrong International, Inc: [www.armstronginternational.com/#sle](http://www.armstronginternational.com/#sle).
  - 3. Flexicraft Industries: [www.flexicraft.com/#sle](http://www.flexicraft.com/#sle).
  - 4. Grinnell Products: [www.grinnell.com/#sle](http://www.grinnell.com/#sle).
  - 5. Nexus Valve, Inc: [www.nexusvalve.com/#sle](http://www.nexusvalve.com/#sle).
  - 6. The Metraflex Company; LPD Y Strainer: [www.metraflex.com/#sle](http://www.metraflex.com/#sle).
  - 7. Substitutions: See Section 016000 - Product Requirements.
- B. Size 2 inch (50 mm, DN) and Under:
  - 1. Provide threaded, grooved, or sweat brass or iron body for up to 175 psi (1,200 kPa) working pressure, Y-pattern strainer with 1/32 inch (0.8 mm) stainless steel perforated screen.
  - 2. Body Material by Fluid Service:
    - a. Cast Iron or Brass:
      - 1) Steam: Up to 250 psi at 450 degrees F (1,723.6 kPa at 232.2 degrees C).
      - 2) Liquids: Up to 400 psi at 150 degrees F (2,758 kPa at 65.6 degrees C).

## 2.03 PRESSURE-TEMPERATURE TEST PLUGS

- A. Manufacturers:
  - 1. FNW: [www.fnw.com/#sle](http://www.fnw.com/#sle).
  - 2. Peterson Equipment Company Inc: [www.petesplug.com/#sle](http://www.petesplug.com/#sle).
  - 3. Sisco Manufacturing Company Inc: [www.siscomfg.com/#sle](http://www.siscomfg.com/#sle).
  - 4. Substitutions: See Section 016000 - Product Requirements.
- B. Construction: Brass body designed to receive temperature or pressure probe with removable protective cap, and Neoprene rated for minimum 200 degrees F (93 degrees C).
- C. Application: Use extended length plugs to clear insulated piping.

## 2.04 BALANCING VALVES

- A. Manufacturers:
  - 1. American Wheatley, a company of Global Flow Products, LLC: [www.wheatleyhvac.com/#sle](http://www.wheatleyhvac.com/#sle).
  - 2. Armstrong International, Inc: [www.armstronginternational.com/#sle](http://www.armstronginternational.com/#sle).
  - 3. Bell & Gossett, a brand of Xylem, Inc: [www.bellgossett.com/#sle](http://www.bellgossett.com/#sle).
  - 4. FNW: [www.fnw.com/#sle](http://www.fnw.com/#sle).
  - 5. Hays Fluid Controls: [www.haysfluidcontrols.com/#sle](http://www.haysfluidcontrols.com/#sle).
  - 6. Nexus Valve, Inc: [www.nexusvalve.com/#sle](http://www.nexusvalve.com/#sle).
  - 7. Oventrop Corporation; Hydrocontrol F: [www.ventrop.com/#sle](http://www.ventrop.com/#sle).
  - 8. Taco, Inc: [www.taco-hvac.com/#sle](http://www.taco-hvac.com/#sle).
  - 9. Substitutions: See Section 016000 - Product Requirements.
- B. Size 2 inch (50 mm, DN) and Smaller:
  - 1. Provide ball or globe style with flow balancing, shut-off capabilities, memory stops, and minimum of two metering ports and female sweat, NPT threaded, press, or soldered connections.
  - 2. Metal construction materials consist of bronze or brass.
  - 3. Non-metal construction materials consist of Teflon, EPDM, or engineered resin.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Install specialties in accordance with manufacturer's instructions.
- B. Provide manual air vents at system high points and as indicated.
- C. For automatic air vents in ceiling spaces or other concealed locations, provide vent tubing to nearest drain.
- D. Provide valved drain and hose connection on strainer blowdown connection.

END OF SECTION 232114



SECTION 233100  
HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Metal ducts.
- B. Flexible ducts.
- C. Ducts for laboratory and industrial-grade applications.

1.02 RELATED REQUIREMENTS

- A. Section 078400 - Firestopping.
- B. Section 230130.51 - HVAC Air-Distribution System Cleaning: Post install duct cleaning.
- C. Section 233300 - Air Duct Accessories.
- D. Section 233319 - Duct Silencers.
- E. Section 233600 - Air Terminal Units.
- F. Section 233700 - Air Outlets and Inlets: Fabric air distribution devices.

1.03 REFERENCE STANDARDS

- A. ANSI Z9.5 - Laboratory Ventilation; 2022.
- B. ASHRAE Std 126 - Method of Testing HVAC Air Ducts; 2020.
- C. ASME AG-1 - Code on Nuclear Air and Gas Treatment; 2019.
- D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2022.
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- F. NFPA 45 - Standard on Fire Protection for Laboratories Using Chemicals; 2019.
- G. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2021.
- H. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2021.
- I. NFPA 91 - Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Particulate Solids; 2020.

- J. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2021.
- K. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; Current Edition, Including All Revisions.

#### 1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data for duct materials.
- C. Shop Drawings: Indicate duct fitting types, gauges, sizes, welds, and configuration.
- D. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

#### 1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum three years of documented experience.

#### 1.06 FIELD CONDITIONS

- A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.
- B. Maintain temperatures within acceptable range during and after installation of duct sealants.

#### 1.07 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.

### PART 2 PRODUCTS

#### 2.01 GENERAL REQUIREMENTS

- A. Provide UL Class 1 ductwork, fittings, hangers, supports, and appurtenances in accordance with NFPA 90A and SMACNA (DCS) guidelines unless stated otherwise.
- B. Provide metal duct unless otherwise indicated. Fibrous glass duct can be substituted at the Contractor's option.
- C. Acoustical Treatment: Provide sound-absorbing liners and sectional silencers for metal-based ducts in compliance with Section 233319.
- D. Duct Shape and Material in accordance with Allowed Static Pressure Range:
  - 1. Round: Plus or minus 2 in-wc (500 Pa) of galvanized steel.
  - 2. Rectangular: Plus or minus 1/2 in-wc (125 Pa) of galvanized steel.
- E. Duct Sealing and Leakage in accordance with Static Pressure Class:

1. Duct Pressure Class and Material for Common Mechanical Ventilation Applications:
  - a. Supply Air: 1/2 in-wc (125 Pa) pressure class, galvanized steel.
  - b. Return and Relief Air: 1/2 in-wc (125 Pa) pressure class, galvanized steel.
  - c. General Exhaust Air: 1/2 in-wc (125 Pa) pressure class, galvanized steel.

F. Duct Fabrication Requirements:

1. Duct and Fitting Fabrication and Support: SMACNA (DCS) including specifics for continuously welded round and oval duct fittings.
2. Use reinforced and sealed sheet-metal materials at recommended gauges for indicated operating pressures or pressure class.
3. Construct tees, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows must be used, provide airfoil turning vanes of perforated metal with glass fiber insulation.
4. Provide turning vanes of perforated metal with glass fiber insulation when acoustical lining is indicated.
5. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
6. Provide turning vanes of perforated metal with glass fiber insulation when an acoustical lining is required.
7. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide blank-out panels sealing louver area around duct. Use same material as duct, painted black on exterior side; seal to louver frame and duct.

2.02 METAL DUCTS

A. Material Requirements:

1. Galvanized Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G90/Z275 coating.

B. Rectangular Metal Duct:

1. Rectangular Double Wall Insulated: Rectangular spiral lock seam duct with galvanized steel outer wall, perforated galvanized steel inner wall; fitting with the solid inner wall.
  - a. Insulation:
    - 1) Thickness: 1 inch (25 mm).
    - 2) Material: Air.

C. Round Metal Ducts:

1. Round Single Wall Duct: Round lock seam duct with galvanized steel outer wall.
  - a. Manufacturers:
    - 1) EHG, a DMI Company: [www.ehgduct.com/#sle](http://www.ehgduct.com/#sle).
    - 2) Elgen Manufacturing Company, Inc; Snap Lock Pipes and Fittings: [www.elgenmfg.com/#sle](http://www.elgenmfg.com/#sle).
    - 3) Linx Industries, Inc, a DMI Company: [www.li-hvac.com/#sle](http://www.li-hvac.com/#sle).
    - 4) MKT Metal Manufacturing: [www.mktduct.com/#sle](http://www.mktduct.com/#sle).
    - 5) Nordfab Ducting: [www.nordfab.com/#sle](http://www.nordfab.com/#sle).
    - 6) Substitutions: See Section 016000 - Product Requirements.
2. Round Connection System: Interlocking duct connection system per SMACNA (DCS).

- a. Manufacturers:
  - 1) Ductmate Industries, Inc, a DMI Company: [www.ductmate.com/#sle](http://www.ductmate.com/#sle).
  - 2) Nordfab Ducting: [www.nordfab.com/#sle](http://www.nordfab.com/#sle).
  - 3) Substitutions: See Section 016000 - Product Requirements.
- D. Connectors, Fittings, Sealants, and Miscellaneous:
  - 1. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
    - a. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.
    - b. VOC Content: Not more than 250 g/L, excluding water.
    - c. Surface Burning Characteristics: Flame spread index of zero and smoke developed index of zero, when tested in accordance with ASTM E84.
    - d. For Use with Flexible Ducts: UL labeled.
    - e. Manufacturers:
      - 1) Carlisle HVAC Products; Hardcast Versa-Grip 181 Water Based Fiber Reinforced Duct Sealant: [www.carlislehvac.com/#sle](http://www.carlislehvac.com/#sle).
      - 2) Design Polymerics; DP 1010 Water Based Smooth Duct Sealant, Premium Quality: [www.designpoly.com/#sle](http://www.designpoly.com/#sle).
      - 3) Ductmate Industries, Inc, a DMI Company: [www.ductmate.com/#sle](http://www.ductmate.com/#sle).
      - 4) Elgen Manufacturing Company, Inc; Duct Sealer: [www.elgenmfg.com/#sle](http://www.elgenmfg.com/#sle).
      - 5) H.B. Fuller Construction Products, Inc: [www.fosterproducts.com//#sle](http://www.fosterproducts.com//#sle).
      - 6) Substitutions: See Section 016000 - Product Requirements.
- E. Hanger Rod and Fasteners: See Specification 230529 - Hangers and Supports for HVAC Piping and Equipment

## 2.03 FLEXIBLE DUCTS

- A. Flexible Air Ducts:
  - 1. UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound spring steel wire.
  - 2. Insulation: Fiberglass insulation with polyethylene vapor barrier film.
  - 3. Pressure Rating: From 10 in-wc (2.5 kPa) to 1 in-wc (250 Pa) negative.
  - 4. Maximum Velocity: 4,000 fpm (20.3 m/s).
  - 5. Temperature Range: Minus 20 to 210 degrees F (Minus 28 to 99 degrees C).
  - 6. Manufacturers:
    - a. Hart & Cooley, Inc; [www.hartandcooley.com/#sle](http://www.hartandcooley.com/#sle).
    - b. Substitutions: See Section 016000 - Product Requirements.

## 2.04 DUCTS FOR LABORATORY AND INDUSTRIAL-GRADE APPLICATIONS

- A. Laboratory Exhaust Applications:
  - 1. Fume Hood Cabinet Exhaust:
    - a. Minimum 20-gauge, 0.035-inch (0.95 mm) Type 316 stainless steel, unless noted otherwise.
      - 1) Fabricate in accordance with ductwork manufacturer's instructions; test duct system to sustain positive and negative pressures in accordance with

ASHRAE Std 126 and ASME AG-1.

- 2) Single-wall, factory built, general use vent system.
  - a) Seal joints during installation with factory-supplied overlapping V-bands and sealant.
  - b. Chemicals: Round, class 1 316 stainless steel.
  - c. Provide ductwork and appurtenances in accordance with NFPA 91 requirements except where NFPA 45 applications take precedence.
  - d. Coordinate duct, fittings, hangers, and accessories to comply with ANSI Z9.5.
  - e. Design, fabricate, and install liquidtight preventing exhaust leakage into the building.
  - f. Seal joints during installation with factory-supplied flanges and airtight gasketing.
  - g. Manufacturers:
    - 1) DuraSystems Barriers Inc; DuraDuct LXD: [www.durasystems.com/#sle](http://www.durasystems.com/#sle).
    - 2) Substitutions: See Section 016000 - Product Requirements.

### PART 3 EXECUTION

#### 3.01 INSTALLATION

- A. Install, support, and seal ducts in accordance with SMACNA (DCS).
- B. Install products following the manufacturer's instructions.
- C. Comply with safety standards NFPA 90A and NFPA 90B.
- D. During construction, provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering the ductwork system.
- E. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- F. Flexible Ducts: Connect to metal ducts with adhesive plus drawbands..
- G. Duct sizes indicated are inside clear dimensions. For lined ducts, maintain sizes inside lining.
- H. Provide openings in ductwork as indicated to accommodate thermometers and controllers. Provide pilot tube openings as indicated for testing of systems, complete with metal can with spring device or screw to insure against air leakage. For openings, insulate ductwork and install insulation material inside a metal ring.
- I. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- J. Use crimp joints with or without bead for joining round duct sizes 8 inch (200 mm) and smaller with a crimp in the direction of airflow.
- K. Use double nuts and lock washers on threaded rod supports.
- L. Connect terminal units to supply ducts directly or with one foot (300 mm) maximum length of flexible duct no closer than 3 times the diameter of the duct inlet. Do not use flexible duct to

change direction.

- M. Connect diffusers or light troffer boots to low-pressure ducts directly or with 5 feet (1.5 m) maximum length of flexible duct held in place with strap or clamp.
- N. Fire Partitions: Provide firestopping sealing. See Section 078400.
- O. Duct Accessories, Terminal Units, Inlets, and Outlets: Interconnect as indicated in Sections 233300, 233600, and 233700.

### 3.02 CLEANING

- A. Clean thoroughly each duct system. See Section 230130.51.

END OF SECTION 233100

SECTION 233300  
AIR DUCT ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Air turning devices/extractors.
- B. Combination fire and smoke dampers.
- C. Duct access doors.
- D. Duct test holes.
- E. Fire dampers.
- F. Flexible duct connectors.
- G. Smoke dampers.
- H. Volume control dampers.
- I. Miscellaneous Products:
  - 1. Fire-rated enclosures.
  - 2. Duct opening closure film.

1.02 RELATED REQUIREMENTS

- A. Section 233100 - HVAC Ducts and Casings.

1.03 REFERENCE STANDARDS

- A. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2021.
- B. NFPA 92 - Standard for Smoke Control Systems; 2021, with Amendment.
- C. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2021.
- D. UL 33 - Safety Heat Responsive Links for Fire-Protection Service; Current Edition, Including All Revisions.
- E. UL 555 - Standard for Fire Dampers; Current Edition, Including All Revisions.
- F. UL 555S - Standard for Smoke Dampers; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.

- B. Product Data: Provide for shop-fabricated assemblies including volume control dampers. Include electrical characteristics and connection requirements.
- C. Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers.
- D. Manufacturer's Installation Instructions: Provide instructions for fire dampers.
- E. Project Record Drawings: Record actual locations of access doors and test holes.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 016000 - Product Requirements for additional provisions.
  - 2. Extra Fusible Links: Two of each type and size.

#### 1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect dampers from damage to operating linkages and blades.

### PART 2 PRODUCTS

#### 2.01 AIR TURNING DEVICES/EXTRACTORS

- A. Manufacturers:
  - 1. Carlisle HVAC Products; Dynair Hollow Vane and Rail (Double Wall Vane): [www.carlislehvac.com/#sle](http://www.carlislehvac.com/#sle).
  - 2. Elgen Manufacturing Company, Inc: [www.elgenmfg.com/#sle](http://www.elgenmfg.com/#sle).
  - 3. Krueger-HVAC, Division of Air System Components: [www.krueger-hvac.com/#sle](http://www.krueger-hvac.com/#sle).
  - 4. Ruskin Company: [www.ruskin.com/#sle](http://www.ruskin.com/#sle).
  - 5. Titus HVAC, a brand of Johnson Controls: [www.titus-hvac.com/#sle](http://www.titus-hvac.com/#sle).
  - 6. Substitutions: See Section 016000 - Product Requirements.
- B. Multi-blade device with blades aligned in short dimension; steel construction; with individually adjustable blades, mounting straps.

#### 2.02 COMBINATION FIRE AND SMOKE DAMPERS

#### 2.03 DUCT ACCESS DOORS

- A. Manufacturers:
  - 1. Acudor Products Inc, a Division of Nelson Industrial Inc: [www.acudor.com/#sle](http://www.acudor.com/#sle).
  - 2. Ductmate Industries, Inc, a DMI Company: [www.ductmate.com/#sle](http://www.ductmate.com/#sle).



3. Elgen Manufacturing Company, Inc: [www.elgenmfg.com/#sle](http://www.elgenmfg.com/#sle).
4. Lloyd Industries, Inc: [www.firedamper.com/#sle](http://www.firedamper.com/#sle).
5. MKT Metal Manufacturing: [www.mktduct.com/#sle](http://www.mktduct.com/#sle).
6. Nailor Industries, Inc: [www.nailor.com/#sle](http://www.nailor.com/#sle).
7. Ruskin Company: [www.ruskin.com/#sle](http://www.ruskin.com/#sle).
8. SEMCO LLC: [www.semcohvac.com/#sle](http://www.semcohvac.com/#sle).
9. \_\_\_\_\_.
10. Substitutions: See Section 016000 - Product Requirements.

B. Fabricate in accordance with SMACNA (DCS) and as indicated.

C. Access doors with sheet metal screw fasteners are not acceptable.

#### 2.04 DUCT TEST HOLES

A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

B. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

1. Manufacturers:

a. Carlisle HVAC Products; Dynair Test Port with Red Cap with O-Ring Seal:  
[www.carlislehvac.com/#sle](http://www.carlislehvac.com/#sle).

b. Substitutions: See Section 016000 - Product Requirements.

#### 2.05 FIRE DAMPERS

A. Manufacturers:

1. AireTechnologies, Inc, a DMI Company: [www.airetechnologies.com/#sle](http://www.airetechnologies.com/#sle).

2. Lloyd Industries, Inc: [www.firedamper.com/#sle](http://www.firedamper.com/#sle).

3. Louvers & Dampers, Inc, a brand of Mestek, Inc: [www.louvers-dampers.com/#sle](http://www.louvers-dampers.com/#sle).

4. Nailor Industries, Inc: [www.nailor.com/#sle](http://www.nailor.com/#sle).

5. NCA, a brand of Metal Industries Inc: [www.ncamfg.com/#sle](http://www.ncamfg.com/#sle).

6. Panasonic Corporation of North America; Flex Damper: [www.panasonic.com/#sle](http://www.panasonic.com/#sle).

7. Pottorff: [www.pottorff.com/#sle](http://www.pottorff.com/#sle).

8. Ruskin Company: [www.ruskin.com/#sle](http://www.ruskin.com/#sle).

9. United Enertech: [www.unitedenertech.com/#sle](http://www.unitedenertech.com/#sle).

10. Substitutions: See Section 016000 - Product Requirements.

B. Fabricate in accordance with NFPA 90A and UL 555, and as indicated.

C. Curtain Type Dampers: Galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for horizontal installations. Configure with blades out of air stream except for 1-inch (250 Pa) pressure-class ducts up to 12 inches (300 mm) in height.

D. Fusible Links: UL 33, separate at 165 degrees F (73.8 degrees C) with adjustable link straps for combination fire/balancing dampers.

## 2.06 FLEXIBLE DUCT CONNECTORS

- A. Manufacturers:
  - 1. Carlisle HVAC Products; Dynair Connector Plus G90 Steel Offset Seam Neoprene Fabric: [www.carlislehvac.com/#sle](http://www.carlislehvac.com/#sle).
  - 2. Ductmate Industries, Inc, a DMI Company: [www.ductmate.com/#sle](http://www.ductmate.com/#sle).
  - 3. Elgen Manufacturing Company, Inc: [www.elgenmfg.com/#sle](http://www.elgenmfg.com/#sle).
  - 4. Substitutions: See Section 016000 - Product Requirements.
- B. Fabricate in accordance with SMACNA (DCS) and as indicated.
- C. Flexible Duct Connections: Fabric crimped into metal edging strip.
  - 1. Metal: 3 inches (75 mm) wide, 24 gauge, 0.0239 inch (0.61 mm) thick galvanized steel.
- D. Leaded Vinyl Sheet: Minimum 0.55 inch (14 mm) thick, 0.87 lbs per sq ft (4.2 kg/sq m), 10 dB attenuation in 10 to 10,000 Hz range.
- E. Maximum Installed Length: 14 inch (356 mm).

## 2.07 SMOKE DAMPERS

- A. Fabricate in accordance with NFPA 90A and UL 555S, and as indicated.
- B. Dampers: UL Class 1 airfoil blade type smoke damper, normally open automatically operated by pneumatic actuator.
- C. Electro Thermal Link: Fusible link melting at 165 degrees F (74 degrees C); 120 volts, single phase, 60 Hz; UL listed and labeled.

## 2.08 VOLUME CONTROL DAMPERS

- A. Manufacturers:
  - 1. AireTechnologies, Inc, a DMI Company: [www.airetechnologies.com/#sle](http://www.airetechnologies.com/#sle).
  - 2. Louvers & Dampers, Inc, a brand of Mestek, Inc: [www.louvers-dampers.com/#sle](http://www.louvers-dampers.com/#sle).
  - 3. Elgen Manufacturing Company, Inc: [www.elgenmfg.com/#sle](http://www.elgenmfg.com/#sle).
  - 4. MKT Metal Manufacturing: [www.mktduct.com/#sle](http://www.mktduct.com/#sle).
  - 5. Nailor Industries, Inc: [www.nailor.com/#sle](http://www.nailor.com/#sle).
  - 6. NCA, a brand of Metal Industries Inc: [www.ncamfg.com/#sle](http://www.ncamfg.com/#sle).
  - 7. Ruskin Company: [www.ruskin.com/#sle](http://www.ruskin.com/#sle).
  - 8. United Enertech: [www.unitedenertech.com/#sle](http://www.unitedenertech.com/#sle).
  - 9. \_\_\_\_\_.
  - 10. Substitutions: See Section 016000 - Product Requirements.
- B. Fabricate in accordance with SMACNA (DCS) and as indicated.
- C. Single Blade Dampers:
  - 1. Fabricate for duct sizes up to 6 by 30 inch (150 by 760 mm).
  - 2. Blade: 24 gauge, 0.0239 inch (0.61 mm), minimum.

- D. Multi-Blade Damper: Fabricate consisting of opposed blades with maximum blade sizes 8 by 72 inches (200 by 1825 mm). Assemble center- and edge-crimped blades in prime-coated or galvanized-channel frame with suitable hardware.
  - 1. Blade: 18 gauge, 0.0478 inch (1.21 mm), minimum.
- E. End Bearings: Except in round ducts 12 inches (300 mm) and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon, thermoplastic elastomer, or sintered bronze bearings.

## 2.09 MISCELLANEOUS PRODUCTS

- A. Fire-Rated Enclosures:
  - 1. Manufacturers:
    - a. Fire Rated Product Specialties Corp: [www.frpsonline.com/#sle](http://www.frpsonline.com/#sle).
  - 2. Provide as required to preserve fire resistance rating of building elements.
- B. Duct Opening Closure Film: Mold-resistant, self-adhesive film to keep debris out of ducts during construction.
  - 1. Thickness: 2 mils (0.6 mm).
  - 2. High tack water based adhesive.
  - 3. UV stable light blue color.
  - 4. Manufacturers:
    - a. Carlisle HVAC Products; Dynair Duct Protection Film: [www.carlislehvac.com/#sle](http://www.carlislehvac.com/#sle).
    - b. Elgen Manufacturing Company, Inc; Shrink Wrap with PSA: [www.elgenmfg.com/#sle](http://www.elgenmfg.com/#sle).
    - c. Substitutions: See Section 016000 - Product Requirements.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA (DCS). See Section 233100 for duct construction and pressure class.
- B. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide minimum 8 by 8 inch (200 by 200 mm) size access door for hand and shoulder access, or as indicated on drawings. Provide minimum 4 by 4 inch (100 by 100 mm) size access door for balancing dampers only. Review locations prior to fabrication.
- C. Provide duct test holes where indicated and required for testing and balancing purposes.
- D. Provide fire dampers at locations indicated, where ducts and outlets pass through fire-rated components, and where required by authorities having jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.
- E. Install smoke dampers and combination smoke and fire dampers in accordance with NFPA 92.

- F. Demonstrate re-setting of fire dampers to Owner's representative.
- G. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.
- H. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum two duct widths from duct take-off.
- I. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

END OF SECTION 233300

SECTION 233600  
AIR TERMINAL UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Single-duct terminal units.
  - 1. Constant-volume units.
  - 2. Variable-volume units.
- B. Venturi-type air valves.
- C. Booster coils.

1.02 RELATED REQUIREMENTS

- A. Section 230548 - Vibration and Seismic Controls for HVAC.
- B. Section 233100 - HVAC Ducts and Casings.
- C. Section 251400 - Integrated Automation Local Control Units: HVAC controllers.

1.03 REFERENCE STANDARDS

- A. AHRI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils; 2001, with Addenda (2011).
- B. AHRI 880 (I-P) - Performance Rating of Air Terminals; 2017.
- C. AHRI 885 - Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets; 2008, with Addendum (2011).
- D. ASHRAE Std 130 - Laboratory Methods of Testing Air Terminal Units; 2016.
- E. ASTM A492 - Standard Specification for Stainless Steel Rope Wire; 1995 (Reapproved 2019).
- F. ASTM A603 - Standard Specification for Metallic-Coated Steel Structural Wire Rope; 2019.
- G. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems; 2008.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Sequencing: Completion utility connections in an orderly and expeditious manner.

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.

- B. **Product Data:** Provide data indicating configuration, general assembly, and materials used in fabrication. Include catalog performance ratings that indicate airflow, static pressure, and NC designation. Include electrical characteristics and connection requirements.
- C. **Manufacturer's Installation Instructions:** Indicate support and hanging details, installation instructions, recommendations, and service clearances required.
- D. **Project Record Documents:** Record actual locations of units and locations of access doors required for access of valving.
- E. **Operation and Maintenance Data:** Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts lists. Include directions for resetting constant-volume regulators.
- F. **Warranty:** Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
- G. **Maintenance Materials:** Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 016000 - Product Requirements for additional provisions.

#### 1.06 QUALITY ASSURANCE

- A. **Manufacturer Qualifications:** Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

#### 1.07 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Provide five year manufacturer warranty for air terminal units.

### PART 2 PRODUCTS

#### 2.01 SINGLE-DUCT, VARIABLE-VOLUME and CONSTANT-VOLUME UNITS

- A. **Manufacturers:**
  - 1. Price Industries, Inc; \_\_\_\_\_: [www.priceindustries.com/#sle](http://www.priceindustries.com/#sle).
  - 2. Titus. a brand of Air Distribution Technologies: [www.titus-hvac.com/#sle](http://www.titus-hvac.com/#sle).
  - 3. Substitutions: See Section 016000 - Product Requirements.
- B. **Basis of Design:** Price Industries, Inc: [www.priceindustries.com/#sle](http://www.priceindustries.com/#sle).
  - 1. Single-Duct Terminal Unit: SDV, (direct digital controls).
- C. **Acoustic Performance Requirements:**
  - 1. Sound ratings of air distribution assemblies: Not to exceed 25 NC at a 0.1 in-wg static pressure drop across the unit.
  - 2. Use attenuation values found in appendix E of AHRI 885.
- D. **General:**

1. Factory-assembled, AHRI 880 (I-P) rated and bearing the AHRI seal, air volume control terminal with damper assembly, flow sensor, externally mounted volume controller, duct collars, and all required features.
  2. Control box bearing identification, including but not necessarily limited to nominal cfm, maximum and minimum factory-set airflow limits, coil type and coil (right or left hand) connection, where applicable.
- E. Unit Casing:
1. Minimum 22 gauge, 0.0299 inch (0.76 mm) galvanized steel.
  2. Air Inlet Collar: Provide round, suitable for standard flexible duct sizes.
  3. Unit Discharge: Rectangular, with slip-and-drive connections.
  4. Acceptable Liners:
    - a. All air terminal units shall be fully lined internally with fiber-free insulation, which shall comply with NFPA 90 (ASTM E84, ASTM C1071) for a flame/smoke spread rating of 25/50 when tested according to ASTM E84. Insulation shall comply with UL 181 and NFPA 90A, including bacteriological standards of ASTM C665.
      - 1) All seams and cut edges shall be sealed from airstream using metal brackets; use of adhesive backed tape is unacceptable. Insulation shall be 4lb/ft<sup>3</sup> density with an R-Value of 3.5.
        - a) Cover liner with mylar film
    - b. Liner not to contain pentabrominated diphenyl ether (CAS #32534-81-9) or octabrominated diphenyl ether.
- F. Sound Attenuator:
1. Provide if required to meet scheduled acoustical performance requirements.
  2. Construction to consist of a continuous extension of the casing and liner as required to achieve required attenuation.
  3. At 2000 fpm (10.16 m/s) inlet velocity, the minimum operating pressure with attenuator added not to exceed 0.14 in-wc (34.84 Pa).
- G. Damper Assembly:
1. Heavy-gauge, galvanized steel, or extruded aluminum construction with solid steel, nickel-plated shaft pivoting on HDPE, self-lubricating bearings.
  2. Provide integral position indicator or alternative method for indicating damper position over full range of 90 degrees.
  3. Incorporate low leak damper blades for tight airflow shutoff.
    - a. Air Leakage Past Closed Damper: Maximum two percent of unit maximum airflow at 3 in-wc (750 Pa) inlet static pressure, tested in accordance with ASHRAE Std 130.
- H. Hot Water Heating Coil:
1. Coil Casing: Minimum 22 gauge, 0.0299 inch (0.76 mm) galvanized steel, factory-installed on terminal discharge with rectangular outlet, duct connection type.
    - a. Access Door: Gasketed and insulated located on bottom, on top, and downstream of coils.
  2. Coil Fins: Aluminum or aluminum plated fins, mechanically-bonded to seamless copper tubes.
  3. Coil leak tested to minimum 350 psig (2413 kPa).

4. Base performance data on tests run in accordance with AHRI 410 and units to bear AHRI 410 label.

I. Controls:

1. DDC (Direct-Digital Controls):
  - a. Bi-directional Damper Actuator: 24 volt, powered closed, spring return open.
  - b. Microprocessor-Based Controller: Air volume controller, pressure-independent with electronic airflow transducers, factory-calibrated maximum and minimum CFMs.
    - 1) Occupied and unoccupied operating mode.
    - 2) Remote reset of temperature or CFM set points.
    - 3) Proportional, plus integral control of room temperature.
    - 4) Monitoring and adjusting with portable terminal.
    - 5) Time-proportional reheat coil control.
  - c. Room Sensor:
    - 1) Compatible with temperature controls specified.
    - 2) Wall-mounted, system powered, with temperature set-point adjustment including connection access for portable operator terminal.
  - d. See Section 25 1400.
2. Airflow Sensor: Differential pressure airflow device measuring total, static, and wake pressures.
  - a. Signal accuracy: Plus/minus five percent throughout terminal operating range.

2.02 VENTURI-TYPE AIR VALVES

A. Manufacturers:

1. Antec Controls, a brand of Price Industries, Inc: [www.antecontrols.com/sle#](http://www.antecontrols.com/sle#).
2. Siemens AG, Building Technologies Division: [www.siemens.com/#sle..](http://www.siemens.com/#sle..)
3. Substitutions: See Section 016000 - Product Requirements.

B. Type: Pressure independent, field adjustable, maintenance-free, directional-flow tagged, factory calibrated to operate across body-stamped flow curve.

C. Construction:

1. Body Material: Aluminum, 14 gauge, 0.064 inch (1.63 mm), uncoated.
2. Cone Material: Aluminum, 14 gauge, 0.064 inch (1.63 mm), uncoated.
3. Shaft, Bearings, and Links Material: 316 stainless steel.
4. Valve-Assembly Orientation: Horizontal flow.
5. Flow-Valve Type:
  - a. Fume Hood: Variable volume, partially closed.
  - b. General Exhaust: Variable volume, partially closed.
  - c. Supply: Variable volume, partially closed.
6. Actuator Configuration: Electronic, high speed, fail closed.
  - a. Fume Hood Exhaust Air Valve shall fail open.
7. Flow Feedback: Built-in calibrated potentiometer with pressure switch.

D. Operating Range:

1. Flow: As indicated on drawings.



2. Accuracy: Plus or minus 5 percent of scheduled flow setpoints.
3. Control Response Time: Under one second.
4. Valve Pressure Drop: Medium pressure, 0.6 to 3.0 in-wc (150 to 750 Pa).
5. Operating Temperature: 32 to 120 degrees F (0 to 49 degrees C).

E. Auxiliary Heating or Reheating: Provide hot water booster coil.

F. Terminal Unit Controls:

1. Controller: DDC, critical-space airflow controller.
2. Factory ship DDC controller including airflow transmitter and damper actuator.
3. Provide accessories for field interfaced controller including duct-mounted temperature sensor and thermostat.
4. Control Sequence: As indicated on the drawings.

## 2.03 BOOSTER COILS

A. Manufacturers:

1. Antec Controls a brand of Price Industries, Inc: [www.antecontrols.com/sle#](http://www.antecontrols.com/sle#).
2. Greenheck Fan Corporation: [www.greenheck.com/#sle](http://www.greenheck.com/#sle).
3. Indeeco, a company of ASPEQ Heating Group: [indeeco.com/sle#](http://indeeco.com/sle#).
4. Substitutions: See Section 016000 - Product Requirements.

B. Hot Water Heating Coil:

1. Coil: Single row, seamless copper tubes mechanically expanded into aluminum or aluminum-plated fins arranged in a counter-flow manner with self-venting drainable circuits.
2. Casing: Slip-in type made of zinc-coated (galvanized) steel.
3. Fin Spacing Capacity: 10 fins per inch (cm).
4. Fluid Service: Low-temperature, up to 250 degrees F (up to 121 degrees C).
5. Maximum Working Pressure: 160 psig (1,103 kPa).
6. Performance: AHRI 410 certified and listed with logo shown on product sheet.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Verify that conditions are suitable for installation.

### 3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install the inlets of air terminal units and air flow sensors a minimum of four duct diameters from elbows, transitions, and duct takeoffs.
- C. See drawings for the size(s) and duct location(s) of the air terminal units.
- D. Provide ceiling access doors or locate units above easily removable ceiling components.

- E. Support units individually from structure with wire rope complying with ASTM A492 and ASTM A603 in accordance with SMACNA (SRM). See Section 23 0548.
- F. Do not support from ductwork.
- G. Connect to ductwork in accordance with Section 233100.
- H. Provide minimum of 5 ft (1.5 m) of 1 inch (25 mm) thick lined ductwork downstream of units.

### 3.03 ADJUSTING

- A. Reset volume with damper operator attached to assembly allowing flow range modulation from 100 percent of design flow to zero percent full flow.

### 3.04 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements for additional requirements.
- B. Provide manufacturer's field representative to inspect, instruct, and observe field-assembled components and equipment installation, including connections and to assist in field testing. Report results in writing.

### 3.05 CLEANING

- A. See Section 017419 - Construction Waste Management and Disposal for additional requirements.
- B. Vacuum clean coils and inside of units.

### 3.06 CLOSEOUT ACTIVITIES

- A. See Section 017800 - Closeout Submittals for closeout submittals.
- B. See Section 017900 - Demonstration and Training for additional requirements.

END OF SECTION 233600

SECTION 233700  
AIR OUTLETS AND INLETS

PART 1 GENERAL

1.01 Section Includes

- A. Diffusers:
  - 1. Perforated ceiling diffusers.
  - 2. Slot ceiling diffusers.
- B. Registers/grilles:
  - 1. Ceiling-mounted, exhaust and return register/grilles.

1.02 Reference Standards

- A. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

PART 2 PRODUCTS

2.01 Manufacturers

- A. Price Industries: [www.price-hvac.com/#sle](http://www.price-hvac.com/#sle).
- B. Titus, a brand of Air Distribution Technologies; \_\_\_\_\_: [www.titus-hvac.com/#sle](http://www.titus-hvac.com/#sle).
- C. Substitutions: See Section 016000 - Product Requirements.

2.02 Perforated Face Ceiling Diffusers

- A. Type: Perforated face with fully adjustable pattern and removable face.
- B. Frame: Inverted T-bar type.
- C. Fabrication: Steel with steel frame and baked enamel finish.
- D. Fabrication: Stainless steel.
- E. Color: As indicated on drawings.

2.03 Ceiling Slot Diffusers

- A. Type: Continuous 1-1/2 inch (38 mm) wide slot, three slots wide, with adjustable vanes for left, right, or vertical discharge.
- B. Fabrication: Aluminum extrusions with factory baked enamel finish.
- C. Color: As indicated on the drawings.

- D. Frame: 1-1/4 inch (32 mm) margin with support clips for T bar mounting and gasket, mitered end border.
- E. Plenum: Integral, galvanized steel, insulated.

### PART 3 EXECUTION

#### 3.01 Installation

- A. Install in accordance with manufacturer's instructions.
- B. Comply with SMACNA (ASMM) for flashing/counter-flashing of roof penetrations and supports for roof curbs and roof mounted equipment.
- C. Check location of outlets and inlets and make necessary adjustments in position to comply with architectural features, symmetry, and lighting arrangement.
- D. Install diffusers to ductwork with air tight connection.
- E. Provide balancing dampers on duct take-off to diffusers and grilles and registers, despite whether dampers are specified as part of diffuser, or grille and register assembly.
- F. Paint ductwork visible behind air outlets and inlets matte black, see Section 099123.

#### 3.02 Protection

- A. Protect installed products until completion of project.
- B. Replace, repair, or touch-up damaged products before Substantial Completion.

END OF SECTION 233700

SECTION 260505  
SELECTIVE DEMOLITION FOR ELECTRICAL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Electrical demolition.

1.02 RELATED REQUIREMENTS

- A. Section 028400 - Polychlorinate Biphenyl (PCB) Remediation: Removal of equipment and materials containing substances regulated under the Federal Toxic Substances Control Act (TSCA), including but not limited to those containing PCBs and mercury.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. Materials and equipment for patching and extending work: As specified in individual sections.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify field measurements and circuiting arrangements are as indicated.
- B. Verify that abandoned wiring and equipment serve only abandoned facilities.
- C. Demolition drawings are based on casual field observation and existing record documents.
- D. Report discrepancies to Owner before disturbing existing installation.
- E. Beginning of demolition means installer accepts existing conditions.

3.02 PREPARATION

- A. Disconnect electrical systems in walls, floors, and ceilings to be removed.
- B. Coordinate utility service outages with utility company.
- C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.
- D. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize

outage duration.

1. Obtain permission from Owner at least 24 hours before partially or completely disabling system.
2. Make temporary connections to maintain service in areas adjacent to work area.

E. Existing Fire Alarm System: Maintain existing system in service until new system is accepted. Disable system only to make switchovers and connections. Minimize outage duration.

1. Notify Owner before partially or completely disabling system.
2. Notify local fire service.
3. Make notifications at least 24 hours in advance.
4. Make temporary connections to maintain service in areas adjacent to work area.

### 3.03 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Perform work for removal and disposal of equipment and materials containing toxic substances regulated under the Federal Toxic Substances Control Act (TSCA) in accordance with applicable federal, state, and local regulations. Applicable equipment and materials include, but are not limited to:

1. Electrical equipment, including transformers, capacitors, and switches.
2. Lighting ballasts.
3. Lamps and tubes, including fluorescent lamps, high intensity discharge (HID), arc lamps, ultra-violet, high pressure sodium, mercury vapor, ignitron tubes, neon, and incandescent containing mercury.

B. Remove, relocate, and extend existing installations to accommodate new construction.

C. Remove abandoned wiring back to the source of supply.

D. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.

E. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.

F. Disconnect and remove abandoned panelboards and distribution equipment.

G. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

H. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.

I. Repair adjacent construction and finishes damaged during demolition and extension work.

J. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.

K. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

3.04 CLEANING AND REPAIR

- A. See Section 017419 - Construction Waste Management and Disposal for additional requirements.
- B. Clean and repair existing materials and equipment that remain or that are to be reused within the scope of work.
- C. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.
- D. Luminaires: Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps, ballasts and broken electrical parts.

END OF SECTION 260505

SECTION 260519  
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Single conductor building wire.
- B. Armored cable.
- C. Metal-clad cable.
- D. Manufactured wiring systems.
- E. Wiring connectors.
- F. Electrical tape.
- G. Wire pulling lubricant.
- H. Cable ties.
- I. Firestop sleeves.

1.02 RELATED REQUIREMENTS

- A. Section 078400 - Firestopping.
- B. Section 260505 - Selective Demolition for Electrical: Disconnection, removal, and/or extension of existing electrical conductors and cables.
- C. Section 260526 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.
- D. Section 260536 - Cable Trays for Electrical Systems: Additional installation requirements for cables installed in cable tray systems.
- E. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

- A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire; 2013 (Reapproved 2018).
- B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft; 2011 (Reapproved 2017).



- C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes; 2010, with Editorial Revision (2020).
- D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation; 2004 (Reapproved 2020).
- E. ASTM B800 - Standard Specification for 8000 Series Aluminum Alloy Wire for Electrical Purposes - Annealed and Intermediate Tempers; 2005 (Reapproved 2015).
- F. ASTM B801 - Standard Specification for Concentric-Lay-Stranded Conductors of 8000 Series Aluminum Alloy Wire for Subsequent Covering of Insulation; 2018.
- G. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape; 2017.
- H. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- I. NECA 104 - Recommended Practice for Installing Aluminum Building Wire and Cable; 2012.
- J. NECA 120 - Standard for Installing Armored Cable (AC) and Metal-Clad Cable (MC); 2012.
- K. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy; 2009.
- L. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2017.
- M. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- N. UL 4 - Armored Cable; Current Edition, Including All Revisions.
- O. UL 44 - Thermoset-Insulated Wires and Cables; Current Edition, Including All Revisions.
- P. UL 83 - Thermoplastic-Insulated Wires and Cables; Current Edition, Including All Revisions.
- Q. UL 183 - Manufactured Wiring Systems; Current Edition, Including All Revisions.
- R. UL 486A-486B - Wire Connectors; Current Edition, Including All Revisions.
- S. UL 486C - Splicing Wire Connectors; Current Edition, Including All Revisions.
- T. UL 486D - Sealed Wire Connector Systems; Current Edition, Including All Revisions.
- U. UL 493 - Thermoplastic-Insulated Underground Feeder and Branch-Circuit Cables; Current Edition, Including All Revisions.
- V. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape; Current Edition, Including All Revisions.
- W. UL 1569 - Metal-Clad Cables; Current Edition, Including All Revisions.

#### 1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
  2. Coordinate the installation of direct burial cable with other trades to avoid conflicts with piping or other potential conflicts.
  3. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
  4. Notify Owner of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

#### 1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.
- C. Manufactured Wiring System Shop Drawings: Provide plan views indicating proposed system layout with components identified; indicate branch circuit connections.
- D. Design Data: Indicate voltage drop and ampacity calculations for aluminum conductors substituted for copper conductors. Include proposed modifications to raceways, boxes, wiring gutters, enclosures, etc. to accommodate substituted conductors.
- E. Field Quality Control Test Reports.
- F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- G. Project Record Documents: Record actual installed circuiting arrangements. Record actual routing for underground circuits.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 016000 - Product Requirements, for additional provisions.
  2. Extra Manufactured Wiring Systems Cable Assemblies: One of each configuration, 6 feet (2000 mm) length.

#### 1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 CONDUCTOR AND CABLE APPLICATIONS

- A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.
- B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.
- C. Nonmetallic-sheathed cable is not permitted.
- D. Underground feeder and branch-circuit cable is permitted only as follows:
  - 1. Where not otherwise restricted, may be used:
    - a. For damp, wet, or corrosive locations as a substitute for NFPA 70, Type NMC nonmetallic-sheathed cable, when nonmetallic-sheathed cable is permitted.
  - 2. In addition to other applicable restrictions, may not be used:
    - a. Where exposed to view.
    - b. Where exposed to damage.
- E. Armored cable is permitted only as follows:
  - 1. Where not otherwise restricted, may be used:
    - a. Where concealed above accessible ceilings for final connections from junction boxes to luminaires.
      - 1) Maximum Length: 6 feet (1.8 m).
    - b. Where concealed in hollow stud walls, above accessible ceilings, and under raised floors for branch circuits up to 20 A.
      - 1) Exception: Provide single conductor building wire in raceway for circuit homerun from first outlet to panelboard.
    - c. For general purpose, non-essential electrical systems in non-hazardous patient care areas of health care facilities, when provided with additional insulated grounding conductor for redundant grounding.
  - 2. In addition to other applicable restrictions, may not be used:
    - a. Unless approved by Owner.
    - b. Where not approved for use by the authority having jurisdiction.

- c. Where exposed to view, except in dedicated electrical, communications, and mechanical rooms where not subject to damage.
  - d. Where exposed to damage.
  - e. For damp, wet, or corrosive locations.
  - f. For isolated ground circuits.
- F. Metal-clad cable is permitted only as follows:
- 1. Where not otherwise restricted, may be used:
    - a. Where concealed above accessible ceilings for final connections from junction boxes to luminaires.
      - 1) Maximum Length: 6 feet (1.8 m).
    - b. Where concealed in hollow stud walls, above accessible ceilings, and under raised floors for branch circuits up to 20 A.
      - 1) Exception: Provide single conductor building wire in raceway for circuit homerun from first outlet to panelboard.
  - 2. In addition to other applicable restrictions, may not be used:
    - a. Unless approved by Owner.
    - b. Where not approved for use by the authority having jurisdiction.
    - c. Where exposed to view, except in dedicated electrical, communications, and mechanical rooms where not subject to damage.
    - d. Where exposed to damage.
    - e. For damp, wet, or corrosive locations, unless provided with a PVC jacket listed as suitable for those locations.
    - f. For isolated ground circuits, unless provided with an additional isolated/insulated grounding conductor.
    - g. For patient care areas of health care facilities requiring redundant grounding.
- G. Manufactured wiring systems are permitted only as follows:
- 1. Where not otherwise restricted, may be used:
    - a. For branch circuits where concealed above accessible ceilings for lighting and in open ceiling areas for lighting.
      - 1) Exception: Provide single conductor building wire in raceway for circuit homerun from distribution box to panelboard.
    - b. For general purpose, non-essential electrical systems in non-hazardous patient care areas of health care facilities, when provided with additional insulated grounding conductor for redundant grounding.
  - 2. In addition to other applicable restrictions, may not be used:
    - a. Unless approved by Owner.
    - b. Where not approved for use by the authority having jurisdiction.
    - c. Where exposed to view.
    - d. Where exposed to damage.
    - e. For damp, wet, or corrosive locations.
    - f. For isolated ground circuits, unless provided with an additional isolated/insulated grounding conductor.

## 2.02 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

- A. Provide products that comply with requirements of NFPA 70.

- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.
- D. Comply with NEMA WC 70.
- E. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.
- F. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.
- G. Conductors for Grounding and Bonding: Also comply with Section 260526.
- H. Conductors and Cables Installed in Cable Tray: Listed and labeled as suitable for cable tray use.
- I. Conductors and Cables Installed Where Exposed to Direct Rays of Sun: Listed and labeled as sunlight resistant.
- J. Conductors and Cables Installed Exposed in Spaces Used for Environmental Air (only where specifically permitted): Plenum rated, listed and labeled as suitable for use in return air plenums.
- K. Conductor Material:
  - 1. Provide copper conductors except where aluminum conductors are specifically indicated or permitted for substitution. Conductor sizes indicated are based on copper unless specifically indicated as aluminum. Conductors designated with the abbreviation "AL" indicate aluminum.
    - a. Substitution of aluminum conductors for copper is permitted, when approved by Owner and authority having jurisdiction, only for the following:
      - 1) Copper conductors size 1/0 AWG and larger..
    - b. Where aluminum conductors are substituted for copper, comply with the following:
      - 1) Size aluminum conductors to provide, when compared to copper sizes indicated, equivalent or greater ampacity and equivalent or less voltage drop.
      - 2) Increase size of raceways, boxes, wiring gutters, enclosures, etc. as required to accommodate aluminum conductors.
      - 3) Provide copper equipment grounding conductor sized according to NFPA 70.
      - 4) Equip electrical distribution equipment with compression lugs for terminating aluminum conductors.
  - 2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.
  - 3. Tinned Copper Conductors: Comply with ASTM B33.
  - 4. Aluminum Conductors (only where specifically indicated or permitted for substitution): AA-8000 series aluminum alloy conductors recognized by ASTM B800 and compact stranded in accordance with ASTM B801 unless otherwise indicated.

L. Minimum Conductor Size:

1. Branch Circuits: 12 AWG.
  - a. Exceptions:
    - 1) 20 A, 120 V circuits longer than 75 feet (23 m): 10 AWG, for voltage drop.
- M. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- N. Conductor Color Coding:
  1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
  2. Color Coding Method: Integrally colored insulation.
    - a. Conductors size 4 AWG and larger may have black insulation color coded using vinyl color coding electrical tape.
  3. Color Code:
    - a. 208Y/120 V, 3 Phase, 4 Wire System:
      - 1) Phase A: Black.
      - 2) Phase B: Red.
      - 3) Phase C: Blue.
      - 4) Neutral/Grounded: White.
    - b. Equipment Ground, All Systems: Green.
    - c. Isolated Ground, All Systems: Green with yellow stripe.
    - d. Travelers for 3-Way and 4-Way Switching: Pink.
    - e. For modifications or additions to existing wiring systems, comply with existing color code when existing code complies with NFPA 70 and is approved by the authority having jurisdiction.
    - f. For control circuits, comply with manufacturer's recommended color code.

## 2.03 SINGLE CONDUCTOR BUILDING WIRE

- A. Manufacturers:
  1. Copper Building Wire:
    - a. Cerro Wire LLC
    - b. Encore Wire Corporation
    - c. General Cable Technologies Corporation; \_\_\_\_\_
    - d. Service Wire Co
    - e. Southwire Company
    - f. Substitutions: See Section 016000 - Product Requirements.
  2. Aluminum Building Wire (only where specifically indicated or permitted for substitution):
    - a. Encore Wire Corporation
    - b. Southwire Company
    - c. Stabiloy, a brand of General Cable Technologies Corporation; \_\_\_\_\_
    - d. Substitutions: See Section 016000 - Product Requirements.
- B. Description: Single conductor insulated wire.
- C. Conductor Stranding:
  1. Feeders and Branch Circuits:

- a. Size 10 AWG and Smaller: Solid.
  - b. Size 8 AWG and Larger: Stranded.
  - 2. Control Circuits: Stranded.
- D. Insulation Voltage Rating: 600 V.
- E. Insulation:
- 1. Copper Building Wire: Type THHN/THWN, except as indicated below.
    - a. Size 4 AWG and Larger: Type XHHW-2 or THHN/THWN.
    - b. Installed Underground: Type XHHW-2.
  - 2. Aluminum Building Wire (only where specifically indicated or permitted for substitution): Type XHHW-2.

#### 2.04 UNDERGROUND FEEDER AND BRANCH-CIRCUIT CABLE

- A. Manufacturers:
- 1. Cerro Wire LLC
  - 2. Encore Wire Corporation
  - 3. Service Wire Co
  - 4. Southwire Company
  - 5. Substitutions: See Section 016000 - Product Requirements.
- B. Description: NFPA 70, Type UF multiple-conductor cable listed and labeled as complying with UL 493, Type UF-B.
- C. Provide equipment grounding conductor unless otherwise indicated.
- D. Conductor Stranding:
- 1. Size 10 AWG and Smaller: Solid.
  - 2. Size 8 AWG and Larger: Stranded.
- E. Insulation Voltage Rating: 600 V.

#### 2.05 ARMORED CABLE

- A. Manufacturers:
- 1. AFC Cable Systems Inc
  - 2. Encore Wire Corporation
  - 3. Southwire Company
  - 4. Substitutions: See Section 016000 - Product Requirements.
- B. Description: NFPA 70, Type AC cable listed and labeled as complying with UL 4, and listed for use in classified firestop systems to be used.
- C. Conductor Stranding:
- 1. Size 10 AWG and Smaller: Solid.
  - 2. Size 8 AWG and Larger: Stranded.
- D. Insulation Voltage Rating: 600 V.
- E. Insulation: Type THHN.

- F. Grounding: Combination of interlocking armor and integral bonding wire.
  - 1. Provide additional full-size integral insulated equipment grounding conductor for redundant grounding, suitable for general purpose, non-essential electrical systems in non-hazardous patient care areas of health care facilities.
- G. Armor: Steel, interlocked tape.

## 2.06 METAL-CLAD CABLE

- A. Manufacturers:
  - 1. AFC Cable Systems Inc
  - 2. Encore Wire Corporation
  - 3. Service Wire Co
  - 4. Southwire Company
  - 5. Substitutions: See Section 016000 - Product Requirements.
- B. Description: NFPA 70, Type MC cable listed and labeled as complying with UL 1569, and listed for use in classified firestop systems to be used.
- C. Conductor Stranding:
  - 1. Size 10 AWG and Smaller: Solid.
  - 2. Size 8 AWG and Larger: Stranded.
- D. Insulation Voltage Rating: 600 V.
- E. Insulation: Type THHN, THHN/THWN, or THHN/THWN-2.
- F. Provide oversized neutral conductors where indicated or required.
- G. Grounding: Full-size integral equipment grounding conductor.
  - 1. Provide additional isolated/insulated grounding conductor where indicated or required.
- H. Armor: Steel, interlocked tape.
- I. Provide PVC jacket applied over cable armor where indicated or required for environment of installed location.

## 2.07 MANUFACTURED WIRING SYSTEMS

- A. Description: Manufactured wiring assemblies complying with NFPA 70 Article 604, and listed and labeled as complying with UL 183.
- B. Provide components necessary to transition between manufactured wiring system and other wiring methods.
- C. Branch Circuit Cables:
  - 1. Conductor Stranding (Size 10 AWG and Smaller): Solid.
  - 2. Insulation Voltage Rating: 600 V.
  - 3. Insulation: Type THHN.
  - 4. Grounding: Full-size integral equipment grounding conductor.



- a. Provide additional isolated/insulated grounding conductor where indicated or required.
  - b. Provide redundant grounding, suitable for general purpose, non-essential electrical systems in non-hazardous patient care areas of health care facilities<> where indicated or required.
5. Armor: Steel, interlocked tape.
- D. Connectors: Keyed and color-coded to prevent interconnection of different voltages.
- E. Fixture Leads: Type TFN insulation.

## 2.08 WIRING CONNECTORS

- A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.
- B. Connectors for Grounding and Bonding: Comply with Section 260526.
- C. Wiring Connectors for Splices and Taps:
- 1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors.
  - 2. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.
  - 3. Connectors for Aluminum Conductors: Use compression connectors.
- D. Wiring Connectors for Terminations:
- 1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
  - 2. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.
  - 3. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.
  - 4. Provide motor pigtail connectors for connecting motor leads in order to facilitate disconnection.
  - 5. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.
  - 6. Aluminum Conductors: Use compression connectors for all connections.
  - 7. Stranded Conductors Size 10 AWG and Smaller: Use crimped terminals for connections to terminal screws.
  - 8. Conductors for Control Circuits: Use crimped terminals for all connections.
- E. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.
- F. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.
- G. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F (105 degrees C) for standard applications and 302 degrees F (150 degrees C) for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.

- H. Mechanical Connectors: Provide bolted type or set-screw type.
- I. Compression Connectors: Provide circumferential type or hex type crimp configuration.
- J. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.

## 2.09 ACCESSORIES

- A. Electrical Tape:
  - 1. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil (0.18 mm); resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F (105 degrees C).
  - 2. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil (0.18 mm); resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F (-18 degrees C) and suitable for continuous temperature environment up to 221 degrees F (105 degrees C).
- B. Oxide Inhibiting Compound: Listed; suitable for use with the conductors or cables to be installed.
- C. Wire Pulling Lubricant: Listed; suitable for use with the conductors or cables to be installed and suitable for use at the installation temperature.
- D. Cable Ties: Material and tensile strength rating suitable for application.
- E. Firestop Sleeves: Listed; provide as required to preserve fire resistance rating of building elements.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that interior of building has been protected from weather.
- B. Verify that work likely to damage wire and cable has been completed.
- C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.
- D. Verify that field measurements are as indicated.
- E. Verify that conditions are satisfactory for installation prior to starting work.

### 3.02 PREPARATION

- A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

### 3.03 INSTALLATION

- A. Circuiting Requirements:
1. Unless dimensioned, circuit routing indicated is diagrammatic.
  2. When circuit destination is indicated without specific routing, determine exact routing required.
  3. Arrange circuiting to minimize splices.
  4. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
  5. Maintain separation of wiring for emergency systems in accordance with NFPA 70.
  6. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are indicated as separate, combining them together in a single raceway is permitted, under the following conditions:
    - a. Provide no more than six current-carrying conductors in a single raceway. Dedicated neutral conductors are considered current-carrying conductors.
    - b. Increase size of conductors as required to account for ampacity derating.
    - c. Size raceways, boxes, etc. to accommodate conductors.
  7. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.
  8. Provide oversized neutral/grounded conductors where indicated and as specified below.
    - a. Provide 200 percent rated neutral for feeders fed from K-rated transformers.
- B. Install products in accordance with manufacturer's instructions.
- C. Perform work in accordance with NECA 1 (general workmanship).
- D. Install aluminum conductors in accordance with NECA 104.
- E. Install armored cable (Type AC) in accordance with NECA 120.
- F. Install metal-clad cable (Type MC) in accordance with NECA 120.
- G. Installation in Raceway:
1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
  2. Pull all conductors and cables together into raceway at same time.
  3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
  4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.
- H. Exposed Cable Installation (only where specifically permitted):
1. Route cables parallel or perpendicular to building structural members and surfaces.
  2. Protect cables from physical damage.
- I. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.

- J. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.
  - 1. Installation Above Suspended Ceilings: Do not provide support from ceiling support system.
  - 2. Do not provide support from ceiling grid or allow conductors and cables to lay on ceiling tiles.
  - 3. Installation in Vertical Raceways: Provide supports where vertical rise exceeds permissible limits.
  
- K. Terminate cables using suitable fittings.
  - 1. Armored Cable (Type AC):
    - a. Use listed fittings and anti-short, insulating bushings.
    - b. Cut cable armor only using specialized tools to prevent damaging conductors or insulation. Do not use hacksaw or wire cutters to cut armor.
  - 2. Metal-Clad Cable (Type MC):
    - a. Use listed fittings.
    - b. Cut cable armor only using specialized tools to prevent damaging conductors or insulation. Do not use hacksaw or wire cutters to cut armor.
  
- L. Install conductors with a minimum of 12 inches (300 mm) of slack at each outlet.
  
- M. Where conductors are installed in enclosures for future termination by others, provide a minimum of 5 feet (1.5 m) of slack.
  
- N. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.
  
- O. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.
  
- P. Make wiring connections using specified wiring connectors.
  - 1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
  - 2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
  - 3. Do not remove conductor strands to facilitate insertion into connector.
  - 4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.
  - 5. Connections for Aluminum Conductors: Fill connectors with oxide inhibiting compound where not pre-filled by manufacturer.
  - 6. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
  - 7. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
  
- Q. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.

- R. Insulate ends of spare conductors using vinyl insulating electrical tape.
- S. Field-Applied Color Coding: Where vinyl color coding electrical tape is used in lieu of integrally colored insulation as permitted in Part 2 under "Color Coding", apply half overlapping turns of tape at each termination and at each location conductors are accessible.
- T. Identify conductors and cables in accordance with Section 260553.
- U. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 078400.
- V. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

#### 3.04 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.3.2. The insulation resistance test is required for all conductors. The resistance test for parallel conductors listed as optional is not required.
  - 1. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.
- D. Correct deficiencies and replace damaged or defective conductors and cables.

END OF SECTION 260519

SECTION 260526  
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Grounding and bonding requirements.
- B. Conductors for grounding and bonding.
- C. Connectors for grounding and bonding.

1.02 RELATED REQUIREMENTS

- A. Section 260519 - Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.
- B. Section 260536 - Cable Trays for Electrical Systems: Additional grounding and bonding requirements for cable tray systems.
- C. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

- A. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System; 2012.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- C. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2017.
- D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. UL 467 - Grounding and Bonding Equipment; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Coordinate the work with other trades to provide steel reinforcement complying with specified requirements for concrete-encased electrode.
  - 2. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

#### 1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittals procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.
- C. Shop Drawings
- D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- E. Field quality control test reports.
- F. Project Record Documents: Record actual locations of grounding electrode system components and connections.

#### 1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

#### 1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

### PART 2 PRODUCTS

#### 2.01 GROUNDING AND BONDING REQUIREMENTS

- A. Existing Work: Where existing grounding and bonding system components are indicated to be reused, they may be reused only where they are free from corrosion, integrity and continuity are verified, and where acceptable to the authority having jurisdiction.
- B. Do not use products for applications other than as permitted by NFPA 70 and product listing.
- C. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.
- D. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

- E. Grounding System Resistance:
1. Achieve specified grounding system resistance under normally dry conditions unless otherwise approved by Owner. Precipitation within the previous 48 hours does not constitute normally dry conditions.
  2. Grounding Electrode System: Not greater than 5 ohms to ground, when tested according to IEEE 81 using "fall-of-potential" method.
  3. Between Grounding Electrode System and Major Electrical Equipment Frames, System Neutral, and Derived Neutral Points: Not greater than 0.5 ohms, when tested using "point-to-point" methods.
- F. Separately Derived System Grounding:
1. Separately derived systems include, but are not limited to:
    - a. Transformers (except autotransformers such as buck-boost transformers).
    - b. Uninterruptible power supplies (UPS), when configured as separately derived systems.
  2. Provide grounding electrode conductor to connect derived system grounded conductor to nearest effectively grounded metal building frame. Unless otherwise indicated, make connection at neutral (grounded) bus in source enclosure.
  3. Provide bonding jumper to connect derived system grounded conductor to nearest metal building frame and nearest metal water piping in the area served by the derived system, where not already used as a grounding electrode for the derived system. Make connection at same location as grounding electrode conductor connection.
  4. Provide system bonding jumper to connect system grounded conductor to equipment ground bus. Make connection at same location as grounding electrode conductor connection. Do not make any other connections between neutral (grounded) conductors and ground on load side of separately derived system disconnect.
  5. Where the source and first disconnecting means are in separate enclosures, provide supply-side bonding jumper between source and first disconnecting means.
- G. Bonding and Equipment Grounding:
1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.
  2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
  3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
  4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
  5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
  6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.
- H. Isolated Ground System:



1. Where isolated ground receptacles or other isolated ground connections are indicated, provide separate isolated/insulated equipment grounding conductors.
2. Connect isolated/insulated equipment grounding conductors only to separate isolated/insulated equipment ground busses.
3. Connect the isolated/insulated equipment grounding conductors to the solidly bonded equipment ground bus only at the service disconnect or separately derived system disconnect. Do not make any other connections between isolated ground system and normal equipment ground system on the load side of this connection.

I. Cable Tray Systems: Also comply with Section 260536.

## 2.02 GROUNDING AND BONDING COMPONENTS

A. General Requirements:

1. Provide products listed, classified, and labeled as suitable for the purpose intended.
2. Provide products listed and labeled as complying with UL 467 where applicable.

B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 260526:

1. Use insulated copper conductors unless otherwise indicated.
  - a. Exceptions:
    - 1) Use bare copper conductors where installed underground in direct contact with earth.
    - 2) Use bare copper conductors where directly encased in concrete (not in raceway).

C. Connectors for Grounding and Bonding:

1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
2. Unless otherwise indicated, use exothermic welded connections for underground, concealed, and other inaccessible connections.
3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that work likely to damage grounding and bonding system components has been completed.
- B. Verify that field measurements are as indicated.
- C. Verify that conditions are satisfactory for installation prior to starting work.

### 3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).

- C. Make grounding and bonding connections using specified connectors.
  - 1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
  - 2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
  - 3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
  - 4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
  - 5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
  
- D. Identify grounding and bonding system components in accordance with Section 260553.

### 3.03 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.13.
- D. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.
- E. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.
- F. Submit detailed reports indicating inspection and testing results and corrective actions taken.

END OF SECTION 260526

SECTION 260529  
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other electrical work.

1.02 RELATED REQUIREMENTS

- A. Section 055000 - Metal Fabrications: Materials and requirements for fabricated metal supports.
- B. Section 260533.13 - Conduit for Electrical Systems: Additional support and attachment requirements for conduits.
- C. Section 260536 - Cable Trays for Electrical Systems: Additional support and attachment requirements for cable tray.
- D. Section 260533.16 - Boxes for Electrical Systems: Additional support and attachment requirements for boxes.
- E. Section 265100 - Interior Lighting: Additional support and attachment requirements for interior luminaires.

1.03 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.
- D. MFMA-4 - Metal Framing Standards Publication; 2004.
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.

2. Coordinate the work with other trades to provide additional framing and materials required for installation.
3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

#### 1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for channel (strut) framing systems, non-penetrating rooftop supports, and post-installed concrete and masonry anchors.
- C. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.
- D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

#### 1.06 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Comply with applicable building code.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

#### 1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

### PART 2 PRODUCTS

#### 2.01 SUPPORT AND ATTACHMENT COMPONENTS

- A. General Requirements:
  1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of electrical work.
  2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
  3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be

- supported with a minimum safety factor of \_\_\_\_\_. Include consideration for vibration, equipment operation, and shock loads where applicable.
4. Do not use products for applications other than as permitted by NFPA 70 and product listing.
  5. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
  6. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
    - a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
    - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
    - c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
    - d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
- B. Conduit and Cable Supports: Straps, clamps, etc. suitable for the conduit or cable to be supported.
1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
  2. Conduit Clamps: Bolted type unless otherwise indicated.
- C. Outlet Box Supports: Hangers, brackets, etc. suitable for the boxes to be supported.
- D. Metal Channel (Strut) Framing Systems: Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
1. Comply with MFMA-4.
- E. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.
- F. Anchors and Fasteners:
1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
  2. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
  3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
  4. Hollow Masonry: Use toggle bolts.
  5. Hollow Stud Walls: Use toggle bolts.
  6. Steel: Use beam clamps, machine bolts, or welded threaded studs.
  7. Sheet Metal: Use sheet metal screws.
  8. Wood: Use wood screws.
  9. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
    - a. Comply with MFMA-4.
    - b. Channel Material: Use galvanized steel.
    - c. Manufacturer: Same as manufacturer of metal channel (strut) framing system.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

### 3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- G. Field-Welding (where approved by Architect): Comply with Section 055000.
- H. Equipment Support and Attachment:
  - 1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
  - 2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
  - 3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
  - 4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- I. Conduit Support and Attachment: Also comply with Section 260533.13.
- J. Cable Tray Support and Attachment: Also comply with Section 260536.
- K. Box Support and Attachment: Also comply with Section 260533.16.
- L. Interior Luminaire Support and Attachment: Also comply with Section 265100.
- M. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.
- N. Secure fasteners according to manufacturer's recommended torque settings.

- O. Remove temporary supports.
- P. Identify independent electrical component support wires above accessible ceilings (only where specifically indicated or permitted) with color distinguishable from ceiling support wires in accordance with NFPA 70.

3.03 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Inspect support and attachment components for damage and defects.
- C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION 260529

SECTION 260533.13  
CONDUIT FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Galvanized steel rigid metal conduit (RMC).
- B. Aluminum rigid metal conduit (RMC).
- C. Intermediate metal conduit (IMC).
- D. PVC-coated galvanized steel rigid metal conduit (RMC).
- E. Flexible metal conduit (FMC).
- F. Liquidtight flexible metal conduit (LFMC).
- G. Electrical metallic tubing (EMT).
- H. Rigid polyvinyl chloride (PVC) conduit.
- I. Electrical nonmetallic tubing (ENT).
- J. Liquidtight flexible nonmetallic conduit (LFNC).
- K. Reinforced thermosetting resin conduit (RTRC).
- L. Conduit fittings.
- M. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 078400 - Firestopping.
- B. Section 260519 - Low-Voltage Electrical Power Conductors and Cables: Metal clad cable (Type MC), armored cable (Type AC), and manufactured wiring systems, including uses permitted.
- C. Section 260526 - Grounding and Bonding for Electrical Systems.
  - 1. Includes additional requirements for fittings for grounding and bonding.
- D. Section 260529 - Hangers and Supports for Electrical Systems.
- E. Section 260533.16 - Boxes for Electrical Systems.
- F. Section 260533.23 - Surface Raceways for Electrical Systems.
- G. Section 260553 - Identification for Electrical Systems: Identification products and requirements.



- H. Section 271000 - Structured Cabling: Additional requirements for communications systems conduits.

1.03 REFERENCE STANDARDS

- A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2015.
- B. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S); 2015.
- C. ANSI C80.5 - American National Standard for Electrical Rigid Metal Conduit -- Aluminum (ERMC-A); 2015.
- D. ANSI C80.6 - American National Standard for Electrical Intermediate Metal Conduit (EIMC); 2018.
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- F. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); 2013.
- G. NECA 102 - Standard for Installing Aluminum Rigid Metal Conduit; 2004.
- H. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC); 2017.
- I. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.
- J. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit; 2018.
- K. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit; 2020.
- L. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing; 2016.
- M. NEMA TC 13 - Electrical Nonmetallic Tubing (ENT); 2014 (Reaffirmed 2019).
- N. NEMA TC 14 (SERIES) - Reinforced Thermosetting Resin Conduit and Fittings Series; 2015.
- O. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- P. UL 1 - Flexible Metal Conduit; Current Edition, Including All Revisions.
- Q. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.
- R. UL 6A - Electrical Rigid Metal Conduit-Aluminum, Red Brass, and Stainless Steel; Current Edition, Including All Revisions.
- S. UL 360 - Liquid-Tight Flexible Steel Conduit; Current Edition, Including All Revisions.
- T. UL 514B - Conduit, Tubing, and Cable Fittings; Current Edition, Including All Revisions.

- U. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings; Current Edition, Including All Revisions.
- V. UL 797 - Electrical Metallic Tubing-Steel; Current Edition, Including All Revisions.
- W. UL 1203 - Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations; Current Edition, Including All Revisions.
- X. UL 1242 - Electrical Intermediate Metal Conduit-Steel; Current Edition, Including All Revisions.
- Y. UL 1653 - Electrical Nonmetallic Tubing; Current Edition, Including All Revisions.
- Z. UL 1660 - Liquid-Tight Flexible Nonmetallic Conduit; Current Edition, Including All Revisions.

#### 1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Coordinate minimum sizes of conduits with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
  - 2. Coordinate the arrangement of conduits with structural members, ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
  - 3. Verify exact conduit termination locations required for boxes, enclosures, and equipment installed under other sections or by others.
  - 4. Coordinate the work with other trades to provide roof penetrations that preserve the integrity of the roofing system and do not void the roof warranty.
  - 5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
  - 1. Do not begin installation of conductors and cables until installation of conduit is complete between outlet, junction and splicing points.

#### 1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittals procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conduits and fittings.
- C. Shop Drawings:
  - 1. Indicate proposed arrangement for conduits to be installed within structural concrete slabs, where permitted.
  - 2. Include proposed locations of roof penetrations and proposed methods for sealing.
- D. Project Record Documents: Record actual routing for conduits installed underground, conduits embedded within concrete slabs, and conduits 2 inch (53 mm) trade size and larger.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 CONDUIT APPLICATIONS

- A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70 and product listing.
- B. Unless otherwise indicated and where not otherwise restricted, use the conduit types indicated for the specified applications. Where more than one listed application applies, comply with the most restrictive requirements. Where conduit type for a particular application is not specified, use galvanized steel rigid metal conduit.
- C. Concealed Within Masonry Walls: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).
- D. Concealed Within Hollow Stud Walls: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).
- E. Concealed Above Accessible Ceilings: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).
- F. Interior, Damp or Wet Locations: Use galvanized steel rigid metal conduit.
- G. Exposed, Interior, Not Subject to Physical Damage: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).
- H. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).
- I. Corrosive Locations Above Ground: Use PVC-coated galvanized steel rigid metal conduit, aluminum rigid metal conduit, or reinforced thermosetting resin conduit (RTRC).
- J. Hazardous (Classified) Locations: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), aluminum rigid metal conduit, or PVC-coated galvanized steel rigid metal conduit.
- K. Connections to Luminaires Above Accessible Ceilings: Use flexible metal conduit.

1. Maximum Length: 6 feet (1.8 m).
- L. Connections to Vibrating Equipment:
  1. Dry Locations: Use flexible metal conduit.
  2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit.
  3. Maximum Length: 6 feet (1.8 m) unless otherwise indicated.
  4. Vibrating equipment includes, but is not limited to:
    - a. Transformers.
    - b. Motors.
    - c. Stationary Air Compressors
- M. Fished in Existing Walls, Where Necessary: Use flexible metal conduit.

## 2.02 CONDUIT REQUIREMENTS

- A. Existing Work: Where existing conduits are indicated to be reused, they may be reused only where they comply with specified requirements, are free from corrosion, and integrity is verified by pulling a mandrel through them.
- B. Communications Systems Conduits: Also comply with Section 271000.
- C. Fittings for Grounding and Bonding: Also comply with Section 260526.
- D. Provide all conduit, fittings, supports, and accessories required for a complete raceway system.
- E. Provide products listed, classified, and labeled as suitable for the purpose intended.
- F. Minimum Conduit Size, Unless Otherwise Indicated:
  1. Branch Circuits: 3/4 inch (21 mm) trade size.
  2. Branch Circuit Homeruns: 3/4 inch (21 mm) trade size.
  3. Control Circuits: 1/2 inch (16 mm) trade size.
  4. Flexible Connections to Luminaires: 3/8 inch (12 mm) trade size.
  5. Underground, Interior: 3/4 inch (21 mm) trade size.
- G. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

## 2.03 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

- A. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.
- B. Fittings:
  1. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
  2. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
  3. Material: Use steel or malleable iron.
  4. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.04 ALUMINUM RIGID METAL CONDUIT (RMC)

- A. Description: NFPA 70, Type RMC aluminum rigid metal conduit complying with ANSI C80.5 and listed and labeled as complying with UL 6A.
- B. Fittings:
  - 1. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
  - 2. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
  - 3. Material: Use aluminum.
  - 4. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.05 INTERMEDIATE METAL CONDUIT (IMC)

- A. Description: NFPA 70, Type IMC galvanized steel intermediate metal conduit complying with ANSI C80.6 and listed and labeled as complying with UL 1242.
- B. Fittings:
  - 1. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
  - 2. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
  - 3. Material: Use steel or malleable iron.
  - 4. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.06 PVC-COATED GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

- A. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit with external polyvinyl chloride (PVC) coating complying with NEMA RN 1 and listed and labeled as complying with UL 6.
- B. Exterior Coating: Polyvinyl chloride (PVC), nominal thickness of 40 mil (1.02 mm).
- C. PVC-Coated Fittings:
  - 1. Manufacturer: Same as manufacturer of PVC-coated conduit to be installed.
  - 2. Non-Hazardous Locations: Use fittings listed and labeled as complying with UL 514B.
  - 3. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
  - 4. Material: Use steel or malleable iron.
  - 5. Exterior Coating: Polyvinyl chloride (PVC), minimum thickness of 40 mil (1.02 mm).
- D. PVC-Coated Supports: Furnish with exterior coating of polyvinyl chloride (PVC), minimum thickness of 15 mil (0.38 mm).

2.07 FLEXIBLE METAL CONDUIT (FMC)

- A. Description: NFPA 70, Type FMC standard wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems to be used.
- B. Fittings:
  - 1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
  - 2. Material: Use steel or malleable iron.

2.08 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

- A. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.
- B. Fittings:
  - 1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
  - 2. Material: Use steel or malleable iron.

2.09 ELECTRICAL METALLIC TUBING (EMT)

- A. Description: NFPA 70, Type EMT steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.
- B. Fittings:
  - 1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
  - 2. Material: Use steel or malleable iron.
  - 3. Connectors and Couplings: Use compression (gland) or set-screw type.
    - a. Do not use indenter type connectors and couplings.
  - 4. Damp or Wet Locations (where permitted): Use fittings listed for use in wet locations.
  - 5. Embedded Within Concrete (where permitted): Use fittings listed as concrete-tight. Fittings that require taping to be concrete-tight are acceptable.

2.10 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

- A. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 degrees C.
- B. Fittings:
  - 1. Manufacturer: Same as manufacturer of conduit to be connected.
  - 2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

2.11 ELECTRICAL NONMETALLIC TUBING (ENT)

- A. Description: NFPA 70, Type ENT electrical nonmetallic tubing complying with NEMA TC 13 and listed and labeled as complying with UL 1653.
- B. Fittings:
  - 1. Manufacturer: Same as manufacturer of ENT to be connected.
  - 2. Use solvent-welded type fittings.
  - 3. Solvent-Welded Fittings: Rigid PVC fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; suitable for use with ENT.

2.12 LIQUIDTIGHT FLEXIBLE NONMETALLIC CONDUIT (LFNC)

- A. Description: NFPA 70, Type LFNC liquidtight flexible nonmetallic conduit listed and labeled as complying with UL 1660.
- B. Fittings:
  - 1. Manufacturer: Same as manufacturer of conduit to be connected.
  - 2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B; suitable for the type of conduit to be connected.

2.13 REINFORCED THERMOSETTING RESIN CONDUIT (RTRC)

- A. Description: NFPA 70, Type RTRC reinforced thermosetting resin conduit complying with NEMA TC 14 (SERIES).
- B. Supports: Per manufacturer's recommendations.
- C. Fittings: Same type and manufacturer as conduit to be connected.

2.14 ACCESSORIES

- A. Corrosion Protection Tape: PVC-based, minimum thickness of 20 mil (0.51 mm).
- B. Conduit Joint Compound: Corrosion-resistant, electrically conductive; suitable for use with the conduit to be installed.
- C. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.
- D. Epoxy Adhesive for RTRC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.
- E. Pull Strings: Use nylon cord with average breaking strength of not less than 200 pound-force (890 N).
- F. Sealing Compound for Sealing Fittings: Listed for use with the particular fittings to be installed.

- G. Modular Seals for Conduit Penetrations: Rated for minimum of 40 psig; Suitable for the conduits to be installed.
- H. Firestop Sleeves: Listed; provide as required to preserve fire resistance rating of building elements.

### PART 3 EXECUTION

#### 3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive conduits.
- C. Verify that conditions are satisfactory for installation prior to starting work.

#### 3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.
- D. Install aluminum rigid metal conduit (RMC) in accordance with NECA 102.
- E. Install intermediate metal conduit (IMC) in accordance with NECA 101.
- F. Install PVC-coated galvanized steel rigid metal conduit (RMC) using only tools approved by the manufacturer.
- G. Install rigid polyvinyl chloride (PVC) conduit in accordance with NECA 111.
- H. Install electrical nonmetallic tubing (ENT) in accordance with NECA 111.
- I. Install liquidtight flexible nonmetallic conduit (LFNC) in accordance with NECA 111.
- J. Conduit Routing:
  - 1. Unless dimensioned, conduit routing indicated is diagrammatic.
  - 2. When conduit destination is indicated without specific routing, determine exact routing required.
  - 3. Conceal all conduits unless specifically indicated to be exposed.
  - 4. Conduits in the following areas may be exposed, unless otherwise indicated:
    - a. Electrical rooms.
    - b. Mechanical equipment rooms.
    - c. Within joists in areas with no ceiling.
  - 5. Conduits installed underground or embedded in concrete may be routed in the shortest possible manner unless otherwise indicated. Route all other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.
  - 6. Arrange conduit to maintain adequate headroom, clearances, and access.



7. Arrange conduit to provide no more than the equivalent of four 90 degree bends between pull points.
8. Route conduits above water and drain piping where possible.
9. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
10. Maintain minimum clearance of 12 inches (300 mm) between conduits and hot surfaces. This includes, but is not limited to:
  - a. Heaters.
  - b. Hot water piping.
  - c. Flues.
11. Group parallel conduits in the same area together on a common rack.

K. Conduit Support:

1. Secure and support conduits in accordance with NFPA 70 and Section 260529 using suitable supports and methods approved by the authority having jurisdiction.
2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
3. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
4. Use conduit strap to support single surface-mounted conduit.
  - a. Use clamp back spacer with conduit strap for damp and wet locations to provide space between conduit and mounting surface.
5. Use metal channel (strut) with accessory conduit clamps to support multiple parallel surface-mounted conduits.
6. Use conduit clamp to support single conduit from beam clamp or threaded rod.
7. Use trapeze hangers assembled from threaded rods and metal channel (strut) with accessory conduit clamps to support multiple parallel suspended conduits.
8. Use non-penetrating rooftop supports to support conduits routed across rooftops (only where approved).
9. Use of wire for support of conduits is not permitted.
10. Where conduit support intervals specified in NFPA 70 and NECA standards differ, comply with the most stringent requirements.

L. Connections and Terminations:

1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
3. Use suitable adapters where required to transition from one type of conduit to another.
4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
6. Where spare conduits stub up through concrete floors and are not terminated in a box or enclosure, provide threaded couplings equipped with threaded plugs set flush with finished floor.
7. Provide insulating bushings or insulated throats at all conduit terminations to protect conductors.

8. Secure joints and connections to provide maximum mechanical strength and electrical continuity.
- M. Penetrations:
1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
  2. Make penetrations perpendicular to surfaces unless otherwise indicated.
  3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
  4. Conceal bends for conduit risers emerging above ground.
  5. Seal interior of conduits entering the building from underground at first accessible point to prevent entry of moisture and gases.
  6. Provide suitable modular seal where conduits penetrate exterior wall below grade.
  7. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
  8. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty. Include proposed locations of penetrations and methods for sealing with submittals.
  9. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 078400.
- N. Hazardous (Classified) Locations: Where conduits cross boundaries of hazardous (classified) locations, provide sealing fittings located as indicated or in accordance with NFPA 70.
- O. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
  2. Where calculated in accordance with NFPA 70 for rigid polyvinyl chloride (PVC) conduit installed above ground to compensate for thermal expansion and contraction.
  3. Where calculated in accordance with NFPA 70 for reinforced thermosetting resin conduit (RTRC) conduit installed above ground to compensate for thermal expansion and contraction.
  4. Where conduits are subject to earth movement by settlement or frost.
- P. Condensation Prevention: Where conduits cross barriers between areas of potential substantial temperature differential, provide sealing fitting or approved sealing compound at an accessible point near the penetration to prevent condensation. This includes, but is not limited to:
1. Where conduits pass from outdoors into conditioned interior spaces.
  2. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.
- Q. Provide pull string in all empty conduits and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches (300 mm) at each end.
- R. Provide grounding and bonding in accordance with Section 260526.
- S. Identify conduits in accordance with Section 260553.

3.03 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- C. Where coating of PVC-coated galvanized steel rigid metal conduit (RMC) contains cuts or abrasions, repair in accordance with manufacturer's instructions.
- D. Correct deficiencies and replace damaged or defective conduits.

3.04 CLEANING

- A. Clean interior of conduits to remove moisture and foreign matter.

3.05 PROTECTION

- A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

END OF SECTION 260533.13

SECTION 260533.16  
BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

- A. Section 083100 - Access Doors and Panels: Panels for maintaining access to concealed boxes.
- B. Section 260526 - Grounding and Bonding for Electrical Systems.
- C. Section 260529 - Hangers and Supports for Electrical Systems.
- D. Section 260533.13 - Conduit for Electrical Systems:
  - 1. Conduit bodies and other fittings.
  - 2. Additional requirements for locating boxes to limit conduit length and/or number of bends between pulling points.
- E. Section 260533.23 - Surface Raceways for Electrical Systems:
  - 1. Accessory boxes designed specifically for surface raceway systems.
  - 2. Lay-in wireways and wiring troughs with removable covers.
- F. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- G. Section 262726 - Wiring Devices:
  - 1. Wall plates.
  - 2. Additional requirements for locating boxes for wiring devices.
- H. Section 271000 - Structured Cabling: Additional requirements for communications systems outlet boxes.

1.02 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- B. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2010.
- C. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.
- D. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; 2013 (Reaffirmed 2020).
- E. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports; 2013.
- F. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

- H. SCTE 77 - Specification for Underground Enclosure Integrity; 2017.
- I. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- J. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- K. UL 508A - Industrial Control Panels; Current Edition, Including All Revisions.
- L. UL 514A - Metallic Outlet Boxes; Current Edition, Including All Revisions.
- M. UL 514C - Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers; Current Edition, Including All Revisions.
- N. UL 1203 - Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations; Current Edition, Including All Revisions.

### 1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
  - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
  - 3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
  - 4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
  - 5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
  - 6. Coordinate the work with other trades to preserve insulation integrity.
  - 7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.
  - 8. Notify Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

### 1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for cabinets and enclosures, boxes for hazardous (classified) locations, floor boxes, and underground boxes/enclosures.
- C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

- D. Project Record Documents: Record actual locations for outlet and device boxes, pull boxes, cabinets and enclosures, floor boxes, and underground boxes/enclosures.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 016000 - Product Requirements, for additional provisions.
  - 2. Keys for Lockable Enclosures: Two of each different key.

#### 1.05 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

### PART 2 PRODUCTS

#### 2.01 BOXES

- A. General Requirements:
  - 1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
  - 2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
  - 3. Provide products listed, classified, and labeled as suitable for the purpose intended.
  - 4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
  - 5. Provide grounding terminals within boxes where equipment grounding conductors terminate.
- B. Outlet and Device Boxes Up to 100 cubic inches (1,650 cu cm), Including Those Used as Junction and Pull Boxes:
  - 1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
  - 2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
  - 3. Use suitable concrete type boxes where flush-mounted in concrete.
  - 4. Use suitable masonry type boxes where flush-mounted in masonry walls.
  - 5. Use raised covers suitable for the type of wall construction and device configuration where required.
  - 6. Use shallow boxes where required by the type of wall construction.
  - 7. Do not use "through-wall" boxes designed for access from both sides of wall.

8. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
  9. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
  10. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
  11. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes unless specifically indicated or permitted.
  12. Minimum Box Size, Unless Otherwise Indicated:
    - a. Wiring Devices (Other Than Communications Systems Outlets): 4 inch square by 1-1/2 inch deep (100 by 38 mm) trade size.
    - b. Communications Systems Outlets: 4 inch square by 2-1/8 inch (100 by 54 mm) trade size.
    - c. Ceiling Outlets: 4 inch octagonal or square by 1-1/2 inch deep (100 by 38 mm) trade size.
  13. Wall Plates: Comply with Section 262726.
- C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches (1,650 cu cm):
1. Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
  2. NEMA 250 Environment Type, Unless Otherwise Indicated:
    - a. Indoor Clean, Dry Locations: Type 1, painted steel.
    - b. Outdoor Locations: Type 3R, painted steel.
  3. Junction and Pull Boxes Larger Than 100 cubic inches (1,650 cu cm):
    - a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.
  4. Cabinets and Hinged-Cover Enclosures, Other Than Junction and Pull Boxes:
  5. Finish for Painted Steel Enclosures: Manufacturer's standard grey unless otherwise indicated.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive boxes.
- C. Verify that conditions are satisfactory for installation prior to starting work.

### 3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install boxes in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.

- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide separate boxes for emergency power and normal power systems.
- E. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.
- F. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.
- G. Unless otherwise indicated, boxes may be surface-mounted where exposed conduits are indicated or permitted.
- H. Box Locations:
  - 1. Locate boxes to be accessible. Provide access panels in accordance with Section 083100 as required.
  - 2. Unless dimensioned, box locations indicated are approximate.
  - 3. Locate boxes as required for devices installed under other sections or by others.
    - a. Switches, Receptacles, and Other Wiring Devices: Comply with Section 262726.
    - b. Communications Systems Outlets: Comply with Section 271000.
  - 4. Locate boxes so that wall plates do not span different building finishes.
  - 5. Locate boxes so that wall plates do not cross masonry joints.
  - 6. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.
  - 7. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches (150 mm) horizontal separation unless otherwise indicated.
  - 8. Acoustic-Rated Walls: Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches (610 mm) horizontal separation.
  - 9. Fire Resistance Rated Walls: Install flush-mounted boxes such that the required fire resistance will not be reduced.
    - a. Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches (610 mm) separation where wall is constructed with individual noncommunicating stud cavities or protect both boxes with listed putty pads.
  - 10. Locate junction and pull boxes as indicated, as required to facilitate installation of conductors, and to limit conduit length and/or number of bends between pulling points in accordance with Section 260533.13.
  - 11. Locate junction and pull boxes in the following areas, unless otherwise indicated:
    - a. Concealed above accessible suspended ceilings.
    - b. Within joists in areas with no ceiling.
    - c. Electrical rooms.
    - d. Mechanical equipment rooms.
- I. Box Supports:
  - 1. Secure and support boxes in accordance with NFPA 70 and Section 260529 using suitable supports and methods approved by the authority having jurisdiction.
  - 2. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.



3. Installation Above Suspended Ceilings: Do not provide support from ceiling grid or ceiling support system.
  4. Use far-side support to secure flush-mounted boxes supported from single stud in hollow stud walls. Repair or replace supports for boxes that permit excessive movement.
- J. Install boxes plumb and level.
- K. Flush-Mounted Boxes:
1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is set back from finished surface not more than 1/4 inch (6 mm) or does not project beyond finished surface.
  2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.
  3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch (3 mm) at the edge of the box.
- L. Install boxes as required to preserve insulation integrity.
- M. Metallic Floor Boxes: Install box level at the proper elevation to be flush with finished floor.
- N. Nonmetallic Floor Boxes: Cut box flush with finished floor after concrete pour.
- O. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- P. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 078400.
- Q. Close unused box openings.
- R. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.
- S. Provide grounding and bonding in accordance with Section 260526.
- T. Identify boxes in accordance with Section 260553.
- 3.03 CLEANING
- A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.
- 3.04 PROTECTION
- A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

END OF SECTION 260533.16

SECTION 260533.23  
SURFACE RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface raceway systems.

1.02 RELATED REQUIREMENTS

- A. Section 260526 - Grounding and Bonding for Electrical Systems.
- B. Section 260529 - Hangers and Supports for Electrical Systems.
- C. Section 260533.13 - Conduit for Electrical Systems.
- D. Section 260533.16 - Boxes for Electrical Systems.
- E. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- F. Section 262726 - Wiring Devices: Receptacles.
- G. Section 271000 - Structured Cabling: Voice and data jacks.

1.03 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. NEMA PRP 5 - Installation Guidelines for Surface Nonmetallic Raceway; 2015.
- D. UL 5 - Surface Metal Raceways and Fittings; Current Edition, Including All Revisions.
- E. UL 111 - Outline of Investigation for Multioutlet Assemblies; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Coordinate the placement of raceways with millwork, furniture, equipment, etc. installed under other sections or by others.
  - 2. Coordinate rough-in locations of outlet boxes provided under Section 260533.16 and conduit provided under Section 260533.13 as required for installation of raceways provided under this section.

3. Verify minimum sizes of raceways with the actual conductors and components to be installed.
4. Notify Owner of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:

1. Do not install raceways until final surface finishes and painting are complete.
2. Do not begin installation of conductors and cables until installation of raceways is complete between outlet, junction and splicing points.

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets including dimensions, knockout sizes and locations, materials, fabrication details, finishes, service condition requirements, and accessories.
  1. Surface Raceway Systems: Include information on fill capacities for conductors and cables.
- C. Shop Drawings:
  1. Pre-wired Surface Raceway Systems: Provide plan and elevation views including dimensioned locations of wiring devices and circuiting arrangements.
  2. Wireways: Provide dimensioned plan and elevation views including adjacent equipment with all required clearances indicated.
- D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

## PART 2 PRODUCTS

### 2.01 RACEWAY REQUIREMENTS

- A. Provide all components, fittings, supports, and accessories required for a complete raceway system.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Do not use raceways for applications other than as permitted by NFPA 70 and product listing.

### 2.02 SURFACE RACEWAY SYSTEMS

- A. Manufacturers:
  - 1. Wiremold, a brand of Legrand North America, Inc: [www.legrand.us/#sle](http://www.legrand.us/#sle).
- B. Surface Metal Raceways: Listed and labeled as complying with UL 5.
- C. Multioutlet Assemblies: Listed and labeled as complying with UL 111.

### 2.03 SOURCE QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Factory test each production unit for pre-wired surface raceway systems to verify proper wiring.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes and conduit terminations are installed in proper locations and are properly sized in accordance with NFPA 70 to accommodate raceways.
- C. Verify that mounting surfaces are ready to receive raceways and that final surface finishes are complete, including painting.
- D. Verify that conditions are satisfactory for installation prior to starting work.

### 3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Surface Nonmetallic Raceways: Install in accordance with NEMA PRP 5.
- D. Install raceways plumb and level.

- E. Secure and support raceways in accordance with Section 260529 at intervals complying with NFPA 70 and manufacturer's requirements.
- F. Close unused raceway openings.
- G. Provide grounding and bonding in accordance with Section 260526.
- H. Identify raceways in accordance with Section 260553.

### 3.03 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Inspect raceways for damage and defects.
- C. Surface Raceway Systems with Integrated Devices: Test each wiring device to verify operation and proper polarity.
- D. Correct wiring deficiencies and replace damaged or defective raceways.

### 3.04 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

### 3.05 PROTECTION

- A. Protect installed raceways from subsequent construction operations.

END OF SECTION 260533.23

SECTION 260536  
CABLE TRAYS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Metal cable tray systems:
  - 1. Metal ladder cable tray.
  - 2. Metal solid-bottom cable tray.
  - 3. Metal single rail/center spine cable tray.
  - 4. Metal channel cable tray.
  - 5. Metal wire mesh/basket cable tray.

1.02 RELATED REQUIREMENTS

- A. Section 078400 - Firestopping.
- B. Section 260526 - Grounding and Bonding for Electrical Systems.
- C. Section 260529 - Hangers and Supports for Electrical Systems.
- D. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 271000 - Structured Cabling.

1.03 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2022.
- C. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2009 (Reapproved 2015).
- D. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- F. NEMA VE 1 - Metal Cable Tray Systems; 2017.
- G. NEMA VE 2 - Cable Tray Installation Guidelines; 2018.
- H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

#### 1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Coordinate the arrangement of cable tray with structural members, ductwork, piping, equipment and other potential conflicts installed under other sections or by others. Coordinate the work with other trades to avoid installation of obstructions within cable tray required clearances.
  - 2. Coordinate arrangement of cable tray with the dimensions and clearance requirements of the actual products to be installed.
  - 3. Coordinate the work with placement of supports, anchors, etc. required for mounting.
  - 4. Notify of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Preinstallation Meeting: Convene one week prior to commencing work of this section; require attendance of all affected installers. Review proposed routing, sequence of installation, and protection requirements for installed cable tray.
- C. Sequencing:
  - 1. Do not begin installation of cables until installation of associated cable tray run is complete.

#### 1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for cable tray system components and accessories. Include dimensions, materials, fabrication details, finishes, and span/load ratings.
  - 1. Fiberglass Cable Tray Systems: Include requirements for strength derating according to ambient temperature.
- C. Shop Drawings: Include dimensioned plan views and sections indicating proposed cable tray routing, required clearances, and locations and details of supports, fittings, building element penetrations, and equipment connections.
- D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

#### 1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions and NEMA VE 2, except do not store cable tray outdoors without cover as permitted in NEMA VE 2.
- B. Handle products carefully to avoid damage to finish.

PART 2 PRODUCTS

2.01 CABLE TRAY SYSTEM - GENERAL REQUIREMENTS

- A. Provide new cable tray system consisting of all required components, fittings, supports, accessories, etc. as necessary for a complete system.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Do not use cable tray for applications other than as permitted by NFPA 70 and product listing/classification.
- D. Provide cable tray system and associated components suitable for use at indicated span/load ratings under the service conditions at the installed location.
- E. Unless otherwise indicated, specified span/load ratings are based on safety factor of 1.5 and working load only (no additional concentrated static load), with ratings for metal cable tray systems in accordance with NEMA VE 1.
- F. Unless otherwise indicated, specified load/fill depths and inside widths are nominal values, with values for metal cable tray systems in accordance with NEMA VE 1 including applicable allowable tolerances.

2.02 METAL CABLE TRAY SYSTEMS

- A. Comply with NEMA VE 1.
- B. Finishes:
  - 1. Zinc Electroplated Steel: Comply with ASTM B633.
  - 2. Mill-Galvanized Before Fabrication (Pre-Galvanized) Steel: Comply with ASTM A653/A653M, G90 coating.
  - 3. Hot-Dip Galvanized After Fabrication (H.D.G.A.F.) Steel: Comply with ASTM A123/A123M.
  - 4. Stainless Steel: Type 304 or Type 316.
- C. Metal Ladder Cable Tray:
  - 1. Material: Mill-galvanized before fabrication (pre-galvanized) steel.
  - 2. Side Rail Construction: I-beam, C-channel flange out, or C-channel flange in.
  - 3. Load/Fill Depth: As indicated on drawings.
  - 4. Span/Load Rating: Per manufacturer recommendation.
  - 5. Rung Spacing: 9 inches (229 mm) on center for straight lengths.



6. Inside Width: As indicated on drawings.
7. Inside Radius of Fittings: 12 inches (305 mm).
8. Covers: Solid flat flanged.

D. Metal Ventilated Trough Cable Tray:

1. Material: Mill-galvanized before fabrication (pre-galvanized) steel.
2. Bottom Type: Vented corrugated.
3. Load/Fill Depth: As indicated on drawings.
4. Span/Load Rating: Per manufacturer recommendation.
5. Inside Width: As indicated on drawings.
6. Inside Radius of Fittings: 12 inches (305 mm).

E. Metal Solid-Bottom Cable Tray:

1. Material: Mill-galvanized before fabrication (pre-galvanized) steel.
2. Bottom Type: Solid corrugated or flat.
3. Load/Fill Depth: As indicated on drawings.
4. Span/Load Rating: Per manufacturer recommendation.
5. Inside Width: As indicated on drawings.
6. Inside Radius of Fittings: 12 inches (305 mm).

F. Metal Single Rail/Center Spine Cable Tray:

1. Material: Mill-galvanized before fabrication (pre-galvanized) steel.
2. Configuration: Center rail or wall mount as indicated.
3. Number of Tiers: Single tier.
4. Load/Fill Depth: As indicated on drawings.
5. Span/Load Rating: Per manufacturer recommendation.
6. Rung Spacing: 9 inches (229 mm) on center for straight lengths.
7. Inside Width: As indicated on drawings.
8. Inside Radius of Fittings: 12 inches (305 mm).

G. Metal Channel Cable Tray:

1. Material: Mill-galvanized before fabrication (pre-galvanized) steel.
2. Bottom Type: Solid bottom.
3. Tray Depth: 1-3/4 inches (44 mm).
4. Span/Load Rating: Per manufacturer recommendation.
5. Tray Width: 4 inches (102 mm).
6. Inside Radius of Fittings: 12 inches (305 mm).

H. Metal Wire Mesh/Basket Cable Tray:

1. Material: Zinc electroplated steel or mill-galvanized before fabrication (pre-galvanized) steel.
2. Tray Depth: As indicated on drawings.
3. Span/Load Rating: Per manufacturer recommendation.
4. Mesh Spacing: 2 by 4 inches (51 by 102 mm).
5. Tray Width: As indicated on drawings.

## 2.03 SOURCE QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.

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SPECIFICATIONS

Cable Trays for Electrical Systems

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- B. Metal Cable Tray: Perform factory design tests in accordance with NEMA VE 1, including electrical continuity and load testing.

### PART 3 EXECUTION

#### 3.01 EXAMINATION

- A. Verify that work likely to damage cable tray system has been completed.
- B. Verify that field measurements are as indicated.
- C. Verify that the dimensions and span/load ratings of cable tray system components are consistent with the indicated requirements.
- D. Verify that mounting surfaces are ready to receive cable tray and associated supports.
- E. Verify that conditions are satisfactory for installation prior to starting work.

#### 3.02 PREPARATION

- A. Modifications to Existing Cable Tray Systems: Remove inactive or abandoned cables from existing cable tray system.

#### 3.03 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install cable tray in accordance with NECA 1 (general workmanship), and NEMA VE 2.
- C. Unless otherwise indicated, arrange cable tray to be parallel or perpendicular to building lines.
- D. Arrange cable tray to provide required clearances and maintain cable access.
- E. Install cable tray plumb and level, with sections aligned and with horizontal runs at the proper elevation.
- F. Metal Wire Mesh/Basket Cable Tray: Field fabricate fittings in accordance with manufacturer's instructions, using only manufacturer-approved connectors classified for bonding.
  - 1. Inside Radius of Fittings: 12 inches (305 mm).
- G. Hot-Dip Galvanized After Fabrication (H.D.G.A.F.) Steel Cable Tray: After cutting, drilling, or deburring, use approved zinc-rich paint to repair finish in accordance with ASTM A780/A780M.
- H. Cable Tray Movement Provisions:
  - 1. Provide suitable expansion fittings where cable tray is subject to movement, including but not limited to:
    - a. Where cable tray crosses structural joints intended for expansion.
    - b. Long straight cable tray runs in accordance with NEMA VE 2.
  - 2. Use expansion guides in lieu of hold-down clamps where prescribed in NEMA VE 2.

3. Set gaps for expansion fittings in accordance with NEMA VE 2.
- I. Cable Provisions:
1. Use suitable fixed barrier strips to maintain separation of cables as indicated and as required by NFPA 70.
  2. Use suitable drop-out fittings or bushings where cables exit cable tray as required to maintain minimum cable bending radius.
  3. Use suitable cable support fittings for long vertical cable tray runs with heavy cables.
- J. Provide end closures at unconnected ends of cable tray runs.
- K. Cable Tray Support:
1. Use manufacturer's recommended hangers and supports, located in accordance with NEMA VE 2 and manufacturer's requirements, but not exceeding specified span unless otherwise approved by Engineer. Provide required support and attachment in accordance with Section 260529, where not furnished by cable tray manufacturer.
  2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- L. Grounding and Bonding Requirements, in Addition to Requirements of Section 260526:
1. Comply with grounding and bonding requirements of NEMA VE 2.
  2. Metal Cable Tray Systems: Use suitable bonding jumpers or classified connectors to provide electrical continuity.
  3. Provide suitable equipment grounding conductor in each cable tray, except where cable tray contains only multiconductor cables with integral equipment grounding conductors. Do not use metal cable tray system as sole equipment grounding conductor.
    - a. Equipment Grounding Conductor for Steel Cable Tray: Use bare or insulated copper conductor.
    - b. Equipment Grounding Conductor for Aluminum Cable Tray: Use insulated copper conductor only; do not use bare copper conductor.
    - c. Minimum Equipment Grounding Conductor Size: 6 AWG copper.
    - d. Bond equipment grounding conductor to each cable tray section using suitable listed ground clamps. Separate bonding jumpers are not required where properly bonded equipment grounding conductor provides equivalent continuity.
- M. Conduit Termination:
1. Use listed cable tray conduit clamps (evaluated for bonding connection) to terminate conduits at cable tray.
  2. Provide insulating bushing at conduit termination to protect cables.
  3. Provide independent support for conduit.
- N. Cable Installation:
1. Comply with cable installation requirements of NEMA VE 2.
  2. Use appropriate cable pulling tools, applied to prevent excessive force on cable tray system and maintain minimum cable bending radius.
  3. Use cable clamps or cable ties to fasten conductors/cables to vertical and horizontal runs of cable tray.
    - a. Distance Between Fastening Points for Vertical Runs: 18 inches (450 mm).
    - b. Distance Between Fastening Points for Horizontal Runs: As required to maintain spacing and confine conductor/cable within the cable fill area.

- O. Penetrations: Install firestopping to preserve fire resistance rating of building elements, using materials and methods specified in Section 078400.
- P. Identification Requirements, in Addition to Those Specified in Section 260553.
  - 1. Use warning labels to identify cable tray with the word message "WARNING! Do Not Use As A Walkway, Ladder, Or Support For Personnel. Use Only As A Mechanical Support For Cables, Tubing and Raceways." at maximum intervals of 20 feet (6 m).
- Q. Install cable tray covers where indicated and as follows:
  - 1. For first 6 feet (1.8 m) of cable tray extending vertically from a floor penetration.
  - 2. Where cable tray passes under open walkways.

#### 3.04 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Inspect cable tray system for damage and defects.
- C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- D. Correct deficiencies and replace damaged or defective cable tray system components.

#### 3.05 ADJUSTING

- A. Adjust tightness of mechanical connections to manufacturer's recommended torque settings.

#### 3.06 CLEANING

- A. Remove dirt and debris from cable tray.
- B. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

#### 3.07 PROTECTION

- A. Protect cable tray system from subsequent construction operations.

END OF SECTION 260536

SECTION 260553  
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Electrical identification requirements.
- B. Identification nameplates and labels.
- C. Wire and cable markers.
- D. Voltage markers.
- E. Warning signs and labels.

1.02 RELATED REQUIREMENTS

- A. Section 099113 - Exterior Painting.
- B. Section 099123 - Interior Painting.
- C. Section 260519 - Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.
- D. Section 260536 - Cable Trays for Electrical Systems: Additional identification requirements for cable tray systems.
- E. Section 262726 - Wiring Devices - Lutron: Device and wallplate finishes; factory pre-marked wallplates.
- F. Section 271000 - Structured Cabling: Identification for communications cabling and devices.

1.03 REFERENCE STANDARDS

- A. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. NFPA 70E - Standard for Electrical Safety in the Workplace; 2018.
- C. UL 969 - Marking and Labeling Systems; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.

B. Sequencing:

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SPECIFICATIONS

Identification for Electrical Systems

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1. Do not conceal items to be identified, in locations such as above suspended ceilings, until identification products have been installed.
2. Do not install identification products until final surface finishes and painting are complete.

#### 1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittals procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.
- C. Shop Drawings: Provide schedule of items to be identified indicating proposed designations, materials, legends, and formats.
- D. Samples:
  1. Identification Nameplates: One of each type and color specified.
  2. Warning Signs and Labels: One of each type and legend specified.
- E. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation and installation of product.

#### 1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

#### 1.07 FIELD CONDITIONS

- A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

### PART 2 PRODUCTS

#### 2.01 IDENTIFICATION REQUIREMENTS

- A. Existing Work: Unless specifically excluded, identify existing elements to remain that are not already identified in accordance with specified requirements.
- B. Identification for Equipment:
  1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
    - a. Panelboards:
      - 1) Identify ampere rating.
      - 2) Identify voltage and phase.
      - 3) Identify power source and circuit number. Include location when not within sight of equipment.
      - 4) Identify main overcurrent protective device. Use identification label for panelboards with a door. For power distribution panelboards without a door, use identification nameplate.

- 5) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces.
- b. Transformers:
  - 1) Identify kVA rating.
  - 2) Identify voltage and phase for primary and secondary.
  - 3) Identify power source and circuit number. Include location when not within sight of equipment.
  - 4) Identify load(s) served. Include location when not within sight of equipment.
2. Emergency System Equipment:
  - a. Use identification nameplate or voltage marker to identify emergency system equipment in accordance with NFPA 70.
  - b. Use identification nameplate at each piece of service equipment to identify type and location of on-site emergency power sources.
3. Use identification nameplate to identify equipment utilizing series ratings, where permitted, in accordance with NFPA 70.
4. Use identification nameplate to identify disconnect location for equipment with remote disconnecting means.
5. Use identification label or handwritten text using indelible marker on inside of door at each fused switch to identify required NEMA fuse class and size.
6. Use identification label to identify overcurrent protective devices for branch circuits serving fire alarm circuits. Identify with text "FIRE ALARM CIRCUIT".
7. Available Fault Current Documentation: Use identification label to identify the available fault current and date calculations were performed at locations requiring documentation by NFPA 70 including but not limited to the following.
  - a. Service equipment.
  - b. Industrial control panels.
  - c. Motor control centers.
  - d. Elevator control panels.
  - e. Industrial machinery.
8. Arc Flash Hazard Warning Labels: Use warning labels to identify arc flash hazards for electrical equipment, such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers that are likely to require examination, adjustment, servicing, or maintenance while energized.
  - a. Minimum Size: 3.5 by 5 inches (89 mm by 127 mm).
  - b. Legend: Include orange header that reads "WARNING", followed by the word message "Arc Flash and Shock Hazard; Appropriate PPE Required; Do not operate controls or open covers without appropriate personal protection equipment; Failure to comply may result in injury or death; Refer to NFPA 70E for minimum PPE requirements" or approved equivalent.
9. Use warning signs to identify electrical hazards for entrances to all rooms and other guarded locations that contain exposed live parts operating at 600 V nominal or less with the word message "DANGER; Electrical hazard; Authorized personnel only" or approved equivalent.
10. Use warning signs to identify electrical hazards for entrances to all buildings, vaults, rooms, or enclosures containing exposed live parts or exposed conductors operating at over 600 V nominal with the word message "DANGER; HIGH VOLTAGE; KEEP OUT".

11. Use warning labels to identify electrical hazards for equipment, compartments, and enclosures containing exposed live parts or exposed conductors operating at over 600 V nominal with the word message "DANGER; HIGH VOLTAGE; KEEP OUT".
  12. Use warning labels, identification nameplates, or identification labels to identify electrical hazards for equipment where multiple power sources are present with the word message "DANGER; Hazardous voltage; Multiple power sources may be present; Disconnect all electric power including remote disconnects before servicing" or approved equivalent.
- C. Identification for Conductors and Cables:
1. Color Coding for Power Conductors 600 V and Less: Comply with Section 260519.
  2. Identification for Communications Conductors and Cables: Comply with Section 271000.
  3. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.
  4. Use wire and cable markers to identify circuit number or other designation indicated for power, control, and instrumentation conductors and cables at the following locations:
    - a. Within boxes when more than one circuit is present.
    - b. Within equipment enclosures when conductors and cables enter or leave the enclosure.
- D. Identification for Raceways:
1. Use voltage markers or color-coded bands to identify systems other than normal power system for accessible conduits at maximum intervals of 20 feet (6.1 m).
    - a. Color-Coded Bands: Use field-painting or vinyl color coding electrical tape to mark bands 3 inches (76 mm) wide.
      - 1) Color Code:
        - a) Emergency Power System: Red.
        - b) Fire Alarm System: Red.
      - 2) Field-Painting: Comply with Section 099123 and 099113.
      - 3) Vinyl Color Coding Electrical Tape: Comply with Section 260519.
  2. Use identification labels, handwritten text using indelible marker, or plastic marker tags to identify circuits enclosed for accessible conduits at wall penetrations, at floor penetrations, at roof penetrations, and at equipment terminations when source is not within sight.
  3. Use identification labels, handwritten text using indelible marker, or plastic marker tags to identify spare conduits at each end. Identify purpose and termination location.
- E. Identification for Cable Tray: Comply with Section 260536.
- F. Identification for Boxes:
1. Use voltage markers or color coded boxes to identify systems other than normal power system.
    - a. Color-Coded Boxes: Field-painted in accordance with Section 099123 and 099113 per the same color code used for raceways.
      - 1) Emergency Power System: Red.
      - 2) Fire Alarm System: Red.



2. Use identification labels or handwritten text using indelible marker to identify circuits enclosed.
  - a. For exposed boxes in public areas, use only identification labels.
3. Use warning labels to identify electrical hazards for boxes containing exposed live parts or exposed conductors operating at over 600 V nominal with the word message "DANGER; HIGH VOLTAGE; KEEP OUT".

G. Identification for Devices:

1. Identification for Communications Devices: Comply with Section 271000.
2. Wiring Device and Wallplate Finishes: Comply with Section 262726.
3. Factory Pre-Marked Wallplates: Comply with Section 262726.
4. Use identification label to identify fire alarm system devices.
  - a. For devices concealed above suspended ceilings, provide additional identification on ceiling tile below device location.
5. Use identification label or engraved wallplate to identify serving branch circuit for all receptacles.
6. Use identification label to identify receptacles protected by upstream GFI protection, where permitted.

H. Identification for Luminaires:

1. Use permanent red dot on luminaire frame to identify luminaires connected to emergency power system.

## 2.02 IDENTIFICATION NAMEPLATES AND LABELS

A. Identification Nameplates:

1. Materials:
  - a. Indoor Clean, Dry Locations: Use plastic nameplates.
  - b. Outdoor Locations: Use plastic, stainless steel, or aluminum nameplates suitable for exterior use.
2. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch (1.6 mm); engraved text.
3. Stainless Steel Nameplates: Minimum thickness of 1/32 inch (0.8 mm); engraved or laser-etched text.
4. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch (0.8 mm); engraved or laser-etched text.
5. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch (25 mm) high; Four, located at corners for larger sizes.

B. Identification Labels:

1. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
  - a. Use only for indoor locations.
2. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.

C. Format for Equipment Identification:

1. Minimum Size: 1 inch (25 mm) by 2.5 inches (64 mm).

2. Legend:
  - a. System designation where applicable:
    - 1) Emergency Power System: Identify with text "EMERGENCY".
    - 2) Fire Alarm System: Identify with text "FIRE ALARM".
  - b. Equipment designation or other approved description.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height:
  - a. System Designation: 1 inch (25 mm).
  - b. Equipment Designation: 1/2 inch (13 mm).
5. Color:
  - a. Normal Power System: White text on black background.
  - b. Emergency Power System: White text on red background.
  - c. Fire Alarm System: White text on red background.

D. Format for Caution and Warning Messages:

1. Minimum Size: 2 inches (51 mm) by 4 inches (100 mm).
2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 1/2 inch (13 mm).
5. Color: Black text on yellow background unless otherwise indicated.

E. Format for Receptacle Identification:

1. Minimum Size: 3/8 inch (10 mm) by 1.5 inches (38 mm).
2. Legend: Power source and circuit number or other designation indicated.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 3/16 inch (5 mm).
5. Color: Black text on clear background.

F. Format for Control Device Identification:

1. Minimum Size: 3/8 inch (10 mm) by 1.5 inches (38 mm).
2. Legend: Load controlled or other designation indicated.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 3/16 inch (5 mm).
5. Color: Black text on clear background.

G. Format for Fire Alarm Device Identification:

1. Minimum Size: 3/8 inch (10 mm) by 1.5 inches (38 mm).
2. Legend: Designation indicated and device zone or address.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 3/16 inch (5 mm).
5. Color: Red text on white background.

## 2.03 WIRE AND CABLE MARKERS

- A. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.

- B. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.
- C. Legend: Power source and circuit number or other designation indicated.
- D. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.
  - 1. Do not use handwritten text.
- E. Minimum Text Height: 1/8 inch (3 mm).
- F. Color: Black text on white background unless otherwise indicated.

#### 2.04 VOLTAGE MARKERS

- A. Markers for Conduits: Use factory pre-printed self-adhesive vinyl, self-adhesive vinyl cloth, or vinyl snap-around type markers.
- B. Markers for Boxes and Equipment Enclosures: Use factory pre-printed self-adhesive vinyl or self-adhesive vinyl cloth type markers.
- C. Minimum Size:
  - 1. Markers for Equipment: 1 1/8 by 4 1/2 inches (29 by 110 mm).
  - 2. Markers for Conduits: As recommended by manufacturer for conduit size to be identified.
  - 3. Markers for Pull Boxes: 1 1/8 by 4 1/2 inches (29 by 110 mm).
  - 4. Markers for Junction Boxes: 1/2 by 2 1/4 inches (13 by 57 mm).
- D. Legend:
  - 1. Markers for Voltage Identification: Highest voltage present.
  - 2. Markers for System Identification:
    - a. Emergency Power System: Text "EMERGENCY".
- E. Color: Black text on orange background unless otherwise indicated.

#### 2.05 WARNING SIGNS AND LABELS

- A. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.
- B. Warning Signs:
  - 1. Materials:
    - a. Indoor Dry, Clean Locations: Use factory pre-printed rigid plastic or self-adhesive vinyl signs.
    - b. Outdoor Locations: Use factory pre-printed rigid aluminum signs.
  - 2. Rigid Signs: Provide four mounting holes at corners for mechanical fasteners.
  - 3. Minimum Size: 7 by 10 inches (178 by 254 mm) unless otherwise indicated.
- C. Warning Labels:
  - 1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.

2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.
3. Minimum Size: 2 by 4 inches (51 mm by 102 mm) unless otherwise indicated.

### PART 3 EXECUTION

#### 3.01 PREPARATION

- A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

#### 3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:
  1. Surface-Mounted Equipment: Enclosure front.
  2. Flush-Mounted Equipment: Inside of equipment door.
  3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
  4. Elevated Equipment: Legible from the floor or working platform.
  5. Interior Components: Legible from the point of access.
  6. Conduits: Legible from the floor.
  7. Boxes: Outside face of cover.
  8. Conductors and Cables: Legible from the point of access.
  9. Devices: Outside face of cover.
- C. Install identification products centered, level, and parallel with lines of item being identified.
- D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using self-adhesive backing or epoxy cement.
- E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.
- F. Secure rigid signs using stainless steel screws.
- G. Mark all handwritten text, where permitted, to be neat and legible.

#### 3.03 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

END OF SECTION 260553

SECTION 260583  
WIRING CONNECTIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Electrical connections to equipment.

1.02 RELATED REQUIREMENTS

- A. Section 260519 - Low-Voltage Electrical Power Conductors and Cables.
- B. Section 260533.13 - Conduit for Electrical Systems.
- C. Section 260533.16 - Boxes for Electrical Systems.
- D. Section 262726 - Wiring Devices.

1.03 REFERENCE STANDARDS

- A. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (Reaffirmed 2015).
- B. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2016.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
  - 2. Determine connection locations and requirements.

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide wiring device manufacturer's catalog information showing dimensions, configurations, and construction.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Products: Listed, classified, and labeled as suitable for the purpose intended.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Cords and Caps: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
  - 1. Colors: Comply with NEMA WD 1.
  - 2. Cord Construction: NFPA 70, Type SO, multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
  - 3. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.
- B. Wiring Devices: As specified in Section 262726.
- C. Flexible Conduit: As specified in Section 260533.13.
- D. Wire and Cable: As specified in Section 260519.
- E. Boxes: As specified in Section 260533.16.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.02 ELECTRICAL CONNECTIONS

- A. Make electrical connections in accordance with equipment manufacturer's instructions.
- B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.
- C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.
- D. Provide receptacle outlet to accommodate connection with attachment plug.
- E. Provide cord and cap where field-supplied attachment plug is required.
- F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.

- G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.
- H. Install terminal block jumpers to complete equipment wiring requirements.
- I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

END OF SECTION 260583

SECTION 260923  
LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Occupancy sensors.
- B. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 260526 - Grounding and Bonding for Electrical Systems.
- B. Section 260529 - Hangers and Supports for Electrical Systems
- C. Section 260533.16 - Boxes for Electrical Systems.
- D. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 262726 - Wiring Devices: Devices for manual control of lighting, including wall switches, wall dimmers, and fan speed controllers.
- F. Section 265100 - Interior Lighting.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Coordinate the placement of lighting control devices with millwork, furniture, equipment, etc. installed under other sections or by others.
  - 2. Coordinate the placement of occupancy sensors with millwork, furniture, equipment or other potential obstructions to motion detection coverage installed under other sections or by others.
  - 3. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.
- B. Sequencing:
  - 1. Do not install lighting control devices until final surface finishes and painting are complete.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Include ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.



1. Occupancy Sensors: Include detailed motion detection coverage range diagrams.
  - C. Shop Drawings:
    1. Occupancy Sensors: Provide lighting plan indicating location, model number, and orientation of each occupancy sensor and associated system component.
  - D. Samples:
    1. Occupancy Sensors: One for each type and color specified.
  - E. Field Quality Control Reports.
  - F. Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
  - G. Operation and Maintenance Data: Include detailed information on device programming and setup.
  - H. Project Record Documents: Record actual installed locations and settings for lighting control devices.
- 1.05 QUALITY ASSURANCE
- A. Comply with requirements of NFPA 70.
  - B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
  - C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
  - D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.
- 1.06 DELIVERY, STORAGE, AND PROTECTION
- A. Store products in a clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.
- 1.07 FIELD CONDITIONS
- A. Maintain field conditions within manufacturer's required service conditions during and after installation.
- 1.08 WARRANTY
- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
  - B. Provide five year manufacturer warranty for all occupancy sensors.

## PART 2 PRODUCTS

### 2.01 LIGHTING CONTROL DEVICES - GENERAL REQUIREMENTS

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless specifically indicated to be excluded, provide all required conduit, wiring, connectors, hardware, components, accessories, etc. as required for a complete operating system.

### 2.02 OCCUPANCY SENSORS

- A. All Occupancy Sensors:
  - 1. Description: Factory-assembled commercial specification grade devices for indoor use capable of sensing both major motion, such as walking, and minor motion, such as small desktop level movements, according to published coverage areas, for automatic control of load indicated.
  - 2. Sensor Technology:
    - a. Passive Infrared/Ultrasonic Dual Technology Occupancy Sensors: Designed to detect occupancy using a combination of both passive infrared and ultrasonic technologies.
  - 3. Operation: Unless otherwise indicated, occupancy sensor to turn load on when occupant presence is detected and to turn load off when no occupant presence is detected during an adjustable turn-off delay time interval.
  - 4. Dual Technology Occupancy Sensors: Field configurable turn-on and hold-on activation with settings for activation by either or both sensing technologies.
  - 5. Turn-Off Delay: Field adjustable, with time delay settings up to 30 minutes.
  - 6. Integral Photocell: For field selectable and adjustable inhibition of automatic turn-on of load when ambient lighting is above the selected level.
- B. Ceiling Mounted Occupancy Sensors:
  - 1. All Ceiling Mounted Occupancy Sensors:
    - a. Description: Low profile occupancy sensors designed for ceiling installation.
    - b. Unless otherwise indicated or required to control the load indicated on drawings, provide low voltage units, for use with separate compatible accessory power packs.
    - c. Finish: White unless otherwise indicated.
  - 2. Passive Infrared/Ultrasonic Dual Technology Ceiling Mounted Occupancy Sensors:
    - a. Standard Range Sensors: Capable of detecting motion within an area of 450 square feet (41.8 sq m) at a mounting height of 9 feet (2.7 m), with a field of view of 360 degrees.
- C. Power Packs for Low Voltage Occupancy Sensors:
  - 1. Description: Plenum rated, self-contained low voltage class 2 transformer and relay compatible with specified low voltage occupancy sensors for switching of line voltage loads.
  - 2. Input Supply Voltage: Dual rated for 120/277 V ac.
  - 3. Load Rating: As required to control the load indicated on drawings.

## 2.03 ACCESSORIES

- A. Auxiliary Contacts:
  - 1. Comply with NEMA ICS 5.
  - 2. Provide number and type of contacts indicated or required to perform necessary functions, including holding (seal-in) circuit and interlocking, plus one normally open (NO) and one normally closed (NC) spare contact for each lighting contactor, minimum.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
- C. Verify that openings for outlet boxes are neatly cut and will be completely covered by devices or wall plates.
- D. Verify that final surface finishes are complete, including painting.
- E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to lighting control devices.
- F. Verify that the service voltage and ratings of lighting control devices are appropriate for the service voltage and load requirements at the location to be installed.
- G. Verify that conditions are satisfactory for installation prior to starting work.

### 3.02 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

### 3.03 INSTALLATION

- A. Install lighting control devices in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.
- B. Coordinate locations of outlet boxes provided under Section 260533.16 as required for installation of lighting control devices provided under this section.
- C. Install lighting control devices in accordance with manufacturer's instructions.
- D. Unless otherwise indicated, connect lighting control device grounding terminal or conductor to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

- E. Install lighting control devices plumb and level, and held securely in place.
- F. Where required and not furnished with lighting control device, provide wall plate in accordance with Section 262726.
- G. Provide required supports in accordance with Section 260529.
- H. Where applicable, install lighting control devices and associated wall plates to fit completely flush to mounting surface with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.
- I. Identify lighting control devices in accordance with Section 260553.
- J. Occupancy Sensor Locations:
  - 1. Location Adjustments: Do not make adjustments to locations without obtaining approval from the Engineer.
  - 2. Locate ultrasonic and dual technology passive infrared/ultrasonic occupancy sensors a minimum of 4 feet (1.2 m) from air supply ducts or other sources of heavy air flow and as per manufacturer's recommendations, in order to minimize false triggers.
- K. Lamp Burn-In: Operate lamps at full output for minimum of 100 hours or prescribed period per manufacturer's recommendations prior to use with any dimming controls. Replace lamps that fail prematurely due to improper lamp burn-in.
- L. Unless otherwise indicated, install power packs for lighting control devices above accessible ceiling or above access panel in inaccessible ceiling near the sensor location.
- M. Where indicated, install separate compatible wall switches for manual control interface with lighting control devices or associated power packs.

### 3.04 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Inspect each lighting control device for damage and defects.
- C. Test occupancy sensors to verify proper operation, including time delays and ambient light thresholds where applicable. Verify optimal coverage for entire room or area. Record test results in written report to be included with submittals.
- D. Correct wiring deficiencies and replace damaged or defective lighting control devices.

### 3.05 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.
- B. Where indicated or as directed by Architect, install factory masking material or adjust integral blinders on passive infrared (PIR) and dual technology occupancy sensor lenses to block undesired motion detection.

3.06 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.07 COMMISSIONING

- A. See Section 019113 - General Commissioning Requirements for commissioning requirements.

3.08 CLOSEOUT ACTIVITIES

- A. See Section 017800 - Closeout Submittals, for closeout submittals.
- B. See Section 017900 - Demonstration and Training, for additional requirements.
- C. Demonstration: Demonstrate proper operation of lighting control devices to Architect, and correct deficiencies or make adjustments as directed.
- D. Training: Train Owner's personnel on operation, adjustment, programming, and maintenance of lighting control devices.
  - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.

END OF SECTION 260923

SECTION 262200  
LOW-VOLTAGE TRANSFORMERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. General purpose transformers.

1.02 RELATED REQUIREMENTS

- A. Section 260526 - Grounding and Bonding for Electrical Systems.
- B. Section 260529 - Hangers and Supports for Electrical Systems.
- C. Section 260533.13 - Conduit for Electrical Systems: Flexible conduit connections.
- D. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

- A. 10 CFR 431, Subpart K - Energy Efficiency Program for Certain Commercial and Industrial Equipment - Distribution Transformers; Current Edition.
- B. IEEE C57.94 - IEEE Recommended Practice for Installation, Application, Operation, and Maintenance of Dry-Type Distribution and Power Transformers; 2015.
- C. IEEE C57.96 - IEEE Standard Guide for Loading Dry-Type Distribution and Power Transformers; 2013.
- D. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- E. NECA 409 - Standard for Installing and Maintaining Dry-Type Transformers; 2015.
- F. NEMA ST 20 - Dry-Type Transformers for General Applications; 2014.
- G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- H. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2017.
- I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- J. UL 506 - Standard for Specialty Transformers; Current Edition, Including All Revisions.
- K. UL 1561 - Standard for Dry-Type General Purpose and Power Transformers; Current Edition, Including All Revisions.

#### 1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.
  - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
  - 3. Coordinate the work with placement of supports, anchors, etc. required for mounting.
  - 4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
  - 5. Notify Owner of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

#### 1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Include voltage, kVA, impedance, tap configurations, insulation system class and rated temperature rise, efficiency, sound level, enclosure ratings, outline and support point dimensions, weight, required clearances, service condition requirements, and installed features.
- C. Shop Drawings: Provide dimensioned plan and elevation views of transformers and adjacent equipment with all required clearances indicated.
  - 1. Small Power Centers: Include panel arrangements.
  - 2. Identify mounting conditions required for equipment seismic qualification.
- D. Manufacturer's equipment seismic qualification certification.
- E. Source Quality Control Test Reports: Include reports for tests designated in NEMA ST 20 as design and routine tests.
- F. Field Quality Control Test Reports.
- G. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- H. Maintenance Data: Include recommended maintenance procedures and intervals.
- I. Project Record Documents: Record actual locations of transformers.

#### 1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

1.08 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. ABB/GE; \_\_\_\_\_
- B. Eaton Corporation; \_\_\_\_\_
- C. Schneider Electric; Square D Products
- D. Siemens Industry, Inc; \_\_\_\_\_
- E. Substitutions: See Section 016000 - Product Requirements.

2.02 TRANSFORMERS - GENERAL REQUIREMENTS

- A. Description: Factory-assembled, dry type transformers for 60 Hz operation designed and manufactured in accordance with NEMA ST 20 and listed, classified, and labeled as suitable for the purpose intended.
- B. Unless noted otherwise, transformer ratings indicated are for continuous loading according to IEEE C57.96 under the following service conditions:
  - 1. Altitude: Less than 3,300 feet (1,000 m).
  - 2. Ambient Temperature:
    - a. Less than 10 kVA: Not exceeding 77 degrees F (25 degrees C).
- C. Nameplate: Include transformer connection data, ratings, wiring diagrams, and overload capacity based on rated winding temperature rise.



## 2.03 GENERAL PURPOSE TRANSFORMERS

- A. Description: Self-cooled, two winding transformers listed and labeled as complying with UL 506 or UL 1561; ratings as indicated on the drawings.
- B. Primary Voltage: 120VAC 1 phase.
- C. Secondary Voltage: 24VAC, 1-phase.
- D. Insulation System and Allowable Average Winding Temperature Rise:
  - 1. Less than 15 kVA: Class 180 degrees C insulation system with 115 degrees C average winding temperature rise.
- E. Coil Conductors: Continuous aluminum windings with terminations brazed or welded.
- F. Energy Efficiency: Comply with 10 CFR 431, Subpart K.
- G. Sound Levels: Standard sound levels complying with NEMA ST 20
- H. Mounting Provisions:
  - 1. Less than 15 kVA: Suitable for wall mounting.
- I. Transformer Enclosure: Comply with NEMA ST 20.
  - 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
    - a. Indoor clean, dry locations: Type 1.
  - 2. Construction: Steel.
    - a. Less than 15 kVA: Totally enclosed, non-ventilated.
    - b. 15 kVA and Larger: Ventilated.
  - 3. Finish: Manufacturer's standard grey, suitable for outdoor installations.
  - 4. Provide lifting eyes or brackets.
- J. Accessories:
  - 1. Mounting Brackets: Provide manufacturer's standard brackets.
  - 2. Weathershield Kits: For ventilated transformers installed outdoors, provide a listed NEMA 250, type 3R assembly.
  - 3. Lug Kits: Sized as required for termination of conductors as indicated on the drawings.

## 2.04 SOURCE QUALITY CONTROL

- A. Factory test transformers according to NEMA ST 20.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that field measurements are as indicated.

- B. Verify that suitable support frames and anchors are installed where required and that mounting surfaces are ready to receive transformers.
- C. Perform pre-installation tests and inspections on transformers per manufacturer's instructions and as specified in NECA 409. Correct deficiencies prior to installation.
- D. Verify that conditions are satisfactory for installation prior to starting work.

### 3.02 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions.
- C. Install transformers in accordance with NECA 409 and IEEE C57.94.
- D. Use flexible conduit, under the provisions of Section 260533.13, 2 feet (600 mm) minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.
- E. Arrange equipment to provide minimum clearances as specified on transformer nameplate and in accordance with manufacturer's instructions and NFPA 70.
- F. Install transformers plumb and level.
- G. Transformer Support:
  - 1. Provide required support and attachment in accordance with Section 260529, where not furnished by transformer manufacturer.
  - 2. Use integral transformer flanges, accessory brackets furnished by manufacturer, or field-fabricated supports to support wall-mounted transformers.
- H. Provide grounding and bonding in accordance with Section 260526.
- I. Remove shipping braces and adjust bolts that attach the core and coil mounting bracket to the enclosure according to manufacturer's recommendations in order to reduce audible noise transmission.
- J. Where not factory-installed, install lugs sized as required for termination of conductors as indicated on drawings.
- K. Identify transformers in accordance with Section 260553.

### 3.03 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS Sections 7.2.1.1 and 7.2.1.2. Tests and inspections listed as optional are not required.

3.04 ADJUSTING

- A. Measure primary and secondary voltages and make appropriate tap adjustments.
- B. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.05 CLEANING

- A. Clean dirt and debris from transformer components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 262200

SECTION 262416  
PANELBOARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Power distribution panelboards.
- B. Lighting and appliance panelboards.
- C. Load centers.

1.02 RELATED REQUIREMENTS

- A. Section 260526 - Grounding and Bonding for Electrical Systems.
- B. Section 260529 - Hangers and Supports for Electrical Systems.
- C. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 262200 - Low-Voltage Transformers: Small power centers with integral primary breaker, transformer, and panelboard.
- E. Section 264300 - Surge Protective Devices.

1.03 REFERENCE STANDARDS

- A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; 2013e, with Amendments (2022).
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- C. NECA 407 - Standard for Installing and Maintaining Panelboards; 2015.
- D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- E. NEMA PB 1 - Panelboards; 2011.
- F. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 1000 Volts or Less; 2023.
- G. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2017.
- H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

- I. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- J. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- K. UL 67 - Panelboards; Current Edition, Including All Revisions.
- L. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.
- M. UL 943 - Ground-Fault Circuit-Interruption; Current Edition, Including All Revisions.
- N. UL 1053 - Ground-Fault Sensing and Relaying Equipment; Current Edition, Including All Revisions.
- O. UL 1699 - Arc-Fault Circuit-Interruption; Current Edition, Including All Revisions.

#### 1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
  - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
  - 3. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted panelboards where indicated.
  - 4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
  - 5. Notify Owner of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

#### 1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.
- C. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
  - 1. Include dimensioned plan and elevation views of panelboards and adjacent equipment with all required clearances indicated.
  - 2. Include wiring diagrams showing all factory and field connections.
  - 3. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
  - 4. Include documentation of listed series ratings upon request.

- D. Source Quality Control Test Reports: Include reports for tests designated in NEMA PB 1 as routine tests.
- E. Field Quality Control Test Reports.
- F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- G. Project Record Documents: Record actual installed locations of panelboards and actual installed circuiting arrangements.
- H. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.
- I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 016000 - Product Requirements, for additional provisions.
  - 2. Panelboard Keys: Two of each different key.
  - 3. See Section 262813 for requirements for spare fuses and spare fuse cabinets.

#### 1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

#### 1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store panelboards in accordance with manufacturer's instructions and NECA 407.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle carefully in accordance with manufacturer's written instructions to avoid damage to panelboard internal components, enclosure, and finish.

#### 1.08 FIELD CONDITIONS

- A. Maintain ambient temperature within the following limits during and after installation of panelboards:
  - 1. Panelboards Containing Circuit Breakers: Between 23 degrees F (-5 degrees C) and 104 degrees F (40 degrees C).

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

- A. ABB/GE; \_\_\_\_\_: [www.geindustrial.com/#sle](http://www.geindustrial.com/#sle).
- B. Eaton Corporation; \_\_\_\_\_: [www.eaton.com/#sle](http://www.eaton.com/#sle).
- C. Schneider Electric; Square D Products; \_\_\_\_\_: [www.schneider-electric.us/#sle](http://www.schneider-electric.us/#sle).
- D. Siemens Industry, Inc; \_\_\_\_\_: [www.usa.siemens.com/#sle](http://www.usa.siemens.com/#sle).
- E. Substitutions: See Section 016000 - Product Requirements.
- F. Source Limitations: Furnish panelboards and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

### 2.02 PANELBOARDS - GENERAL REQUIREMENTS

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
  - 1. Altitude: Less than 6,600 feet (2,000 m).
  - 2. Ambient Temperature:
    - a. Panelboards Containing Circuit Breakers: Between 23 degrees F (-5 degrees C) and 104 degrees F (40 degrees C).
- C. Short Circuit Current Rating:
  - 1. Provide panelboards with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
- D. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.
- E. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.
- F. Bussing: Sized in accordance with UL 67 temperature rise requirements.
  - 1. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
  - 2. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
  - 3. Provide separate isolated/insulated ground bus where indicated or where isolated grounding conductors are provided.
- G. Conductor Terminations: Suitable for use with the conductors to be installed.
- H. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.

1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
    - a. Indoor Clean, Dry Locations: Type 1.
  2. Boxes: Galvanized steel unless otherwise indicated.
    - a. Provide wiring gutters sized to accommodate the conductors to be installed.
  3. Fronts:
    - a. Fronts for Surface-Mounted Enclosures: Same dimensions as boxes.
    - b. Fronts for Flush-Mounted Enclosures: Overlap boxes on all sides to conceal rough opening.
  4. Lockable Doors: All locks keyed alike unless otherwise indicated.
- I. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.
- J. Surge Protective Devices: Where factory-installed, internally mounted surge protective devices are provided in accordance with Section 264300, list and label panelboards as a complete assembly including surge protective device.
- K. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.
  1. Where electronic circuit breakers equipped with integral ground fault protection are used, provide separate neutral current sensor where applicable.
  2. Where accessory ground fault sensing and relaying equipment is used, equip companion overcurrent protective devices with ground-fault shunt trips.
    - a. Use zero sequence ground fault detection method unless otherwise indicated.
    - b. Provide test panel and field-adjustable ground fault pick-up and delay settings.
    - c. Provide zone selective interlocking capability where indicated, capable of communicating with other electronic trip circuit breakers and external ground fault sensing systems to control ground fault delay functions for system coordination purposes.
- L. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.
- 2.03 POWER DISTRIBUTION PANELBOARDS
- A. Description: Panelboards complying with NEMA PB 1, power and feeder distribution type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.
- B. Conductor Terminations:
  1. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
  2. Main and Neutral Lug Type: Mechanical.
- C. Bussing:
  1. Phase and Neutral Bus Material: Aluminum or copper.
  2. Ground Bus Material: Aluminum or copper.
- D. Circuit Breakers:



1. Provide bolt-on type or plug-in type secured with locking mechanical restraints.
2. Provide thermal magnetic circuit breakers unless otherwise indicated.
3. Provide electronic trip circuit breakers where indicated.

E. Enclosures:

1. Provide surface-mounted enclosures unless otherwise indicated.
2. Fronts: Provide lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
3. Provide clear plastic circuit directory holder mounted on inside of door.

## 2.04 LIGHTING AND APPLIANCE PANELBOARDS

A. Description: Panelboards complying with NEMA PB 1, lighting and appliance branch circuit type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.

B. Conductor Terminations:

1. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
2. Main and Neutral Lug Type: Mechanical.

C. Bussing:

1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.
2. Phase and Neutral Bus Material: Aluminum or copper.
3. Ground Bus Material: Aluminum or copper.

D. Circuit Breakers: Thermal magnetic bolt-on or plug-in type unless otherwise indicated.

E. Enclosures:

1. Provide flush-mounted enclosures as indicated.
2. Fronts: Provide lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
3. Provide clear plastic circuit directory holder mounted on inside of door.

## 2.05 LOAD CENTERS

A. Description: Circuit breaker type load centers listed and labeled as complying with UL 67; ratings, configurations, and features as indicated on the drawings.

B. Bussing:

1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.
2. Bus Material: Aluminum or copper.

C. Circuit Breakers: Thermal magnetic plug-in type.

D. Enclosures:

1. Provide flush-mounted enclosures unless otherwise indicated.

2. Provide circuit directory label on inside of door or individual circuit labels adjacent to circuit breakers.

## 2.06 OVERCURRENT PROTECTIVE DEVICES

### A. Molded Case Circuit Breakers:

1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
2. Interrupting Capacity:
  - a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
    - 1) 10,000 rms symmetrical amperes at 240 VAC or 208 VAC.
  - b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
3. Conductor Terminations:
  - a. Provide mechanical lugs unless otherwise indicated.
  - b. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
4. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
5. Provide the following circuit breaker types where indicated:
  - a. Ground Fault Circuit Interrupter (GFCI) Circuit Breakers: Listed as complying with UL 943, class A for protection of personnel.
  - b. Ground Fault Equipment Protection Circuit Breakers: Designed to trip at 30 mA for protection of equipment.
  - c. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Combination type listed as complying with UL 1699.
  - d. 100 Percent Rated Circuit Breakers: Listed for application within the panelboard where installed at 100 percent of the continuous current rating.
  - e. Current Limiting Circuit Breakers: Without using fusible elements, designed to limit the let-through energy to a value less than the energy of a one-half cycle wave of the symmetrical prospective current when operating within its current limiting range.
6. Do not use tandem circuit breakers.
7. Do not use handle ties in lieu of multi-pole circuit breakers.
8. Provide multi-pole circuit breakers for multi-wire branch circuits as required by NFPA 70.
9. Provide the following features and accessories where indicated or where required to complete installation:
  - a. Handle Pad-Lock Provision: For locking circuit breaker handle in OFF position.

## 2.07 SOURCE QUALITY CONTROL

- A. Factory test panelboards according to NEMA PB 1.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive panelboards.
- D. Verify that conditions are satisfactory for installation prior to starting work.

### 3.02 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions.
- C. Install panelboards in accordance with NECA 407 and NEMA PB 1.1.
- D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- E. Provide required support and attachment in accordance with Section 260529.
- F. Install panelboards plumb.
- G. Install flush-mounted panelboards so that trims fit completely flush to wall with no gaps and rough opening completely covered.
- H. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches (2000 mm) above the floor or working platform.
- I. Provide minimum of six spare 1 inch (27 mm) trade size conduits out of each flush-mounted panelboard stubbed into accessible space above ceiling and below floor.
- J. Provide grounding and bonding in accordance with Section 260526.
  - 1. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on isolated/insulated ground bus.
  - 2. Terminate branch circuit isolated grounding conductors on isolated/insulated ground bus only. Do not terminate on solidly bonded equipment ground bus.
- K. Install all field-installed branch devices, components, and accessories.
- L. Set field-adjustable circuit breaker tripping function settings as determined by overcurrent protective device coordination study performed according to Section 260573.
- M. Set field-adjustable ground fault protection pickup and time delay settings as indicated.
- N. Provide filler plates to cover unused spaces in panelboards.

- O. Provide circuit breaker lock-on devices to prevent unauthorized personnel from de-energizing essential loads where indicated. Also provide for the following:
  - 1. Emergency and night lighting circuits.
  - 2. Fire detection and alarm circuits.
  - 3. Communications equipment circuits.
  - 4. Intrusion detection and access control system circuits.
  - 5. Video surveillance system circuits.
- P. Identify panelboards in accordance with Section 260553.

### 3.03 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers and circuit breakers larger than \_\_\_\_\_ amperes. Tests listed as optional are not required.
- D. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by NFPA 70.
- E. Test GFCI circuit breakers to verify proper operation.
- F. Test AFCI circuit breakers to verify proper operation.
- G. Correct deficiencies and replace damaged or defective panelboards or associated components.

### 3.04 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.
- B. Adjust alignment of panelboard fronts.
- C. Load Balancing: For each panelboard, rearrange circuits such that the difference between each measured steady state phase load does not exceed 20 percent and adjust circuit directories accordingly. Maintain proper phasing for multi-wire branch circuits.

### 3.05 CLEANING

- A. Clean dirt and debris from panelboard enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 262416

SECTION 262726  
WIRING DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wall dimmers.
- B. Receptacles.
- C. Wall plates.

1.02 RELATED REQUIREMENTS

- A. Section 260526 - Grounding and Bonding for Electrical Systems.
- B. Section 260533.16 - Boxes for Electrical Systems.
- C. Section 260533.23 - Surface Raceways for Electrical Systems: Surface raceway systems, including multioutlet assemblies.
- D. Section 260539 - Underfloor Raceways for Electrical Systems.
- E. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- F. Section 260583 - Wiring Connections: Cords and plugs for equipment.
- G. Section 260923 - Lighting Control Devices: Devices for automatic control of lighting, including occupancy sensors, in-wall time switches, and in-wall interval timers.
- H. Section 271000 - Structured Cabling: Voice and data jacks.

1.03 REFERENCE STANDARDS

- A. FS W-C-596 - Connector, Electrical, Power, General Specification for; 2014h (Validated 2022).
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- C. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2010.
- D. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (Reaffirmed 2015).
- E. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2016.
- F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. UL 498 - Attachment Plugs and Receptacles; Current Edition, Including All Revisions.

- H. UL 514D - Cover Plates for Flush-Mounted Wiring Devices; Current Edition, Including All Revisions.
- I. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.
- J. UL 1449 - Standard for Surge Protective Devices; Current Edition, Including All Revisions.
- K. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.

#### 1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.
  - 2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.
  - 3. Coordinate the placement of outlet boxes for wall switches with actual installed door swings.
  - 4. Coordinate the installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.
  - 5. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.
- B. Sequencing:
  - 1. Do not install wiring devices until final surface finishes and painting are complete.

#### 1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.
  - 1. Wall Dimmers: Include derating information for ganged multiple devices.
  - 2. Surge Protection Receptacles: Include surge current rating, voltage protection rating (VPR) for each protection mode, and diagnostics information.
- C. Samples: One for each type and color of device and wall plate specified.
- D. Field Quality Control Test Reports.
- E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- F. Operation and Maintenance Data:
  - 1. Wall Dimmers: Include information on operation and setting of presets.
  - 2. GFCI Receptacles: Include information on status indicators.
  - 3. Surge Protection Receptacles: Include information on status indicators.
- G. Project Record Documents: Record actual installed locations of wiring devices.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 5 years documented experience.
- D. Products: Listed, classified, and labeled as suitable for the purpose intended.
- E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND PROTECTION

- A. Store in a clean, dry space in original manufacturer's packaging until ready for installation.

PART 2 PRODUCTS

2.01 WIRING DEVICE APPLICATIONS

- A. Provide wiring devices suitable for intended use and with ratings adequate for load served.
- B. For single receptacles installed on an individual branch circuit, provide receptacle with ampere rating not less than that of the branch circuit.
- C. Provide tamper resistant receptacles for receptacles installed in locations required by NEC 406.12.
  - 1. All accessible receptacles in lab, microscopy, and equipment room shall be tamper proof.
- D. Provide GFCI protection for receptacles installed within 6 feet (1.8 m) of sinks.
- E. Provide isolated ground surge protection receptacles for receptacles serving computers.
- F. Unless noted otherwise, do not use combination switch/receptacle devices.

2.02 WIRING DEVICE FINISHES

- A. Provide wiring device finishes as described below unless otherwise indicated.
- B. Wiring Devices, Unless Otherwise Indicated: White with white nylon wall plate.
- C. Wiring Devices Installed in Unfinished Spaces: Gray with galvanized steel wall plate.
- D. Isolated Ground Convenience Receptacles: Orange.
- E. Surge Protection Receptacles: Blue.

- F. Wiring Devices Connected to Emergency Power: Red with red nylon wall plate factory marked "Emergency".

## 2.03 WALL DIMMERS

- A. Wall Dimmers - General Requirements: Solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset memory, air gap switch accessible without removing wall plate, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 1472; types and ratings suitable for load controlled as indicated on the drawings.
  - 1. Exception: Low Voltage wall switches serving power packs shall be compatible with power pack.
- B. Provide accessory wall switches to match dimmer appearance when installed adjacent to each other.

## 2.04 RECEPTACLES

- A. Manufacturers:
  - 1. Hubbell Incorporated; \_\_\_\_\_
  - 2. Leviton Manufacturing Company, Inc; \_\_\_\_\_
  - 3. Lutron Electronics Company, Inc; Designer Style
  - 4. Pass & Seymour, a brand of Legrand North America, Inc; \_\_\_\_\_
  - 5. Eaton Corporation
  - 6. Source Limitations: Where wall controls are furnished as part of lighting control system, provide accessory matching receptacles and wallplates by the same manufacturer in locations indicated.
- B. General Requirements: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498, and where applicable, FS W-C-596; types as indicated on the drawings.
  - 1. Wiring Provisions: Terminal screws for side wiring or screw actuated binding clamp for back wiring with separate ground terminal screw.
  - 2. NEMA configurations specified are according to NEMA WD 6.
  - 3. Hospital Grade Receptacles: Listed as complying with UL 498 Supplement SD, with green dot hospital grade mark on device face.
- C. Convenience Receptacles:
  - 1. Standard Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R; single or duplex as indicated on the drawings.
  - 2. Tamper Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type; single or duplex as indicated on the drawings.
- D. GFCI Receptacles:
  - 1. GFCI Receptacles - General Requirements: Self-testing, with feed-through protection and light to indicate ground fault tripped condition and loss of protection; listed as complying with UL 943, class A.
    - a. Provide test and reset buttons of same color as device.



- b. Remote test and reset buttons not allowed, unless noted on the drawings.
  - 2. Standard GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style.
  - 3. Tamper Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as tamper resistant type.
- E. Surge Protection Receptacles:
- 1. General Requirements: Listed and labeled as complying with UL 1449, Type 2 or 3.
    - a. Energy Dissipation: Not less than 240 J per mode.
    - b. Protected Modes: L-N, L-G, N-G.
    - c. UL 1449 Voltage Protection Rating (VPR): Not more than 700 V for L-N, L-G modes and 1200 V for N-G mode.
    - d. Diagnostics:
      - 1) Visual Notification: Provide indicator light to report functional status of surge protection.
  - 2. Standard Surge Protection Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style.

## 2.05 WALL PLATES

- A. Wall Plates: Comply with UL 514D.
  - 1. Configuration: One piece cover as required for quantity and types of corresponding wiring devices.
  - 2. Size: Standard.
  - 3. Screws: Metal with slotted heads finished to match wall plate finish.
- B. Nylon Wall Plates: Smooth finish, high-impact thermoplastic.
- C. Galvanized Steel Wall Plates: Rounded corners and edges, with corrosion resistant screws.
- D. Premarked Wall Plates: Factory labeled as indicated; hot stamped for nylon wall plates and engraved for metal wall plates.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
- C. Verify that wall openings are neatly cut and will be completely covered by wall plates.
- D. Verify that final surface finishes are complete, including painting.
- E. Verify that floor boxes are adjusted properly.
- F. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

- G. Verify that core drilled holes for poke-through assemblies are in proper locations.
- H. Verify that openings in access floor are in proper locations.
- I. Verify that conditions are satisfactory for installation prior to starting work.

### 3.02 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

### 3.03 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.
- B. Coordinate locations of outlet boxes provided under Section 260533.16 as required for installation of wiring devices provided under this section.
  - 1. Mounting Heights: As indicated on the drawings.
    - a. Where height is not indicated, install receptacles and data outlets at 18" above finished floor.
  - 2. Orient outlet boxes for vertical installation of wiring devices unless otherwise indicated.
  - 3. Where multiple receptacles, wall switches, or wall dimmers are installed at the same location and at the same mounting height, gang devices together under a common wall plate.
  - 4. Locate wall switches on strike side of door with edge of wall plate within 3 inches (80 mm) from edge of door frame. Where locations are indicated otherwise, notify Owner to obtain direction prior to proceeding with work.
  - 5. Locate receptacles for electric drinking fountains concealed behind drinking fountain according to manufacturer's instructions.
- C. Install wiring devices in accordance with manufacturer's instructions.
- D. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- E. Where required, connect wiring devices using pigtails not less than 6 inches (150 mm) long. Do not connect more than one conductor to wiring device terminals.
- F. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.
- G. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
- H. Unless otherwise indicated, GFCI receptacles may be connected to provide feed-through protection to downstream devices. Label such devices to indicate they are protected by upstream GFCI protection.

- I. Where split-wired duplex receptacles are indicated, remove tabs connecting top and bottom receptacles.
- J. Install wiring devices plumb and level with mounting yoke held rigidly in place.
- K. Install wall switches with OFF position down.
- L. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.
- M. Do not share neutral conductor on branch circuits utilizing wall dimmers.
- N. Install vertically mounted receptacles with grounding pole on bottom and horizontally mounted receptacles with grounding pole on right.
- O. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.
- P. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.
- Q. Identify wiring devices in accordance with Section 260553.

#### 3.04 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Inspect each wiring device for damage and defects.
- C. Operate each wall switch, wall dimmer, and fan speed controller with circuit energized to verify proper operation.
- D. Test each receptacle to verify operation and proper polarity.
- E. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.
- F. Inspect each surge protection receptacle to verify surge protection is active.
- G. Correct wiring deficiencies and replace damaged or defective wiring devices.

#### 3.05 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.
- B. Adjust presets for wall dimmers according to manufacturer's instructions as directed by Owner.

3.06 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

END OF SECTION 262726

SECTION 263353  
STATIC UNINTERRUPTIBLE POWER SUPPLY

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

- A. Section 260529 - Hangers and Supports for Electrical Systems.

1.02 REFERENCE STANDARDS

- A. IEEE 519 - IEEE Standard for Harmonic Control in Electric Power Systems; 2022.
- B. NEMA PE 1 - Uninterruptible Power Systems (UPS) - Specification and Performance Verification; 2012 (Reaffirmed 2017).
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.03 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate electrical characteristics and connection requirements. Provide battery rack dimensions; battery type, size, dimensions, and weight; detailed equipment outlines, weight, and dimensions; location of conduit entry and exit; single-line diagram indicating metering, control, and external wiring requirements; heat rejection and air flow requirements.
- C. Product Data: Provide catalog sheets and technical data sheets to indicate physical data and electrical performance, electrical characteristics, and connection requirements.
- D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product. Include equipment installation outline, connection diagram for external cabling, internal wiring diagram, and written instruction for installation.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Operation Data: Description of operating procedures.
- G. Maintenance Data: Description of servicing procedures; list of major components; recommended remedial and preventive maintenance procedures; spare parts list.

1.04 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience with service facilities within 100 miles of Project.
- C. Supplier Qualifications: Authorized distributor of specified manufacturer with minimum three years documented experience.
- D. Products: Listed, classified, and labeled as suitable for the purpose intended.
- E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Protect equipment from extreme temperature and humidity by storing in a conditioned space.
- B. Protect equipment from dust and debris by wrapping unit in dusttight cover and storing away from construction activity.
- C. Deliver batteries no sooner than 7 days before charging.

#### 1.06 FIELD CONDITIONS

- A. Do not store or install unless temperature is maintained between 32 degrees F (0 degrees C) and 104 degrees F (40 degrees C), at a relative humidity less than 95 percent (non-condensing).
- B. Maintain conditions during and after installation of products.

#### 1.07 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year warranty including coverage for batteries.

### PART 2 PRODUCTS

#### 2.01 UNINTERRUPTIBLE POWER SUPPLY (UPS) SYSTEMS

- A. System Configuration: Non-redundant type with reverse transfer. Designed for capacity expansion by addition of parallel modules in field with minimum downtime.
- B. Components:
  - 1. Battery.
  - 2. Rectifier/charger to maintain battery charge and to provide input to inverter when utility power is available.
  - 3. Inverter to provide power to load during normal operation.
  - 4. Static switch to transfer load automatically and without disturbance between inverter and utility power.

5. Manual switch to bypass static switch for maintenance.
6. Input and output isolation transformers and filters to provide appropriate isolation and disturbance attenuation.
7. Monitors, sensors, and control circuits.

C. Design Standards: IEEE 519 and NEMA PE 1.

## 2.02 SYSTEM RATINGS AND OPERATING CHARACTERISTICS

- A. System Continuous Rating: As indicated on drawings, over entire battery voltage range at specified power factor. Maintain output voltage within specified limits at any load from full load to no-load.
- B. Voltage Rating: 120/208 volts, 3 phase.
- C. Input Voltage Operating Range: Plus or minus 10 percent.
- D. Input Frequency Operating Range: 60 Hz.
- E. Input Current Limit: Adjustable to maximum of 125 percent of that required to operate at full load with battery bank on float charge.
- F. UPS Power Factor Over Full Range of Loads and Input Voltages: 74 to 100 percent, lagging.
- G. Harmonic Distortion of Input Current Wave Form: 5 percent maximum at full load.
- H. Output Free Running Frequency: 60 Hz Plus or minus 0.5 percent.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide required support and attachment in accordance with Section 260529.

### 3.02 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Provide the services of the manufacturer's field technician to supervise adjustments, final connections, and system testing.
- C. Verify specification performance criteria.
- D. Measure battery discharge and recharge times.
- E. Simulate fault in each system component and utility power.
- F. Operate unit at 77 degrees F (25 degrees C) for eight hours.
- G. Perform other tests as recommended by manufacturer.

3.03 CLOSEOUT ACTIVITIES

- A. See Section 017800 - Closeout Submittals, for closeout submittals.
- B. Demonstrate operation uninterruptible power supply by simulating an outage.

3.04 MAINTENANCE

- A. See Section 017000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.
- B. Provide a separate maintenance contract for specified maintenance service.
- C. Provide service and maintenance of uninterruptible power supply for one year from Date of Substantial Completion.
- D. Include all costs, including labor, parts, and travel.

END OF SECTION 263353



SECTION 264300  
SURGE PROTECTIVE DEVICES

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

- A. Section 260526 - Grounding and Bonding for Electrical Systems.
- B. Section 262416 - Panelboards.
- C. Section 271000 - Structured Cabling: Protectors for communications service entrance.

1.02 ABBREVIATIONS AND ACRONYMS

- A. SPD: Surge Protective Device.

1.03 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- C. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2017.
- D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. UL 1449 - Standard for Surge Protective Devices; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate size and location of overcurrent device compatible with the actual surge protective device and location to be installed. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to ordering equipment.

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Include detailed component information, voltage, surge current ratings, repetitive surge current capacity, voltage protection rating (VPR) for all protection modes, maximum continuous operating voltage (MCOV), nominal discharge current (I-n), short circuit current rating (SCCR), connection means including any required external overcurrent protection, enclosure ratings, outline and support point dimensions, weight, service condition requirements, and installed features.

- C. Shop Drawings: Include wiring diagrams showing all factory and field connections with wire and circuit breaker/fuse sizes.
  - D. Certificates: Manufacturer's documentation of listing for compliance with the following standards:
    - 1. UL 1449.
    - 2. UL 1283 (for Type 2 SPDs).
  - E. Field Quality Control Test Reports.
  - F. Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
  - G. Operation and Maintenance Data: Include information on status indicators and recommended maintenance procedures and intervals.
  - H. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.
- 1.06 QUALITY ASSURANCE
- A. Comply with requirements of NFPA 70.
  - B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
  - C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.
- 1.07 DELIVERY, STORAGE, AND PROTECTION
- A. Store in a clean, dry space in accordance with manufacturer's written instructions.
- 1.08 FIELD CONDITIONS
- A. Maintain field conditions within manufacturer's required service conditions during and after installation.
- 1.09 WARRANTY
- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
  - B. Manufacturer's Warranty: Provide minimum five year warranty covering repair or replacement of surge protective devices showing evidence of failure due to defective materials or workmanship.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

- A. Basis of Design: Raycap RSE 2.
- B. Field-installed, Externally Mounted Surge Protective Devices - Other Acceptable Manufacturers:
  - 1. ABB/GE; \_\_\_\_\_: [www.geindustrial.com/#sle](http://www.geindustrial.com/#sle).
  - 2. Advanced Protection Technologies, Inc (APT); \_\_\_\_\_: [www.aptsurge.com/#sle](http://www.aptsurge.com/#sle).
  - 3. Current Technology; a brand of Thomas & Betts Power Solutions; \_\_\_\_\_: [www.tnbpowersolutions.com/#sle](http://www.tnbpowersolutions.com/#sle).
  - 4. Schneider Electric; Square D Brand SurgeLogic Products; \_\_\_\_\_: [www.surgeLogic.com/#sle](http://www.surgeLogic.com/#sle).
  - 5. Surge Suppression, LLC (SSI); \_\_\_\_\_: [www.surgesuppression.com/#sle](http://www.surgesuppression.com/#sle).
- C. Factory-installed, Internally Mounted Surge Protective Devices:
  - 1. Same as manufacturer of equipment containing surge protective device, to provide a complete listed assembly including SPD.
- D. Substitutions: See Section 016000 - Product Requirements.
- E. Products other than basis of design are subject to compliance with specified requirements and prior approval of Engineer. By using products other than basis of design, Contractor accepts responsibility for costs associated with any necessary modifications to related work, including any design fees.
- F. Source Limitations: Furnish surge protective devices produced by a single manufacturer and obtained from a single supplier.

### 2.02 SURGE PROTECTIVE DEVICES - GENERAL REQUIREMENTS

- A. Description: Factory-assembled surge protective devices (SPDs) for 60 Hz service; listed, classified, and labeled as suitable for the purpose intended; system voltage as indicated on the drawings.
- B. Unless otherwise indicated, provide field-installed, externally-mounted or factory-installed, internally-mounted SPDs.
- C. List and label as complying with UL 1449, Type 1 when connected on line side of service disconnect overcurrent device and Type 1 or 2 when connected on load side of service disconnect overcurrent device.
- D. Protected Modes:
  - 1. Wye Systems: L-N, L-G, N-G, L-L.
- E. UL 1449 Voltage Protection Ratings (VPRs):
  - 1. 208Y/120V System Voltage: Not more than 1,000 V for L-N, L-G, and N-G modes and 1,200 V for L-L mode.

- F. UL 1449 Maximum Continuous Operating Voltage (MCOV): Not less than 115% of nominal system voltage.
- G. Enclosure Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
  - 1. Indoor clean, dry locations: Type 1.
- H. Mounting for Field-installed, Externally Mounted SPDs: Unless otherwise indicated, as specified for the following locations:
  - 1. Provide surface-mounted SPD where mounted in non-public areas or adjacent to surface-mounted equipment.
  - 2. Provide flush-mounted SPD where mounted in public areas or adjacent to flush-mounted equipment.

### 2.03 SURGE PROTECTIVE DEVICES FOR BRANCH PANELBOARD LOCATIONS

- A. Surge Protective Device - Basis of Design: Raycap RSE 2.
  - 1. Voltage: As indicated on drawings.
  - 2. Features: Discrete "all-mode" protection (10 modes for 3-phase wye circuits); component-level thermal fusing; internal circuit board-mounted overcurrent fusing; 200 kAIC SCCR; 25 year warranty.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the service voltage and configuration marked on the SPD are consistent with the service voltage and configuration at the location to be installed.
- C. Verify that electrical equipment is ready to accept connection of the SPD and that installed overcurrent device is consistent with requirements of drawings and manufacturer's instructions.
- D. Verify system grounding and bonding is in accordance with Section 260526, including bonding of neutral and ground for service entrance and separately derived systems where applicable. Do not energize SPD until deficiencies have been corrected.
- E. Verify that conditions are satisfactory for installation prior to starting work.

### 3.02 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

- D. Unless indicated otherwise, connect service entrance surge protective device on load side of service disconnect main overcurrent device.
- E. Provide conductors with minimum ampacity as indicated on the drawings, as required by NFPA 70, and not less than manufacturer's recommended minimum conductor size.
- F. Install conductors between SPD and equipment terminations as short and straight as possible, not exceeding manufacturer's recommended maximum conductor length. Breaker locations may be reasonably rearranged in order to provide leads as short and straight as possible. Twist conductors together to reduce inductance.
- G. Do not energize SPD until bonding of neutral and ground for service entrance and separately derived systems is complete in accordance with Section 260526 where applicable. Replace SPDs damaged by improper or missing neutral-ground bond.
- H. Disconnect SPD prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPD connected.

### 3.03 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS Section 7.19.1.

### 3.04 CLEANING

- A. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 264300

SECTION 265100  
INTERIOR LIGHTING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Interior luminaires.
- B. Emergency lighting units.
- C. Exit signs.
- D. Ballasts and drivers.

1.02 RELATED REQUIREMENTS

- A. Section 260529 - Hangers and Supports for Electrical Systems.
- B. Section 260533.16 - Boxes for Electrical Systems.
- C. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 260923 - Lighting Control Devices.
- E. Section 262726 - Wiring Devices: Manual wall switches and wall dimmers.

1.03 REFERENCE STANDARDS

- A. IES LM-79 - Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products; 2019.
- B. IES LM-80 - Approved Method: Measuring Maintenance of Light Output Characteristics of Solid-State Light Sources; 2021.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- D. NECA/IESNA 500 - Standard for Installing Indoor Lighting Systems; 2006.
- E. NECA/IESNA 502 - Standard for Installing Industrial Lighting Systems; 2006.
- F. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts; 2020.
- G. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility; 2012 (Reaffirmed 2018).
- H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

- I. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- J. UL 844 - Luminaires for Use in Hazardous (Classified) Locations; Current Edition, Including All Revisions.
- K. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.
- L. UL 1598 - Luminaires; Current Edition, Including All Revisions.
- M. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

#### 1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Coordinate the installation of luminaires with mounting surfaces installed under other sections or by others. Coordinate the work with placement of supports, anchors, etc. required for mounting. Coordinate compatibility of luminaires and associated trims with mounting surfaces at installed locations.
  - 2. Coordinate the placement of luminaires with structural members, ductwork, piping, equipment, diffusers, fire suppression system components, and other potential conflicts installed under other sections or by others.
  - 3. Coordinate the placement of exit signs with furniture, equipment, signage or other potential obstructions to visibility installed under other sections or by others.
  - 4. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

#### 1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings:
  - 1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
  - 2. Provide photometric calculations where luminaires are proposed for substitution upon request.
- C. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features.
  - 1. LED Luminaires:
    - a. Include estimated useful life, calculated based on IES LM-80 test data.
  - 2. Fluorescent Emergency Power Supply Unit: Include list of compatible lamp configurations and associated lumen output.
- D. Field quality control reports.

- E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- F. Operation and Maintenance Data: Instructions for each product including information on replacement parts.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 016000 - Product Requirements, for additional provisions.
- H. Project Record Documents: Record actual connections and locations of luminaires and any associated remote components.

#### 1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

#### 1.07 DELIVERY, STORAGE, AND PROTECTION

- A. Receive, handle, and store products according to NECA/IESNA 500 (commercial lighting), NECA/IESNA 502 (industrial lighting), and manufacturer's written instructions.
- B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

#### 1.08 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

#### 1.09 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer warranty for LED luminaires, including drivers.
- C. Provide five year pro-rata warranty for batteries for emergency lighting units.

### PART 2 PRODUCTS

#### 2.01 LUMINAIRE TYPES

- A. Furnish products as indicated in luminaire schedule included on the drawings.



- B. Substitutions: See Section 016000 - Product Requirements except where individual luminaire types are designated with substitutions not permitted.

## 2.02 LUMINAIRES

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- C. Provide products listed, classified, and labeled as suitable for the purpose intended.
- D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
- E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.
- F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
- G. Recessed Luminaires:
  - 1. Ceiling Compatibility: Comply with NEMA LE 4.
- H. Hazardous (Classified) Location Luminaires: Listed and labeled as complying with UL 844 for the classification of the installed location.
- I. LED Luminaires:
  - 1. Components: UL 8750 recognized or listed as applicable.
  - 2. Tested in accordance with IES LM-79 and IES LM-80.
  - 3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.

## 2.03 EMERGENCY LIGHTING UNITS

- A. Description: Emergency lighting units complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.
- B. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.
- C. Battery:
  - 1. Size battery to supply all connected lamps, including emergency remote heads where indicated.
- D. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.

- E. Provide low-voltage disconnect to prevent battery damage from deep discharge.

## 2.04 EXIT SIGNS

- A. Description: Exit signs complying with NFPA 101 and applicable state and local codes, and listed and labeled as complying with UL 924.
  - 1. Number of Faces: Single- or double-face as indicated or as required for installed location.
  - 2. Directional Arrows: As indicated or as required for installed location.
- B. Powered Exit Signs: Internally illuminated with LEDs unless otherwise indicated.
  - 1. Self-Powered Exit Signs:
    - a. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.
    - b. Battery: Sealed, maintenance-free, nickel cadmium unless otherwise indicated.
    - c. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.
    - d. Provide low-voltage disconnect to prevent battery damage from deep discharge.
    - e. Self-Diagnostics: Provide units that self-monitor functionality and automatically perform testing required by NFPA 101 where indicated; provide indicator light(s) to report test and diagnostic status.

## 2.05 BALLASTS AND DRIVERS

- A. Ballasts/Drivers - General Requirements:
  - 1. Provide ballasts containing no polychlorinated biphenyls (PCBs).
  - 2. Minimum Efficiency/Efficacy: Provide ballasts complying with all current applicable federal and state ballast efficiency/efficacy standards.
  - 3. Electronic Ballasts/Drivers: Inrush currents not exceeding peak currents specified in NEMA 410.
- B. Dimmable LED Drivers:
  - 1. Dimming Range: Continuous dimming from 100 percent to one percent relative light output unless dimming capability to lower level is indicated, without flicker.
  - 2. Control Compatibility: Fully compatible with the dimming controls to be installed.
    - a. Wall Dimmers: See Section 262726.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.

- C. Verify that suitable support frames are installed where required.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.
- E. Verify that conditions are satisfactory for installation prior to starting work.

### 3.02 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

### 3.03 INSTALLATION

- A. Coordinate locations of outlet boxes provided under Section 260533.16 as required for installation of luminaires provided under this section.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Install products in accordance with manufacturer's instructions.
- D. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 500 (commercial lighting) and NECA 502 (industrial lighting).
- E. Provide required support and attachment in accordance with Section 260529.
- F. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- G. Recessed Luminaires:
  - 1. Install trims tight to mounting surface with no visible light leakage.
  - 2. Non-IC Rated Luminaires: Maintain required separation from insulation and combustible materials according to listing.
- H. Install accessories furnished with each luminaire.
- I. Bond products and metal accessories to branch circuit equipment grounding conductor.
- J. Emergency Lighting Units:
  - 1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.
- K. Exit Signs:
  - 1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.
- L. Identify luminaires connected to emergency power system in accordance with Section 260553.

3.04 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Inspect each product for damage and defects.
- C. Operate each luminaire after installation and connection to verify proper operation.
- D. Test self-powered exit signs, emergency lighting units, and fluorescent emergency power supply units to verify proper operation upon loss of normal power supply.
- E. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect.

3.05 ADJUSTING

- A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect. Secure locking fittings in place.
- B. Exit Signs with Field-Selectable Directional Arrows: Set as indicated or as required to properly designate egress path as directed by Architect or authority having jurisdiction.

3.06 CLEANING

- A. Clean surfaces according to NECA 500 (commercial lighting), NECA 502 (industrial lighting), and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.07 CLOSEOUT ACTIVITIES

- A. See Section 017800 - Closeout Submittals, for closeout submittals.
- B. Demonstration: Demonstrate proper operation of luminaires to Architect, and correct deficiencies or make adjustments as directed.

3.08 PROTECTION

- A. Protect installed luminaires from subsequent construction operations.

END OF SECTION 265100

SECTION 270529  
HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

- 1.01 Section Includes
- A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other communications work.
- 1.02 Reference Standards
- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
  - B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
  - C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.
  - D. MFMA-4 - Metal Framing Standards Publication; 2004.
  - E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
  - F. TIA-569 - Telecommunications Pathways and Spaces; 2019e, with Addendum (2022).

PART 2 PRODUCTS

- 2.01 Support and Attachment Components
- A. General Requirements:
    - 1. Comply with the following. Where requirements differ, comply with most stringent.
      - a. TIA-569.
      - b. NFPA 70.
      - c. Requirements of authorities having jurisdiction.
    - 2. Provide required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for complete installation of communications work.
    - 3. Provide products listed, classified, and labeled as suitable for purpose intended, where applicable.
    - 4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for load to be supported with minimum safety factor of \_\_\_\_\_. Include consideration for vibration, equipment operation, and shock loads where applicable.
    - 5. Do not use products for applications other than as permitted by NFPA 70 and product listing.

6. Steel Components: Use corrosion-resistant materials suitable for environment where installed.
  - a. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
  - b. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
  
- B. Conduit Supports: Straps and clamps suitable for conduit to be supported.
  1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
  2. Conduit Clamps: Bolted type unless otherwise indicated.
  
- C. Outlet Box Supports: Hangers and brackets suitable for boxes to be supported.
  
- D. Metal Channel/Strut Framing Systems:
  1. Description: Factory-fabricated, continuous-slot, metal channel/strut and associated fittings, accessories, and hardware required for field assembly of supports.
  2. Comply with MFMA-4.
  
- E. Hanger Rods: Threaded, zinc-plated steel unless otherwise indicated.
  
- F. Anchors and Fasteners:
  1. Unless otherwise indicated and where not otherwise restricted, use anchor and fastener types indicated for specified applications.

END OF SECTION 270529

SECTION 270533.13  
CONDUIT FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Galvanized steel rigid metal conduit (RMC).

1.02 RELATED REQUIREMENTS

- A. Section 078400 - Firestopping.

1.03 REFERENCE STANDARDS

- A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2015.
- B. BICSI ITSIMM - Information Technology Systems Installation Methods Manual (ITSIMM), 8th Edition; 2022.
- C. BICSI N1 - Installation Practices for Telecommunications and ICT Cabling and Related Cabling Infrastructure, 1st Edition; 2019.
- D. BICSI TDMM - Telecommunications Distribution Methods Manual, 14th Edition; 2020.
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- F. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); 2013.
- G. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.
- H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. TIA-568.0 - Generic Telecommunications Cabling for Customer Premises; 2020e.
- J. TIA-569 - Telecommunications Pathways and Spaces; 2019e, with Addendum (2022).
- K. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.
- L. UL 514B - Conduit, Tubing, and Cable Fittings; Current Edition, Including All Revisions.

PART 2 PRODUCTS

2.01 CONDUIT APPLICATIONS

- A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70, TIA-569, BICSI ITSIMM, BICSI TDMM, manufacturers' instructions, and product listing.

- B. Unless otherwise indicated and where not otherwise restricted, use conduit types indicated for specified applications. Where more than one listed application applies, comply with most restrictive requirements. Where conduit type for particular application is not specified, use galvanized steel rigid metal conduit.

## 2.02 CONDUIT - GENERAL REQUIREMENTS

- A. Comply with NFPA 70 and TIA-569.
- B. Provide conduit, fittings, supports, and accessories required for complete communications pathway.
- C. Provide products listed, classified, and labeled as suitable for purpose intended.
- D. Where conduit size is not indicated, size to comply with NFPA 70, TIA-569, and BICSI TDMM, but not less than applicable minimum size requirements specified. Where specified standards differ, comply with most stringent.

## 2.03 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

- A. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.
- B. Fittings:
  - 1. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 6.
  - 2. Material: Use steel or malleable iron.
  - 3. Connectors and Couplings: Use threaded fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.
  - 4. Conduit Bodies: Use only conduit bodies specifically designed for communications cabling. Standard conduit bodies designed for electrical raceways are not permitted.
    - a. Comply with TIA-568.0 minimum bend radius requirements for fiber optic cables.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive conduits.
- C. Verify that conditions are satisfactory for installation prior to starting work.

### 3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install conduit in accordance with NECA 1, BICSI ITSIMM, and BICSI N1.



- C. Galvanized Steel Rigid Metal Conduit (RMC): Install in accordance with NECA 101.
- D. Conduit Support:
  - 1. Secure and support conduits in accordance with NFPA 70 using suitable supports and methods approved by authorities having jurisdiction.
  - 2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- E. Connections and Terminations:
  - 1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
  - 2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
  - 3. Use suitable adapters where required to transition from one type of conduit to another.
  - 4. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
  - 5. Provide insulating bushings, insulated throats, or listed metal fittings with smooth, rounded edges at conduit terminations to protect cables.
  - 6. Secure joints and connections to provide mechanical strength and electrical continuity.
- F. Penetrations:
  - 1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
  - 2. Make penetrations perpendicular to surfaces unless otherwise indicated.
  - 3. Provide sleeves and/or slots for penetrations as indicated or as required to facilitate installation.
  - 4. Conceal bends for conduit risers emerging above ground.
  - 5. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
  - 6. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty.
  - 7. Install firestopping to preserve fire resistance rating of partitions and other elements; see Section 078400.
- G. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed cables or connected equipment. This includes, but is not limited to:
  - 1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
  - 2. Where conduits are subject to earth movement by settlement or frost.
- H. Provide grounding and bonding.

### 3.03 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements for additional requirements.

- B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- C. Correct deficiencies and replace damaged or defective conduits.

END OF SECTION 270533.13

SECTION 270536  
CABLE TRAYS FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.01 Section Includes

- A. Metal cable tray systems:
  - 1. Metal ventilated trough cable tray.
  - 2. Metal solid-bottom cable tray.

1.02 Related Requirements

- A. Section 270529 - Hangers and Supports for Communications Systems.

1.03 Reference Standards

- A. BICSI ITSIMM - Information Technology Systems Installation Methods Manual (ITSIMM), 8th Edition; 2022.
- B. NEMA BI-50016 - Cable Tray Installation Guidelines; 2024.
- C. NEMA VE 1 - Metal Cable Tray Systems; 2017.
- D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

PART 2 PRODUCTS

2.01 Cable Tray System - General Requirements

- A. Provide new cable tray system consisting of required components, fittings, supports, and accessories, as necessary for complete system.
- B. Provide products listed, classified, and labeled as suitable for purpose intended.
- C. Do not use cable tray for applications other than as permitted by NFPA 70 and product listing/classification.
- D. Provide cable tray system and associated components suitable for use at indicated span/load ratings under service conditions at installed location.
- E. Unless otherwise indicated, specified span/load ratings are based on safety factor of 1.5 and working load only (i.e., no additional concentrated static load), with ratings for metal cable tray systems in accordance with NEMA VE 1.
- F. Unless otherwise indicated, specified load/fill depths and inside widths are nominal values, with values for metal cable tray systems in accordance with NEMA VE 1 including applicable

allowable tolerances.

### PART 3 EXECUTION

#### 3.01 Examination

- A. Verify that work likely to damage cable tray system has been completed.
- B. Verify field measurements.
- C. Verify dimensions and span/load ratings of cable tray system components.
- D. Verify that mounting surfaces are ready to receive cable tray and associated supports.
- E. Verify that conditions are satisfactory for installation prior to starting work.

#### 3.02 Installation

- A. Install products in accordance with manufacturer's instructions.
- B. Unless otherwise indicated, arrange cable tray to be parallel or perpendicular to building lines.
- C. Arrange cable tray to provide required clearances and maintain cable access.
- D. Install cable tray plumb and level, with sections aligned and with horizontal runs at specified elevation.
- E. Cable Tray Movement Provisions:
  - 1. Provide expansion fittings where cable tray is subject to movement, including but not limited to:
    - a. Where cable tray crosses structural joints intended for expansion.
    - b. Long straight cable tray runs in accordance with NEMA BI-50016.
  - 2. Use expansion guides in lieu of hold-down clamps where prescribed in NEMA BI-50016.
  - 3. Set gaps for expansion fittings in accordance with NEMA BI-50016.
- F. Cable Provisions:
  - 1. Use fixed barrier strips to maintain separation of cables as indicated and as required by NFPA 70.
  - 2. Use drop-out fittings or bushings where cables exit cable tray as required to maintain minimum cable bending radius.
  - 3. Use cable support fittings for long vertical cable tray runs with heavy cables.
- G. Provide end closures at unconnected ends of cable tray runs.
- H. Cable Tray Support:
  - 1. Use manufacturer's recommended hangers and supports, located in accordance with NEMA BI-50016, BICSI ITSIMM, and manufacturer's requirements, but not exceeding specified span unless otherwise approved by Engineer. Provide required support and attachment where not furnished by cable tray manufacturer.
  - 2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

- I. Penetrations: Install firestopping to preserve fire resistance rating of building elements.
- J. Identification Requirements:
- K. Install cable tray covers where indicated and as follows:

END OF SECTION 270536

SECTION 271000  
STRUCTURED CABLING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Communications system design requirements.
- B. Communications pathways.
- C. Communications identification.

1.02 REFERENCE STANDARDS

- A. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. TIA-606 - Administration Standard for Telecommunications Infrastructure; 2021d.
- C. TIA-607 - Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises; 2019d, with Addendum (2021).

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Keep stored products clean and dry.

PART 2 PRODUCTS

2.01 SYSTEM DESIGN

- A. Provide a complete permanent system of cabling and pathways for voice and data communications, including cables, conduits and wireways, pull wires, support structures, enclosures and cabinets, and outlets.
  - 1. Provide fixed cables and pathways that comply with NFPA 70 and TIA-607 and are UL listed or third party independent testing laboratory certified.
  - 2. Provide connection devices that are rated for operation under conditions of 32 to 140 degrees F (0 to 60 degrees C) at relative humidity of 0 to 95 percent, noncondensing.
  - 3. In this project, the term plenum is defined as return air spaces above ceilings, inside ducts, under raised floors, and other air-handling spaces.
- B. Main Distribution Frame (MDF): Centrally located support structure for terminating horizontal cables that extend to telecommunications outlets, functioning as point of presence to external service provider.
  - 1. Locate main distribution frame as indicated on the drawings.

- C. Cabling to Outlets: Specified horizontal cabling, wired in star topology to distribution frame located at center hub of star; also referred to as "links".

## 2.02 IDENTIFICATION PRODUCTS

- A. Comply with TIA-606.

## PART 3 EXECUTION

### 3.01 INSTALLATION - GENERAL

- A. Comply with Communication Service Provider requirements.
- B. Grounding and Bonding: Perform in accordance with TIA-607 and NFPA 70.

### 3.02 INSTALLATION OF PATHWAYS

- A. Install pathways with the following minimum clearances:
  1. 48 inches (1220 mm) from motors, generators, frequency converters, transformers, x-ray equipment, and uninterruptible power systems.
  2. 12 inches (300 mm) from power conduits and cables and panelboards.
  3. 5 inches (125 mm) from fluorescent and high frequency lighting fixtures.
  4. 6 inches (150 mm) from flues, hot water pipes, and steam pipes.

### 3.03 INSTALLATION OF EQUIPMENT AND CABLING

- A. Cabling:
  1. Do not bend cable at radius less than manufacturer's recommended bend radius; for unshielded twisted pair use bend radius of not less than 4 times cable diameter.
  2. Do not over-cinch or crush cables.
  3. Do not exceed manufacturer's recommended cable pull tension.
  4. When installing in conduit, use only lubricants approved by cable manufacturer and do not chafe or damage outer jacket.
- B. Service Loops (Slack or Excess Length): Provide the following minimum extra length of cable, looped neatly:
  1. At Distribution Frames: 120 inches (3000 mm).
- C. Identification:
  1. Use wire and cable markers to identify cables at each end.

### 3.04 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Comply with inspection and testing requirements of specified installation standards.
- C. Visual Inspection:

1. Inspect cable jackets for certification markings.
  2. Inspect cable terminations for color coded labels of proper type.
  3. Inspect outlet plates and patch panels for complete labels.
- D. Final Testing: After all work is complete, including installation of telecommunications outlets, and telephone dial tone service is active, test each voice jack for dial tone.

END OF SECTION 271000