



SAULT STE. MARIE AREA PUBLIC SCHOOLS

# HIGH SCHOOL

## MULTI-PURPOSE ROOM RENOVATION

904 Marquette Ave. Sault Ste. Marie, MI 49783  
PROJECT No. 25.503

SPECIFICATIONS

**BIDS**

March 17, 2026

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**SECTION 03 30 00**  
**CAST-IN-PLACE CONCRETE**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Concrete formwork.
- B. Slabs on grade.
- C. Concrete foundation walls.
- D. Concrete reinforcement.
- E. Joint devices associated with concrete work.
- F. Concrete curing.
- G. Sealing of concrete.
- H. Anti-Slip Floor Treatment

**1.02 RELATED SECTIONS**

- A. Section 04 22 00 – Concrete Unit Masonry
- B. Section 07 90 00 – Joint Sealers
- C. Section 07 21 00 - Insulation
- D. Section 10 51 13 – Metal Lockers

**1.03 REFERENCES**

- A. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; American Concrete Institute International; 1991 (Reapproved 2002).
- B. ACI 211.2 - Standard Practice for Selecting Proportions for Structural Lightweight Concrete; American Concrete Institute International; 1998 (Reapproved 2004).
- C. ACI 301 - Specifications for Structural Concrete for Buildings; American Concrete Institute International; 2005.
- D. ACI 302.1R-15 - Guide for Concrete Floor and Slab Construction; American Concrete Institute International; 2004.
- E. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; American Concrete Institute International; 2000.
- F. ACI 305R - Hot Weather Concreting; American Concrete Institute International; 1999.
- G. ACI 306R - Cold Weather Concreting; American Concrete Institute International; 1988.
- H. ACI 308R - Guide to Curing Concrete; American Concrete Institute International; 2001.
- I. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; American Concrete Institute International; 2005.
- J. ASTM A 185 - Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete; 2002.
- K. ASTM A 615/A 615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement; 2004b.
- L. ASTM C 33 - Standard Specification for Concrete Aggregates; 2003.
- M. ASTM C 39/C 39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2004a.
- N. ASTM C 94/C 94M - Standard Specification for Ready-Mixed Concrete; 2004a.
- O. ASTM C 143/C 143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2003.
- P. ASTM C 150 - Standard Specification for Portland Cement; 2004a.
- Q. ASTM C 171 - Standard Specification for Sheet Materials for Curing Concrete; 2003.
- R. ASTM C 260 - Standard Specification for Air-Entraining Admixtures for Concrete; 2001.
- S. ASTM C 309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 2003.

- T. ASTM C 330 - Standard Specification for Lightweight Aggregates for Structural Concrete; 2004.
- U. ASTM C 494/C 494M - Standard Specification for Chemical Admixtures for Concrete; 2004.
- V. ASTM C 618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2003.
- W. ASTM C 685/C 685M - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing; 2001.
- X. ASTM C 881/C 881M - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete; 2002.
- Y. ASTM C 989 - Standard Specification for Ground Granulated Blast-Furnace SLAG for Use in Concrete and Mortars; 2005.
- Z. ASTM C 1059 - Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete; 1999.
- AA. ASTM C 1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2002.
- BB. ASTM D 1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types); 2004.
- CC. ASTM E 1155 - Standard Test Method for Determining F(F) Floor Flatness and F(L) Floor Levelness Numbers; 1996 (Reapproved 2001).
- DD. ASTM E 1155M - Standard Test Method for Determining F(F) Floor Flatness and F(L) Floor Levelness Numbers [Metric]; 1996 (Reapproved 2001).
- EE. COE CRD-C 513 - COE Specifications for Rubber Waterstops; Corps of Engineers; 1974.

#### 1.04 SUBMITTALS

- A. See Division 1 for submittal procedures.
- B. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements.
- C. Manufacturer's Installation Instructions: Indicate installation procedures and interface required with adjacent construction for concrete accessories.
- D. Project Record Documents: Accurately record actual locations of embedded utilities and components that will be concealed from view upon completion of concrete work.
- E. Submittals for Environmental Performance:
  - 1. Provide data indicating the percentage of post-industrial pozzolan (fly ash, blast furnace slag) cement substitution as a percentage of the full product composite by weight.
  - 2. Local/Regional Materials:
    - a. Sourcing location(s): Indicate location of extraction, harvesting, and recovery; indicate distance between extraction, harvesting, and recovery and the project site.
    - b. Manufacturing location(s): Indicate location of manufacturing facility; indicate distance between manufacturing facility and the project site.

#### 1.05 QUALITY ASSURANCE

- A. Perform work of this section in accordance with ACI 301 and ACI 318.
- B. Acquire cement from same source and aggregate from same source for entire project.
- C. Follow recommendations of ACI 305R when concreting during hot weather.
- D. Follow recommendations of ACI 306R when concreting during cold weather.

## PART 2 PRODUCTS

## 2.01 FORMWORK

- A. Form Materials: Contractor's choice of standard products with sufficient strength to withstand hydrostatic head without distortion in excess of permitted tolerances.
  - 1. Form Facing for Exposed Finish Concrete: Contractor's choice of materials that will provide smooth, stain-free final appearance.
  - 2. Form Coating: Release agent that will not adversely affect concrete or interfere with application of coatings. Consider the use of water, vegetable, or soy based form release agents in lieu of petroleum based products. Consider agents that contain low or no Volatile Organic Compounds (VOC).
  - 3. Form Ties: Contractor's choice of type that will leave no metal within 1-1/2 inches of concrete surface.

## 2.02 REINFORCEMENT

- A. Reinforcing Steel: ASTM A 615/A 615M Grade 60 (420).
  - 1. Deformed billet-steel bars.
  - 2. Unfinished.
  - 3. Provide reinforcement bar steel with a high percentage of post-consumer recycled content. Maximize the percentage of post-consumer and pre-consumer recycled content.
- B. Steel Welded Wire Reinforcement: ASTM A 185, plain type.
  - 1. Flat Sheets.
  - 2. Mesh Size and Wire Gage: As indicated on drawings.
  - 3. Provide reinforcement welded-wire steel with a high percentage of post-consumer recycled content. Maximize the percentage of post-consumer and pre-consumer recycled content.
- C. Reinforcement Accessories:
  - 1. Tie Wire: Annealed, minimum 16 gage.
  - 2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.
  - 3. Provide galvanized or plastic components for placement within 1-1/2 inches of weathering surfaces.

## 2.03 CONCRETE MATERIALS

- A. Cement: ASTM C 150, Type I - Normal Portland type.
- B. Fine and Coarse Aggregates: ASTM C 33.
- C. Lightweight Aggregate: ASTM C 330.
- D. Fly Ash: ASTM C 618, Class C or F. Report the chemical analysis of the fly ash in accordance with ASTM C311. Evaluate and classify fly ash in accordance with ASTM D5759.
  - 1. Recycled Content: Maximize the percentage of pre-consumer recycled content.
- E. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
  - 1. Recycled Content: Maximize the percentage of pre-consumer recycled content.
- F. Water: Clean and not detrimental to concrete.
- G. Fiber Reinforcement: Synthetic fiber shown to have long-term resistance to deterioration when exposed to moisture and alkalis; 3/4 inch length.
  - 1. Recycled Content: Maximize the percentage of post-consumer and pre-consumer recycled content.

## 2.04 CHEMICAL ADMIXTURES

- A. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.
- B. Air Entrainment Admixture: ASTM C 260.

- C. Chemical Admixtures: ASTM C 494/C 494M, Type A - Water Reducing, Type C - Accelerating, and Type G - Water Reducing, High Range and Retarding.

## 2.05 ACCESSORY MATERIALS

- A. Reglets: Formed steel sheet, galvanized, with temporary filler to prevent concrete intrusion during placement.
- B. Bonding Agent: ASTM C 1059, Type II acrylic non-redispersable type.
- C. Epoxy Bonding System: ASTM C 881, type as required by project conditions.
- D. Underslab Vapor Retarder: Polyethylene sheet, minimum 6 mils thick.
- E. Chemical Hardener: Fluosilicate solution designed for densification of cured concrete slabs.
- F. Non-Shrink Grout: ASTM C 1107; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
  - 1. Minimum Compressive Strength at 48 Hours: 2,400 psi.
  - 2. Minimum Compressive Strength at 28 Days: 7,000 psi.
- G. Moisture-Retaining Cover: ASTM C 171; regular curing paper, white curing paper, clear polyethylene, white polyethylene, or white burlap-polyethylene sheet.
- H. Liquid Curing Compound: ASTM C 309, Type 2, white pigmented, Class B. - Exterior Curb and Gutter Construction.
  - 1. Dissipating, water-based curing compound for newly placed concrete surfaces.
- I. Liquid Curing Compound and Sealer: ASTM C 309, Type 1, clear or translucent. Provide "Cure and Seal HS WB" manufactured by Symons.
  - 1. Water-based, high solids acrylic curing compound and sealer for concrete.
  - 2. Meet V.O.C. emission requirements for curing and sealing compounds.
  - 3. Do not install this material where other floor finishes are called for on the concrete.
  - 4. Substitutions: See Section 01 60 00 - Product Requirements.

## 2.06 BONDING AND JOINTING PRODUCTS

- A. Expandable Waterstops: Expandable waterstop, Self-adhering, expandable bentonite clay waterstop that swells when in contact with water:
  - 1. Basis of design: MiraSTOP™ BW
- B. Joint Filler: Nonextruding, resilient asphalt impregnated fiberboard or felt, complying with ASTM D 1751, 1/4 inch thick and 4 inches deep; tongue and groove profile.
- C. Construction Joint Devices: Integral galvanized steel; formed to tongue and groove profile, with removable top strip exposing sealant trough, knockout holes spaced at 6 inches, ribbed steel spikes with tongue to fit top screed edge.
- D. Sealant, Primer, & Joint Backing: As specified in Section 07 90 00.

## 2.07 CONCRETE MIX DESIGN

- A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.
- B. Proportioning Structural Lightweight Concrete: Comply with ACI 211.2 recommendations.
- C. Concrete Strength: Establish required average strength for concrete on the basis of trial mixtures, as specified in ACI 301.
  - 1. For trial mixtures method, employ independent testing agency acceptable to Architect for preparing and reporting proposed mix designs.
- D. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended by manufacturer.
- E. Fiber Reinforcement: Add to mix at rate of 1.5 pounds per cubic yard, or as recommended by manufacturer for specific project conditions.



1. Recycled Content: Maximize the percentage of post-consumer and pre-consumer recycled content.
- F. Normal Weight Concrete: Refer to the drawings for mix design guidelines.

## 2.08 MIXING

- A. On Project Site: Mix in drum type batch mixer, complying with ASTM C 685. Mix each batch not less than 1-1/2 minutes and not more than 5 minutes.
- B. Transit Mixers: Comply with ASTM C 94/C 94M.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify lines, levels, and dimensions before proceeding with work of this section.

### 3.02 PREPARATION

- A. Formwork: Comply with requirements of ACI 301. Design and fabricate forms to support all applied loads until concrete is cured, and for easy removal without damage to concrete.
- B. Verify that forms are clean and free of rust before applying release agent.
- C. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.
- D. Where new concrete is to be bonded to previously placed concrete, prepare existing surface by cleaning with steel brush and applying bonding agent in accordance with manufacturer's instructions.
- E. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout.
- F. Install vapor retarder under interior slabs on grade. Lap joints minimum 6 inches and seal watertight by taping edges and ends.

### 3.03 INSTALLING REINFORCEMENT

- A. Comply with requirements of ACI 301. Clean reinforcement of loose rust and mill scale, and accurately position, support, and secure in place to achieve not less than minimum concrete coverage required for protection.
- B. Install welded wire reinforcement in maximum possible lengths, and offset end laps in both directions. Splice laps with tie wire.
- C. Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with concrete placement.

### 3.04 PLACING CONCRETE

- A. Place concrete in accordance with ACI 304R.
- B. Place concrete for floor slabs in accordance with **ACI 302.1R-15**.
- C. Ensure reinforcement, inserts, waterstops, embedded parts, and formed construction joint devices will not be disturbed during concrete placement.
- D. At the perimeter, vapor retarder/barrier should be turn up and sealed to wall, grade beam or slab.
- D. Repair underslab vapor retarder damaged during placement of concrete reinforcing. Repair with vapor retarder material; lap over damaged areas minimum 6 inches and seal watertight.
- E. Separate slabs on grade from vertical surfaces with joint filler.
- F. Place joint filler in floor slab pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.

- G. Extend flexible joint filler full depth of finished slab surface. Conform to Section 07 90 00 for finish joint sealer requirements and preparation prior to installation of elastomeric joint sealant where required
- H. Install expansion joint devices in accordance with manufacturer's instructions.
- I. Install construction joint devices in coordination with floor slab pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.
- J. Apply sealants in joint devices in accordance with Section 07 90 00. Ensure proper joint preparation prior to application of sealants.
- K. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.
- L. Place concrete continuously between predetermined expansion, control, and construction joints.
- M. Do not interrupt successive placement; do not permit cold joints to occur.
- N. Saw cut control joints within 24 hours after placing. Use 3/16 inch thick blade, cut into 1/4 depth of slab thickness, minimum.
- O. Screed floors level, maintaining the following minimum F(F) Floor Flatness and F(L) Floor Levelness values when measured in accordance with ASTM E 1155/ASTM E 1155M.
  - 1. F(F): Specified Overall Value (SOV) of 18; Minimum Localized Value (MLV) of 13.
  - 2. F(L): Specified Overall Value (SOV) of 24; Minimum Localized Value (MLV) of 17.

### 3.05 CONCRETE FINISHING

- A. Repair surface defects, including tie holes, immediately after removing formwork.
- B. Unexposed Form Finish: Rub down or chip off fins or other raised areas 1/4 inch or more in height.
- C. Exposed Form Finish: Rub down or chip off and smooth fins or other raised areas 1/4 inch or more in height. Provide finish as follows:
- D. Concrete Slabs: Finish to requirements of ACI 302.1R, and as follows:
  - 1. Steel trowel surfaces that will be left exposed.
    - a. Chemical Hardener: After slab has cured, apply water-diluted hardener in three coats per manufacturer's instructions, allowing 24 hours between coats.
- E. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains as indicated on drawings.

### 3.07 CURING AND PROTECTION

- A. Comply with requirements of ACI 308. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
- B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
  - 1. Normal concrete: Not less than 7 days.
  - 2. High early strength concrete: Not less than 4 days.
- C. Formed Surfaces: Cure by moist curing with forms in place for full curing period.
- D. Surfaces Not in Contact with Forms:
  - 1. Start initial curing as soon as free water has disappeared and before surface is dry. Keep continuously moist for not less than three days by water ponding, water-fog spray, or saturated burlap.
  - 2. Begin final curing after initial curing but before surface is dry.
    - a. Moisture-retaining cover: Seal in place with waterproof tape or adhesive.
    - b. Curing compound: Apply in two coats at right angles, using application rate recommended by manufacturer.

### 3.08 ANTI-SLIP FLOOR TREATMENT

- A. Manufacturer: No Skidding Products, Inc.
- B. Product: Anti-Slip concrete Treatment # 50378
- C. Application: Follow Manufacturer's recommended application process

### 3.09 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Division 1
- B. Provide free access to concrete operations at project site and cooperate with appointed firm.
- C. Submit proposed mix design of each class of concrete to testing firm for review prior to commencement of concrete operations.
- D. Tests of concrete and concrete materials may be performed at any time to ensure conformance with specified requirements.
- E. Compressive Strength Tests: ASTM C 39/C 39M. For each test, mold and cure three concrete test cylinders. Obtain test samples for every 100 cu yd or less of concrete placed.
- F. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.
- G. Perform one slump test for each set of test cylinders taken, following procedures of ASTM C 143/C 143M.

### 3.10 DEFECTIVE CONCRETE

- A. Test Results: The testing agency shall report test results in writing to Architect and Contractor within 24 hours of test.
- B. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.
- C. Repair or replacement of defective concrete will be determined by the Architect. The cost of additional testing shall be borne by Contractor when defective concrete is identified.
- D. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect for each individual area.

**END OF SECTION 03 30 00**

## SECTION 03 54 16

### HYDRAULIC CEMENT UNDERLAYMENT

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings, general provisions of the Contract, and other related construction documents such as Division 01 specifications apply to this Section

##### 1.2 SUMMARY

- A. This Section includes an underlayment that consists of a blend of Portland cement and other hydraulic cements that is used to level and smooth interior concrete, terrazzo, ceramic and quarry tile, epoxy coating systems and non-water-soluble adhesive residue on concrete.

1. [ARDEX K 40™ RAPID Rapid, High Flow Self-Leveling Underlayment](#)
2. [Selected ARDEX Primer](#)
3. ARDEX ARDIFIX™ Low Viscosity Rigid Polyurethane Crack & Joint Repair
4. ARDEX FEATHER FINISH® Self-Drying Cement Based Finish Underlayment
5. ARDEX ARDISEAL™ Rapid Plus Semi-Rigid Joint Sealant B. Related

Sections include the following:

1. Section 03 30 00, Cast-In-Place Concrete
2. Division 09 Flooring Sections

##### 1.3 REFERENCES

- A. ASTM C109M, Compressive Strength Air-Cure Only
- B. ASTM E10M, Standard Test Method for Brinell Hardness
- C. ASTM F2170, Relative Humidity in Concrete Floor Slabs Using in situ Probes
- D. ASTM F710, Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring

##### 1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used. Include manufacturer's Safety Data Sheets.
- B. Qualification Data: For Installer

1.5 QUALITY ASSURANCE

- A. Installation of the ARDEX product must be completed by a factory-trained applicator, such as an ARDEX LevelMaster® Elite, Choice Contractor or INSTALL Substrate Prep Certified Installer, using mixing equipment and tools approved by the manufacturer. Contact ARDEX Americas (724) 203-5000 for a list of recommended installers.
- B. Product must have hydraulic cement-based inorganic binder content as the primary binder which includes Portland cement per ASTM C150: Standard Specification for Portland cement and other specialty hydraulic cements. Gypsum-based products are not acceptable.
- C. Manufacturer Experience: Provide products of this section by companies which have successfully specialized in production of this type of products for not less than 10 years. Contact Manufacturer Representative prior to installation.

1.6 WARRANTY: ARDEX K 40™ RAPID installed as part of a floor system, shall be installed in conjunction with the recommended ARDEX Tile & Stone Installation Materials or WW HENRY Flooring Adhesive, as appropriate, to provide the ARDEX SystemOne comprehensive warranty, depending on the system installed.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver products in original packaging, labeled with product identification, manufacturer, batch number and shelf life.
- B. Store products in a dry area with temperature maintained between 50° and 85°F (10° and 29°C) and protect from direct sunlight.
- C. Handle products in accordance with manufacturer's printed recommendations.

1.8 PROJECT CONDITIONS

- A. Do not install material below 50°F (10°C) surface and air temperatures. These temperatures must also be maintained during and for 48 hours after the installation of products included in this section. Install quickly if substrate is warm and follow warm weather instructions available from the ARDEX Technical Service Department.

**PART 2 – PRODUCTS**

2.1 HYDRAULIC CEMENT UNDERLAYMENT

- A. Hydraulic Cement-based Self-Leveling Underlayment

Acceptable Products:

- 1. ARDEX K 40™ RAPID; manufactured by ARDEX Americas, USA, (724) 203-5000, [www.ardexamericas.com](http://www.ardexamericas.com)
  - a. Selected ARDEX Primer dependent on substrate, and absorbency of substrate and moisture control requirements. See ARDEX K 40 RAPID Technical Data sheet for further information.

2. Performance and Physical Properties: Meet or exceed the following values for material cured at 73° F+/-3°F (23° C+/-3°C) and 50% +/-5% relative humidity:

- a. Mixing: Barrel Mix or Pump
- b. Flow Time: 10 minutes
- c. Walkable: 60 – 90 minutes
- d. Compressive Strength: 8,000 psi (562 kg/cm<sup>2</sup>) at 28 days, ASTM C109M
- e. Flexural Strength: 2,000 psi (140.6 kg/cm<sup>2</sup>) at 28 days, ASTM C348
- h. VOC: 0

## 2.2 CRACK AND JOINT REPAIR

- A. Low Viscosity Rigid Polyurethane Crack and Joint Repair; ARDEX ARDIFIX™; Manufactured by ARDEX Americas; USA; 724-203-5000, [www.ardexamericas.com](http://www.ardexamericas.com)
- B. Semi-Rigid Joint Sealant; ARDEX ARDISEAL™ Rapid Plus Semi-Rigid Joint Sealant; Manufactured by ARDEX Americas; USA; 724-203-5000, [www.ardexamericas.com](http://www.ardexamericas.com)

## 2.3 PATCH

- A. ARDEX FEATHER FINISH® Self-Drying Cement Based Finished Underlayment

# PART 3 – EXECUTION

## 3.1 PREPARATION

- A. General: Prepare substrate in accordance with manufacturer's instructions.
  - 1. Shot blasting or other mechanical means must be used for Prop Pre. Sanding is not a sufficient means of cleaning or preparing concrete. Do not use acid etching, adhesive removers, solvents or sweeping compounds, as these are bond breakers.
  - 2. Handle and dispose of asbestos and other hazardous materials in accordance with prevailing regulations, which supersede the recommendations in this document.
  - 3. All substrates must be sound, solid and thoroughly clean of all bond-breaking contaminants, including but not limited to overwatered or otherwise loose or weak material, unapproved sealers, unsuitable adhesive residues, and patching and leveling materials.
  - 4. Depending on the selected moisture control system or primer, additional prep may be needed. Please see the technical data sheet.
- B. Crack and Joint Preparation:
  - 1. Moving Joints and Moving Cracks – Honor all moving joints and moving cracks up through the underlayment. A flexible sealing compound such as ARDEX ARDISEAL™ Rapid Plus Semi-Rigid Joint Sealant may be installed.
  - 2. Saw Cuts, Dormant Control Joints and Dormant Cracks – Fill all dormant control joints and dormant cracks with ARDEX ARDIFIX™ Low Viscosity Rigid Polyurethane Crack & Joint Repair or ARDEX FEATHER FINISH® Self-Drying, Cement-Based Finish Underlayment as recommended by the manufacturer.

3. If a moisture control system will be installed, the crack and joint preparation recommendations will differ. Please see the technical data sheet.

### 3.2 APPLICATION OF ARDEX K 40™ RAPID

- A. Examine substrates and conditions under which materials will be installed. Do not proceed with installation until unsatisfactory conditions are corrected.
- B. Coordinate installation with adjacent work to ensure proper sequence of construction. Protect adjacent areas from contact due to mixing and handling of materials.
- C. Priming: Comply with manufacturer's printed instructions.
- D. Mixing: Comply with manufacturer's printed instructions. Pumping: Product can be pumped. Please contact the ARDEX Technical Service Department.
- E. Application: Comply with manufacturer's printed instructions.
- F. Curing: The cure time is dependent on the installed thickness and the selected finish flooring. See the Technical Data sheet for further information.

### 3.3 FIELD QUALITY CONTROL

- A. Where specified, field sampling of the ARDEX underlayment is to be done by taking an entire unopened bag of the product being installed to an independent testing facility to perform compressive strength testing in accordance with ASTM C 109/modified: air-cure only. There are no in situ test procedures for the evaluation of compressive strength.

### 3.4 PROTECTION

- A. Prior to the installation of the finish flooring, the surface of the underlayment should be protected from abuse by other trades by the use of plywood, Masonite or other suitable protection course.

## END OF SECTION

**SECTION 03 60 00**  
**POST INSTALLED ANCHORS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section. If differing requirements are identified elsewhere (in these specifications or on drawings or separate instructions), the more stringent requirement shall be met.

**1.2 SUMMARY**

- A. Section includes post installed concrete anchors requirements for the following:
  - 1. Mechanical Anchors.
  - 2. Adhesive Anchors.
- B. Related Sections:
  - 1. Division 03 Section "Cast-In-Place Concrete".
  - 2. Division 04 Section "Unit Masonry".
  - 3. Division 05 Section "Structural Steel Framing".

**1.3 DEFINITION**

- A. Post Installed Anchors: Anchors installed into hardened concrete or fully constructed hollow or grouted masonry.

**1.4 REFERENCE MATERIAL**

- A. ACI 318 – Building Code Requirements for Structural Concrete
- B. ACI 355.2 – Standard for Evaluating the Performance of Post-Installed Mechanical Anchors in Concrete
- C. ASTM A36 – Standard Specification for Carbon Structural Steel
- D. ASTM A153 – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
- E. ASTM A193 – Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
- F. ASTM C881 – Standard Specification Epoxy-Resin-Based Bonding Systems for Concrete
- G. ASTM E488 – Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements
- H. ASTM E1512 – Standard Test Methods for Testing Bond Performance of Bonded Anchors
- I. ASTM F593 – Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
- J. ICC-ES AC01 – Acceptance Criteria for Expansion Anchors in Masonry Elements
- K. ICC-ES AC58 – Acceptance Criteria for Adhesive Anchors in Masonry Elements
- L. ICC-ES AC60 – Acceptance Criteria for Anchors in Unreinforced Masonry Elements
- M. ICC-ES AC106 – Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Concrete or Masonry Elements
- N. ICC-ES AC193 – Acceptance Criteria for Mechanical Anchors in Concrete Elements
- O. ICC-ES AC308 – Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements



## 1.5 SUBMITTAL

- A. General: Submit in accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.
  - 1. Product specifications with recommended design values and physical characteristics for epoxy dowels, expansion and undercut anchors.
  - 2. Quality Assurance Submittals:
    - a. Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties.
    - b. Certificates
      - 1) ICC ES Evaluation Reports
- B. Manufacturer's installation instructions.
- C. Installer Qualifications & Procedures: Submit installer qualifications to special inspector for approval prior to commencement of work.

## 1.6 QUALITY ASSURANCE

- A. Installer(s) Training:
  - 1. Product Manufacturer's certificate for each installer certifying they have been trained on the means and methods for installing the particular anchor.
- B. For horizontal and upwardly inclined adhesive installations, the installer shall be certified by an ACI/CRSI Adhesive Anchor Installing Certification Program or equivalent.
- C. Certifications: Unless otherwise authorized by the Engineer, anchors shall have one of the following certifications.
  - 1. ICC ES Evaluation Report indicating conformance with current applicable ICC ES Acceptance Criteria.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to job site in manufacturer's or distributor's packaging undamaged, complete with installation instructions.
- B. General: Comply with Division 1 Section—Product Storage and Handling Requirements
  - 1. Store anchors in accordance with manufacturer's recommendations.

# PART 2 - PRODUCTS

## 2.1 MANUFACTURER

- A. All products are based on Hilti Corporation.
- B. Substitution:
  - 1. Upon approval by the engineer, the installer may substitute a product by a different manufacturer, provided that the manufacturer submits calculations signed and sealed by an engineer registered in the state of the project's location.
    - a. These calculations must show that the strength of the substituted anchor meets or exceeds the strength of the specified anchor at each application in the project

where a substituted anchor is proposed, with consideration for combined stress and any applicable reduction factors.

- C. The substitution request and submittal shall be made a minimum of 2 weeks prior to planned installation of the anchors.
- D. The finish of the anchor shall remain the same as specified.

## 2.2 MECHANICAL ANCHORS

- A. Torque Controlled (TC) Anchors. Hilti Kwik Bolt TZ2 is a torque controlled expansion anchor suited to seismic and cracked concrete applications.
  - 1. Size: As indicated on drawings
  - 2. Finish: Plain carbon steel or Stainless Steel type 304 (316) as indicated on drawings.
- B. Screw Anchors: Hilti Kwik HUS-EZ anchors are comprised of a body with hex washer head.
  - 1. Size: As indicated on drawings
  - 2. Finish: As indicated on drawings
- C. Sleeve Anchors: Hilti HLC Sleeve Anchor are mechanical expansion anchors consisting of an externally threaded stud with an expanding sleeve for use in concrete and hollow and solid masonry base material.
  - 1. Size: As indicated on drawings
  - 2. Finish: As indicated on drawings

## 2.3 ADHESIVE ANCHORS

- A. In contract documents adhesive anchors may be generically referred to as epoxy anchors. Where this is the case the word adhesive should be substituted for epoxy.
- B. Adhesive anchors used in concrete under a tension condition cannot be installed until after the concrete has cured for a minimum 21 days in accordance with ACI 17.4.5.2.
- C. Concrete Anchor
  - 1. Hilti HIT-RE 500-V3 is a high strength, two part epoxy adhesive.
    - a. Base material temperature range: 23 degrees up to 120 degrees Fahrenheit.
    - b. Size: As indicated on drawings, up to 1.25" diameter maximum.
    - c. Finish: As indicated on drawings
    - d. Anchor material: HAS Threaded Rod Standard ISO 898 Class 5.8, and Deformed Reinforcing Bars.
  - 2. Hilti HIT HY 200 V3 is a two-component hybrid adhesive.
    - a. Base material temperature range: 14 degrees up to 104 degrees Fahrenheit.
    - b. Size: As indicated on drawings, up to 1" diameter maximum.
    - c. Finish: As indicated on drawings
    - d. Anchor material: HAS Threaded Rod Standard ISO 898 Class 5.8, and Deformed Reinforcing Bars.
  - 3. Hilti HIT HY 200 V3 Safeset is a two-component hybrid adhesive.
    - a. Base material temperature range: 14 degrees up to 104 degrees Fahrenheit.
    - b. Size: As indicated on drawings, up to 1" diameter maximum.
    - c. Finish: As indicated on drawings
    - d. Anchor material based on cleaning:
      - 1) No cleaning of hole:
        - a) HIT-Z, HIT-Z-R Threaded Rods

- 2) Automatic cleaning of hole:
  - a) HAS Threaded Rod Standard ISO 898 Class 5.8, and Deformed Reinforcing Bars.
- D. Masonry Anchor:
  - 1. Hilti HIT HY-270 System is a hybrid adhesive consisting of a dual cylinder adhesive refill pack, a mixing nozzle, a screen tube, and either a threaded rod or rebar.
    - a. Size: As indicated on drawings
    - b. Finish: As indicated on drawings
    - c. Anchor Rod: HAS-E Standard ISO 898 Class 5.8.
    - d. Use: Hollow brick, hollow concrete masonry block, or grouted solid concrete masonry block.
  - 2. Hilti HIT HY 200 is a two-component hybrid adhesive.
    - a. Base material temperature range: 14 degrees up to 104 degrees Fahrenheit.
    - b. Size: As indicated on drawings, up to 1" diameter maximum.
    - c. Finish: As indicated on drawings
    - d. Anchor material: HY200 HAS Threaded Rod Standard ISO 898 Class 5.8, and Deformed Reinforcing Bars.
    - e. Use: Solid or grouted solid masonry only.

### **PART 3 - EXECUTION**

#### **3.1 POST INSTALLED ANCHORS**

- A. All installation into concrete and masonry shall be done in accordance with manufacturer's ICC-ES report.
- B. Drilling:
  - 1. Drill holes with rotary impact hammer drills. Drill bits shall be of diameters as specified by the anchor manufacturer. Unless otherwise shown on the Drawings, all holes shall be drilled perpendicular to the concrete surface.
  - 2. Embedded Items: Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Exercise care in coring or drilling to avoid damaging existing reinforcing or embedded items. Notify the Engineer if reinforcing steel or other embedded items are encountered during drilling. Take precautions as necessary to avoid damaging prestressing tendons, electrical and telecommunications conduit, and gas lines.
  - 3. Base Material Strength: Unless otherwise specified, do not drill holes in concrete or masonry until concrete, mortar, or grout has met Manufacturer's specifications.
- C. Torque Controlled Anchors and Sleeve Anchors: Protect threads from damage during anchor installation. Set anchors to manufacturer's recommended torque, using a torque wrench. Following attainment of 10% of the specified torque, 100% of the specified torque shall be reached within 7 or fewer complete turns of the nut. If the specified torque is not achieved within the required number of turns, the anchor shall be removed and replaced unless otherwise directed by the Engineer.
- D. Screw Anchors: Install screw anchors to a snug tight condition unless noted otherwise.
- E. Adhesive Anchors: Clean all holes per manufacturer instructions to remove loose material and drilling dust prior to installation of adhesive. Inject adhesive into holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive. Follow manufacturer recommendations to ensure proper mixing

of adhesive components. Sufficient adhesive shall be injected in the hole to ensure that the annular gap is filled to the surface. Remove excess adhesive from the surface. Shim anchors with suitable device to center the anchor in the hole. Do not disturb or load anchors before manufacturer specified cure time has elapsed.

### 3.2 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Continuous special Inspection of post-installed concrete and masonry anchors shall be provided as required by ICC-ES evaluation reports. This service shall be performed by personnel independent of the Manufacturer or Contractor so as to prevent a conflict of interest.
- C. The Engineer or Architect of Record may require pullout or shear tests, in addition to Special Inspection, to determine the adequacy of anchors. A field testing program shall be established by the independent testing and inspecting agency and/or Engineer of Record and performed in accordance with appropriate ASTM test standards. Field tests shall be non-destructive whenever possible.

**END OF SECTION**

**03 60 00**

## **SECTION 04 05 00**

### **MORTAR AND MASONRY GROUT**

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Mortar for masonry.
- B. Grout for masonry.

##### **1.02 RELATED SECTIONS**

- A. Section 04 21 00 - Clay Unit Masonry: Installation of mortar and grout.
- B. Section 04 22 00 - Concrete Unit Masonry: Installation of mortar and grout.
- D. Section 08 11 13 - Metal Doors and Frames: Grouting steel door frames installed in masonry.

##### **1.03 REFERENCES**

- A. ACI 530/ASCE 5/TMS 402 - Building Code Requirements For Masonry Structures; American Concrete Institute International; 2005.
- B. ACI 530.1/ASCE 6/TMS 602 - Specification for Masonry Structures; American Concrete Institute International; 2005.
- C. ASTM C 91 - Standard Specification for Masonry Cement; 2003a.
- D. ASTM C 94/C 94M - Standard Specification for Ready-Mixed Concrete; 2004a.
- E. ASTM C 144 - Standard Specification for Aggregate for Masonry Mortar; 2004.
- F. ASTM C 150 - Standard Specification for Portland Cement; 2004a.
- G. ASTM C 207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2004.
- H. ASTM C 270 - Standard Specification for Mortar for Unit Masonry; 2004a.
- I. ASTM C 387 - Standard Specification for Packaged, Dry, Combined Materials for Mortar and Concrete; 2004.
- J. ASTM C 404 - Standard Specification for Aggregates for Masonry Grout; 2004.
- K. ASTM C 476 - Standard Specification for Grout for Masonry; 2002.
- L. ASTM C 595 - Standard Specification for Blended Hydraulic Cements; 2003.
- M. ASTM C 780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry; 2002.
- N. ASTM C 1019 - Standard Test Method for Sampling and Testing Grout; 2003.
- O. ASTM C 1142 - Standard Specification for Extended Life Mortar for Unit Masonry; 1995 (Reapproved 2001).
- P. IMIABC (CW) - Recommended Practices & Guide Specifications for Cold Weather Masonry Construction; International Masonry Industry All-Weather Council; 1993.
- Q. IMIABC (HW) - Recommended Practices & Guide Specifications for Hot Weather Masonry Construction; International Masonry Industry All-Weather Council; current edition.

#### 1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Include design mix and indicate whether the Proportion or Property specification of ASTM C 270 is to be used. Also include required environmental conditions and admixture limitations. Mix design submittal for information: For each type of mortar. Include description of type and proportions of ingredients.
  - 1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.
  - 2. Include test reports, according to AASTM C1019, for grout mixes required to comply with compressive strength requirement.
- C. Samples: Submit two samples of mortar, illustrating mortar color and color range.
- D. Reports: Submit reports on mortar indicating conformance of mortar to property requirements of ASTM C 270 and test and evaluation reports per ASTM C 780.
- E. Reports: Submit reports on grout indicating conformance of component grout materials to requirements of ASTM C 476 and test and evaluation reports to requirements of ASTM C 1019.
- F. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- G. Manufacturer's Instructions: Submit packaged dry mortar manufacturer's installation instructions.

#### 1.05 QUALITY ASSURANCE

- A. Comply with provisions of ACI 530/ASCE 5/TMS 402 and ACI 530.1/ASCE 6/TMS 602, except where exceeded by requirements of the contract documents.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Maintain packaged materials clean, dry, and protected against dampness, freezing, and foreign matter.

#### 1.07 ENVIRONMENTAL REQUIREMENTS

- A. Cold Weather Requirements: Comply with recommendations of IMIABC (CW).
- B. Hot Weather Requirements: Comply with IMIABC (HW).

### **PART 2 PRODUCTS**

#### 2.01 MATERIALS

- A. Masonry Cement: ASTM C 91, Type N.
  - 1. Colored mortar: Premixed cement selected from available standard colors.
- B. Portland Cement: ASTM C 150, Type I - Normal; color as required to produce approved color sample.
  - 1. Used for grouting requirements.
- C. Blended Cement: ASTM C 595, Type S; color as required to produce approved color sample.
- D. Packaged Dry Mortar: ASTM C 387, Type N, using existing color cement.
- E. Hydrated Lime: ASTM C 207, Type S.
- F. Mortar Aggregate: ASTM C 144.
- G. Grout Aggregate: ASTM C 404.

- H. Pigments for Colored Mortar: Iron or chromium oxides with demonstrated stability and colorfastness.
  - 1. Colors: As required to match Architect's color samples.
- I. Water: Clean and potable.
- J. Accelerating Admixture: Nonchloride type for use in cold weather.
- K. Moisture-Resistant Admixture: Water repellent compound designed to reduce capillarity.
- L. Bonding Agent: Latex type.

## 2.02 MORTAR MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
  - 1. Do not use calcium chloride in mortar or grout.
  - 2. Use portland cement-lime, mortar cement mortar, or masonry cement mortar unless otherwise indicated.
  - 3. For exterior masonry, use portland cement-lime or mortar cement mortar.
  - 4. For veneer masonry use masonry cement.
  - 5. For reinforced masonry, use portland cement-lime or mortar cement mortar.
  - 6. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
- A. Ready Mixed Mortar: ASTM C 1142, Type RM.
- B. Mortar for Unit Masonry: ASTM C 270, Proportion Specification.
  - 1. Engineered masonry: Type M.
  - 2. Masonry below grade and in contact with earth: Type S.
  - 3. Exterior, loadbearing masonry: Type N.
  - 4. Exterior, non-loadbearing masonry: Type N.
  - 5. Interior, loadbearing masonry: Type N.
  - 6. Interior, non-loadbearing masonry: Type O.
  - 7. Pointing mortar: Type N with maximum 2 percent ammonium stearate or calcium stearate per cement weight.
- C. Stain Resistant Pointing Mortar: One part Portland cement, 1/8 part hydrated lime, and two parts graded (80 mesh) aggregate, proportioned by volume. Add aluminum tristearate, calcium stearate, or ammonium stearate equal to 2 percent of Portland cement by weight.
- D. Colored Mortar: Proportion selected pigments and other ingredients to match Architect's sample, without exceeding manufacturer's recommended pigment-to-cement ratio.

## 2.03 MORTAR MIXING

- A. Thoroughly mix mortar ingredients using mechanical batch mixer, in accordance with ASTM C 270 and in quantities needed for immediate use.
- B. Maintain sand uniformly damp immediately before the mixing process.
- C. Add mortar color in accordance with manufacturer's instructions. Provide uniformity of mix and coloration.
- D. Do not use anti-freeze compounds to lower the freezing point of mortar.

- E. If water is lost by evaporation, re-temper only within two hours of mixing.
- F. Use mortar within two hours after mixing at temperatures of 90 degrees F, or two-and-one-half hours at temperatures under 40 degrees F.

#### 2.04 GROUT MIXES

- A. Bond Beams and Lintels: 4,000 psi strength at 28 days; 8-10 inches slump; provide premixed type in accordance with ASTM C 94/C 94M.
  - 1. Fine grout for spaces with smallest horizontal dimension of 2 inches or less.
  - 2. Coarse grout for spaces with smallest horizontal dimension greater than 2 inches.
- B. Engineered Masonry: 4,000 psi strength at 28 days; 8-10 inches slump; provide premixed type in accordance with ASTM C 94/C 94M.
  - 1. Fine grout for spaces with smallest horizontal dimension of 2 inches or less.
  - 2. Coarse grout for spaces with smallest horizontal dimension greater than 2 inches.

#### 2.05 GROUT MIXING

- A. Mix grout in accordance with ASTM C 94/C 94M.
- B. Thoroughly mix grout ingredients in quantities needed for immediate use in accordance with ASTM C 476 for fine and coarse grout.
- C. Add admixtures in accordance with manufacturer's instructions; mix uniformly.
- D. Do not use anti-freeze compounds to lower the freezing point of grout.

#### 2.06 PRECONSTRUCTION TESTING

- A. Testing will be conducted by an independent test agency, in accordance with provisions of Section 01400.
- B. Mortar Mixes: Test mortars pre-batched by weight in accordance with ASTM C 780 recommendations for preconstruction testing.
  - 1. Test results will be used to establish optimum mortar proportions and establish quality control values for construction testing.
- C. Grout Mixes: Test grout batches in accordance with ASTM C 1019 procedures.
  - 1. Test results will be used to establish optimum grout proportions and establish quality control values for construction testing.

### **PART 3 EXECUTION**

#### 3.01 PREPARATION

- A. Apply bonding agent to existing concrete surfaces.
- B. Plug clean-out holes for grouted masonry with brick masonry units. Brace masonry to resist wet grout pressure.

#### 3.02 INSTALLATION

- A. Install mortar and grout to requirements of section(s) in which masonry is specified.
- B. Work grout into masonry cores and cavities to eliminate voids.
- C. Do not install grout in lifts greater than 16 inches without consolidating grout by rodding.
- D. Do not displace reinforcement while placing grout.



- E. Remove excess mortar from grout spaces.

### 3.03 GROUTING

- A. Use either high-lift or low-lift grouting techniques, at Contractor's option, subject to other limitations of contract documents.
- B. Perform grouting by means of high-lift technique, except in locations that mandate use of low-lift grouting technique.
  - 1. Do not use high-lift grouting where size of cavities mandates use of fine grout.
- C. Low-Lift Grouting:
  - 1. Limit height of pours to 12 inches.
  - 2. Limit height of masonry to 16 inches above each pour.
  - 3. Pour grout only after vertical reinforcing is in place; place horizontal reinforcing as grout is poured. Prevent displacement of bars as grout is poured.
  - 4. Place grout for each pour continuously and consolidate immediately; do not interrupt pours for more than 1-1/2 hours.
- D. High-Lift Grouting:
  - 1. Verify that horizontal and vertical reinforcement is in proper position and adequately secured before beginning pours.
  - 2. Brick: Limit pours to maximum 12 feet in height and 25 feet horizontally.
  - 3. Hollow Masonry: Limit lifts to maximum 4 feet and pours to maximum height of 24 feet.
  - 4. Place grout for spanning elements in single, continuous pour.

### 3.04 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field tests, in accordance with provisions of Section 01 40 00 – Quality Requirements.
- B. Test and evaluate mortar in accordance with ASTM C 780 procedures.
  - 1. Test with same frequency as specified for masonry units.
- C. Test and evaluate grout in accordance with ASTM C 1019 procedures.
  - 1. Test with same frequency as specified for masonry units.

**END OF SECTION 04 05 00**

**SECTION 04 22 00**  
**CONCRETE UNIT MASONRY**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Concrete masonry units.
- B. Reinforcement, anchorage, and accessories.
- C. Flashings.

**1.02 RELATED SECTIONS**

- A. Section 04 05 19 - Mortar and Masonry Grout: Mortar and grout for single wythe unit masonry.
- B. Section 07 11 13 - Bituminous Dampproofing: Dampproofing masonry surfaces.
- C. Section 07 54 19 - Thermoplastic Membrane Roofing: Installation of two-piece reglet counter-flashing as furnished herein.
- D. Section 07 84 00 - Firestopping: Firestopping at penetrations of masonry work.
- E. Section 07 90 00 - Joint Sealers: Rod and sealant at control joints.

**1.03 REFERENCES**

- A. ACI 530/ASCE 5/TMS 402 - Building Code Requirements for Masonry Structures; American Concrete Institute International; 2005.
- B. ACI 530.1/ASCE 6/TMS 602 - Specification For Masonry Structures; American Concrete Institute International; 2005.
- C. ASTM A 82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement; 2002.
- D. ASTM A 153/A 153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2004.
- E. ASTM A 615/A 615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement; 2004b.
- F. ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2004a.
- G. ASTM C 90 - Standard Specification for Loadbearing Concrete Masonry Units; 2003.
- H. ASTM C 129 - Standard Specification for Nonloadbearing Concrete Masonry Units; 2003.
- I. ASTM C 140 - Standard Test Methods of Sampling and Testing Concrete Masonry Units and Related Units; 2003.
- J. IMIAWC (CW) - Recommended Practices & Guide Specifications for Cold Weather Masonry Construction; International Masonry Industry All-Weather Council; 1993.

- K. IMIABC (HW) - Recommended Practices & Guide Specifications for Hot Weather Masonry Construction; International Masonry Industry All-Weather Council; current edition.

#### 1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for concrete masonry units and fabricated wire reinforcement.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Submittals for Environmental Performance:
  - 1. Provide data indicating the percentage of post-industrial pozzolan (i.e. fly ash) cement substitution as a percentage of the full product composite by weight.
  - 2. Provide product data stating the location where all unit masonry products were manufactured and where the raw materials were harvested, extracted or recovered.
- E. Shop drawings for reinforcing steel. Detailing bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315

#### 1.05 QUALITY ASSURANCE

- A. Comply with provisions of ACI 530/ASCE 5/TMS 402 and ACI 530.1/ASCE 6/TMS 602, except where exceeded by requirements of the contract documents.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

#### 1.07 ENVIRONMENTAL REQUIREMENTS

- A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
- B. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

### **PART 2 PRODUCTS**

#### 2.01 CONCRETE MASONRY UNITS

- A. Concrete Block: Comply with referenced standards and as follows:
  - 1. Size: Standard units with nominal face dimensions of 16 x 8 inches and nominal depths as indicated on the drawings for specific locations.
  - 2. Special Shapes: Provide non-standard blocks configured for corners, headers, control joint edges, and other detailed conditions.
  - 3. Provide bull-nosed block at the following locations where exposed and indicated on drawings:
    - a. Outside corners.
    - b. Door jambs.
    - c. Wing walls.

4. Load-Bearing Units: ASTM C 90, medium and light weight.
    - a. Hollow block.
    - b. Exposed faces: Manufacturer's standard color and texture.
  5. Non-Loadbearing Units: ASTM C 129.
- C. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6, except as modified by requirements in the Contract Documents.
- D. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work.
- E. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.

## 2.02 MORTAR AND GROUT MATERIALS

- A. Mortar and Grout: As specified in Section 04 05 00.

## 2.03 REINFORCEMENT AND ANCHORAGE

- A. Manufacturers of Joint Reinforcement and Anchors:
1. Dur-O-Wal: [www.dur-o-wal.com](http://www.dur-o-wal.com).
  2. Hohmann & Barnard, Inc: [www.h-b.com](http://www.h-b.com).
  3. Masonry Reinforcing Corporation of America: [www.wirebond.com](http://www.wirebond.com).
  4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Reinforcing Steel: ASTM A 615/A 615M Grade 60 (420) deformed billet bars; galvanized.
- C. Single Wythe Joint Reinforcement: Truss type; ASTM A 82 steel wire, hot dip galvanized after fabrication to ASTM A 153/A 153M, Class B; 0.1483 inch side rods with 0.1483 inch cross rods; width as required to provide not more than 1 inch and not less than 1/2 inch of mortar coverage on each exposure.
- D. Strap Anchors: Bent steel shapes configured as required for specific situations, 1-1/4 in width, 0.105 in thick, lengths as required to provide not more than 1 inch and not less than 1/2 inch of mortar coverage from masonry face, corrugated for embedment in masonry joint, hot dip galvanized to ASTM A 153/A 153M, Class B.
- E. Flexible Anchors: 2-piece anchors that permit differential movement between masonry and building frame, sized to provide not more than 1 inch and not less than 1/2 inch of mortar coverage from masonry face.
1. Steel frame: Crimped wire anchors for welding to frame, 0.25 inch thick, with trapezoidal wire ties 0.1875 inch thick, hot dip galvanized to ASTM A 153/A 153M, Class B.

## 2.04 FLASHINGS

- A. Rubberized Asphalt Flashing: Self-adhering composite material comprising rubberized asphalt adhesive compound bonded to cross-laminated polyethylene film, minimum 0.030 inch total thickness.
- B. Galvanized Steel: ASTM A 653/A 653M, with G90/Z275 coating.

- C. Lap Sealant: Butyl type as specified in Section 07 90 00.

## 2.05 ACCESSORIES

- A. Preformed Control Joints: Rubber material. Provide with corner and tee accessories, fused joints.
- B. Joint Filler: Closed cell polyvinyl chloride; oversized 50 percent to joint width; self expanding; 4 inch wide x by maximum lengths available.
- C. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive masonry.
- B. Verify that related items provided under other sections are properly sized and located.
- C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

### 3.02 PREPARATION

- A. Direct and coordinate placement of metal anchors supplied for installation under other sections.
- B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

### 3.03 COURSING

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. Concrete Masonry Units:
  - 1. Bond: Running.
  - 2. Coursing: One unit and one mortar joint to equal 8 inches.
  - 3. Mortar Joints: Concave.

### 3.04 PLACING AND BONDING

- A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
- B. Lay hollow masonry units with face shell bedding on head and bed joints.
- C. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
- D. Remove excess mortar as work progresses.
- E. Interlock intersections and external corners.
- F. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- G. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
- H. Cut mortar joints flush where wall tile is scheduled or resilient base is scheduled.

- I. Isolate masonry partitions from vertical structural framing members with a control joint as indicated.
- J. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.

### 3.05 REINFORCEMENT AND ANCHORAGE

- A. Install horizontal joint reinforcement 16 inches on center.
- B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
- C. Place continuous joint reinforcement in first and second joint below top of walls.
- D. Lap joint reinforcement ends minimum 6 inches.
- E. Reinforce joint corners and intersections with strap anchors 16 inches on center.
- F. Fasten anchors to structural framing and embed in masonry joints as masonry is laid. Space anchors at maximum of 24 inches horizontally and 16 inches vertically.
- G. Install anchors to structural framing at not more than 16 inches on center.

### 3.06 MASONRY FLASHINGS

- A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
  - 1. Extend flashings full width at such interruptions and at least 4 inches into adjacent masonry or turn up at least 4 inches to form watertight pan at non-masonry construction.
  - 2. Remove or cover protrusions or sharp edges that could puncture flashings.
  - 3. Seal lapped ends and penetrations of flashing before covering with mortar.
- B. Extend metal flashings through exterior face of masonry and turn down to form drip.
- C. Extend laminated flashings to within 1/4 inch of exterior face of masonry.
- D. Lap end joints of flashings at least 4 inches and seal watertight with mastic or elastic sealant.

### 3.07 LINTELS

- A. Install loose steel lintels over openings.
- B. Maintain minimum 8 inch bearing on each side of opening.

### 3.08 CONTROL AND EXPANSION JOINTS

- A. Do not continue horizontal joint reinforcement through control and expansion joints.
- B. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.
- C. Size control joint in accordance with Section 07 90 00 for sealant performance.
- D. Form expansion joint as detailed.

### 3.09 BUILT-IN WORK

- A. As work progresses, install built-in metal door frames and other items to be built into the work and furnished under other sections.
- B. Install built-in items plumb, level, and true to line.

- C. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout.
- D. Do not build into masonry construction organic materials that are subject to deterioration.

### 3.10 TOLERANCES

- A. Maximum Variation from Alignment of Columns: 1/4 inch.
- B. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.
- C. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.
- D. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.
- E. Maximum Variation of Joint Thickness: 1/8 inch in 3 ft.
- F. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.

### 3.11 CUTTING AND FITTING

- A. Cut and fit for chases. Coordinate with other sections of work to provide correct size, shape, and location.
- B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

### 3.12 FIELD QUALITY CONTROL

- A. An independent testing agency, as specified in Section 01 40 00 – Quality Requirements, will conduct field tests.
- B. Concrete Masonry Unit Tests: Test each variety of concrete unit masonry in accordance with ASTM C 140 for conformance to requirements of this specification.

### 3.13 CLEANING

- A. Remove excess mortar and mortar smears as work progresses.
- B. Replace defective mortar. Match adjacent work.
- C. Clean soiled surfaces with cleaning solution.
- D. Use non-metallic tools in cleaning operations.

### 3.14 PROTECTION OF FINISHED WORK

- A. Without damaging completed work, provide protective boards at exposed external corners which are subject to damage by construction activities.

**END OF SECTION 04 22 00**

**SECTION 05 12 00  
STRUCTURAL STEEL**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Structural steel framing members, and support members.
- B. Base plates.
- C. Grouting under base plates.

**1.02 RELATED SECTIONS**

- A. Section 05 50 00 - Metal Fabrications: Steel fabrications affecting structural steel work.

**1.03 REFERENCES**

- A. AISC (AMAN) - ASD Manual of Steel Construction; American Institute of Steel Construction, Inc.; 1989, Ninth Edition.
- B. AISC 303 - Code of Standard Practice for Steel Buildings and Bridges; American Institute of Steel Construction, Inc.; 2005.
- C. AISC S348 - Specification for Structural Joints Using ASTM A325 or A490 Bolts; 2004.
- D. AISC 360 - Specification for Structural Steel Buildings; American Institute of Steel Construction, Inc.; 2005.
- E. ASTM A 36/A 36M - Standard Specification for Carbon Structural Steel; 2005.
- F. ASTM A 53/A 53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2004a.
- G. ASTM A 108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold Finished; 2003.
- H. ASTM A 123/A 123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2002.
- I. ASTM A 153/A 153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2004.
- J. ASTM A 242/A 242M - Standard Specification for High-Strength Low-Alloy Structural Steel; 2004.
- K. ASTM A 307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength; 2004.
- L. ASTM A 325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength; 2004b.
- M. ASTM A 325M - Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Tensile Strength (Metric); 2004b.
- N. ASTM A 490 - Standard Specification for Structural Bolts, Alloy Steel, Heat-Treated, 150 ksi Minimum Tensile Strength; 2004a.



- O. ASTM A 490M - Standard Specification for High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints (Metric); 2004a.
- P. ASTM A 500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2003a.
- Q. ASTM A 501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2001.
- R. ASTM A 563 - Standard Specification for Carbon and Alloy Steel Nuts; 2004a.
- S. ASTM A 563M - Standard Specification for Carbon and Alloy Steel Nuts (Metric); 2004.
- T. ASTM A 992/A 992M - Standard Specification for Structural Steel Shapes; 2004a.
- U. ASTM A 1008/A 1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability; 2004b.
- V. ASTM A 1011/A 1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability; 2004a.
- W. ASTM C 1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2002.
- X. ASTM E 164 - Standard Practice for Ultrasonic Contact Examination of Weldments; 2003.
- Y. ASTM E 165 - Standard Test Method for Liquid Penetrant Examination; 2002.
- Z. ASTM E 709 - Standard Guide for Magnetic Particle Examination; 2001.
- AA. ASTM F 436 - Standard Specification for Hardened Steel Washers; 2004.
- AB. ASTM F 959 - Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners; 2005. AC. AWS D1.1/D1.1M - Structural Welding Code - Steel; American Welding Society; 2004 and errata.

#### 1.04 SUBMITTALS

- A. See Section 01300 - Administrative Requirements, for submittal procedures.
- B. Manufacturer's Mill Certificate: Certify that products meet or exceed specified requirements.
- C. Mill Test Reports: Indicate structural strength, destructive test analysis and non-destructive test analysis.
- D. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within the previous 12 months.

#### 1.05 QUALITY ASSURANCE

- A. Fabricate structural steel members in accordance with AISC "ASD Manual of Steel Construction".
- B. Comply with Section 10 of AISC "Code of Standard Practice for Steel Buildings and Bridges" for architecturally exposed structural steel.

- C. Fabricator: Company specializing in performing the work of this section with minimum five years of documented experience.
- D. Erector: Company specializing in performing the work of this section with minimum five years of documented experience.
- E. Design connections not detailed on the drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.

## **PART 2 PRODUCTS**

### **2.01 MATERIALS**

- A. Steel Angles and Plates: ASTM A 36/A 36M.
- B. Steel W Shapes and Tees: ASTM A 992/A 992M.
- C. Rolled Steel Structural Shapes: ASTM A 992/A 992M.
- D. Steel Shapes, Plates, and Bars: ASTM A 242/A 242M high-strength, corrosion-resistant structural steel.
- E. Cold-Formed Structural Tubing: ASTM A 500, Grade B.
- F. Hot-Formed Structural Tubing: ASTM A 501, seamless or welded.
- G. Steel Bars: ASTM A 108.
- H. Steel Sheet: ASTM A 1011/A 1011M, Designation SS, Grade 30 hot-rolled, or ASTM A 1008/A 1008M, Designation SS, Grade 30 cold-rolled.
- I. Pipe: ASTM A 53/A 53M, Grade B, Finish black.
- J. Carbon Steel Bolts and Nuts: ASTM A 307, Grade A galvanized to ASTM A 153/A 153M, Class C.
- K. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, medium carbon, galvanized.
- L. High-Strength Structural Bolts: ASTM A 490 (ASTM A 490M), with matching ASTM A 563 (ASTM A 563M) nuts and ASTM F 436 washers; Type 1 alloy steel.
- M. Anchor Bolts: ASTM A 307, Grade C.
- N. High-Strength Anchor Bolts: ASTM A 325, Type 1 medium carbon, plain.
- O. Load Indicator Washers: Provide washers complying with ASTM F 959 at all connections requiring high-strength bolts.
- P. Welding Materials: AWS D1.1; type required for materials being welded.
- S. Grout: Non-shrink, non-metallic aggregate type, complying with ASTM C 1107 and capable of developing a minimum compressive strength of 7,000 psi at 28 days.
- T. Shop and Touch-Up Primer: Fabricator's standard, complying with VOC limitations of authorities having jurisdiction.

- U. Touch-Up Primer for Galvanized Surfaces: Fabricator's standard, complying with VOC limitations of authorities having jurisdiction.

## 2.02 FABRICATION

- A. Shop fabricate to greatest extent possible.
- B. Continuously seal joined members by continuous welds. Grind exposed welds smooth.
- C. Fabricate connections for bolt, nut, and washer connectors.
- D. Develop required camber for members.

## 2.03 FINISH

- A. Prepare structural component surfaces in accordance with SSPC SP 3.
- B. Galvanize structural steel members to comply with ASTM A 123/A 123M. Provide minimum 1.25 oz/sq ft galvanized coating.
  - 1. Galvanize exterior steel components: Lintels, shelf angles, and W shapes.
- C. Shop prime steel members, except the following:
  - 1. Steel members that require field applied coating.
  - 2. Machined or milled surfaces.
  - 3. Surfaces adjacent to field welds.
  - 4. Flaying surfaces of slip critical bolted connections.
  - 5. Galvanized surfaces.
  - 6. Surfaces to receive sprayed fire-resistive materials.
- D. Clean surfaces to be shop primed removing loose rust, loose mill scale, dirt, oil, grease, and free of visible residue and defects.
- E. Clean steel in accordance with following SSPC procedures, unless noted otherwise:
  - 1. SSPC-SP 2: Hand tool cleaning.
  - 2. SSPC-SP 3: Power tool cleaning.
- F. Priming: Immediately after cleaning, apply specified primer paint in accordance with paint manufacturer's instructions, at a rate to achieve a dry film thickness of greater than 1.5 mils and an average of 2.0 mils.
  - 1. Use priming methods resulting in full coverage of joints, corners, edges, and exposed surfaces.
- G. Steel Exposed to View: Prepare surface and clean in accordance with SSPC-SP 6 - Commercial Blast Cleaning.

## 2.04 SOURCE QUALITY CONTROL AND TESTS

- A. High-Strength Bolts: Provide testing and verification of shop-bolted connections in accordance with AISC "Specification for Structural Joints Using ASTM A325 or A490 Bolts", testing at least 25 percent of bolts at each connection.
- B. Welded Connections: Visually inspect all shop-welded connections and test at least 20 percent of welds using one of the following:
  - 1. Ultrasonic testing performed in accordance with ASTM E 164.
  - 2. Liquid penetrant inspection performed in accordance with ASTM E 165.
  - 3. Magnetic particle inspection performed in accordance with ASTM E 709.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that conditions are appropriate for erection of structural steel and that the work may properly proceed.
- B. Do not commence erection of the structural steel until unsatisfactory conditions have been corrected or fabricated steel components have been adjusted and approved by the Architect.
- C. Verify with steel erector on site the elevations of concrete and masonry bearing surfaces, locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
- D. Set structural steel accurately in locations and to elevations indicated in accordance with AISC 303 and 360.
- E. Base and Bearing Plates: Clean concrete and masonry bearing surfaces of bond reducing materials, and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.
  - 1. Set base and bearing plates for structural members on wedges, shims, or setting nuts to elevations required.
  - 2. Weld plate washers to top of base plate.
  - 3. Snug-tighten pretension anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims if protruding, cut off flush with edges of base plate before packing with grout.
  - 4. Pack grout solidly between bearing surfaces and base or bearing plates so no voids remain. Finish exposed surfaces smooth, protect grout, and allow to cure.
  - 5. Comply with manufacturer's written installation instructions for shrinkage resistant grouts.
- F. Maintain erection tolerances of structural steel in compliance with AISC 303.

### 3.02 PREPARATION

- A. Temporary Support: Contractor is responsible for erection procedures and sequence, and to ensure the safety of the structure and its components during erection.
  - 1. Provide temporary guys, tie-downs, braces, false work, cribbing, or other elements required to secure the steel framing against loads equivalent to design loads.
  - 2. Remove temporary supports when permanent connections are made and the steel framing is fully capable of supporting design loads, including temporary construction loads.

### 3.03 FIELD CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts in compliance with AISC S348, for type of bolt and type of joint specified.
  - 1. Joint Type: Snug Tightened.
- B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, quality of welds, and for methods used in correcting welding work.
  - 1. Comply with AISC 303 for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.

### 3.04 ERECTION

- A. Erect structural steel in compliance with AISC 303.
- B. Assembly:
  - 1. Set structural members accurately at locations and elevations indicated, within tolerances established and before making final connections.
  - 2. Do not use thermal cutting to correct fabrication errors on major structural member.
    - a. Thermal cutting of secondary members may be permitted when members are not loaded upon written approval by the Engineer.

- C. Columns and Bearing Surfaces:
  - 1. Clean bearing and contact surfaces before assembly. Slightly roughen concrete and masonry surfaces to improve bond.
  - 2. Set base and bearing plates accurately, using metal wedges, shims, or setting nuts as necessary.
  - 3. Verify that structure is plumb and tighten anchor bolts before grouting solid between plates and bearing surfaces.
    - a. Comply with manufacturer's instructions for grout.
    - b. Finish exposed surfaces; protect grout and allow to cure. 1) Trowel grouted surfaces smooth, splaying to 45 degrees.
- D. Allow for erection loads, and provide sufficient temporary bracing to maintain structure in safe condition, plumb, and in true alignment until completion of erection and installation of permanent bracing.
- E. Field weld components and shear studs as indicated on shop drawings.
  - 1. Do not perform field welding when ambient temperature is at 0 degrees F or below or when surfaces are wet, exposed to rain, snow, or high wind.
  - 2. Perform field welding in accordance with AWS D1.1.
  - 3. Tighten and leave in place erection bolts used in field-welded construction
- F. Use carbon steel bolts for temporary bracing during construction, unless otherwise permitted on drawings. Install high-strength bolts in accordance with AISC S348.
- G. Do not field cut or alter structural members without written approval of Architect.
- H. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.
  - 1. Immediately after erection of primed structural steel, clean painted areas that have been abraded or otherwise damaged by welding, bolting, or other field operations. Apply touch-up paint matching shop coating by brush or spray to damaged paint areas, achieving a minimum final thickness of 1.5 mils.
- I. Grout solidly between column plates and bearing surfaces, complying with manufacturer's instructions for grout. Trowel grouted surfaces smooth, splaying to 45 degrees.

### 3.05 ERECTION TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.

### 3.06 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01400.
- B. High-Strength Bolts: Provide testing and verification of field-bolted connections in accordance with AISC "Specification for Structural Joints Using ASTM A325 or A490 Bolts", testing at least 25 percent of bolts at each connection.
- C. Welded Connections: Visually inspect all field-welded connections and test at least 25 percent of welds using one of the following:
  - 1. Ultrasonic testing performed in accordance with ASTM E 164.
  - 2. Liquid penetrant inspection performed in accordance with ASTM E 165.
  - 3. Magnetic particle inspection performed in accordance with ASTM E 709.

**END OF SECTION 05120**

**SECTION 05 31 00  
STEEL DECK**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Roof deck.
- B. Supplementary framing for openings up to and including 18 inches.
- C. Bearing plates and angles.

**1.02 RELATED SECTIONS**

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete topping over metal deck.
- B. Section 05 12 00 - Structural Steel: Support framing for openings larger than 18 inches and shear stud connectors.
- C. Section 05 21 00 - Steel Joists: Support framing for openings larger than 18 inches and shear stud connectors.
- D. Section 05 50 00 - Metal Fabrications: Steel angle concrete stops at deck edges.
- E. Section 07 53 00 - Elastomeric Membrane Roofing: placement of acoustic insulation in deck flutes.

**1.03 REFERENCES**

- A. ASTM A 36/A 36M - Standard Specification for Carbon Structural Steel; 2005.
- B. ASTM A 108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished; 2003.
- C. ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2004a.
- D. AWS D1.1/D1.1M - Structural Welding Code - Steel; American Welding Society; 2004 and errata.
- E. AWS D1.3 - Structural Welding Code - Sheet Steel; American Welding Society; 1998.
- F. SDI (DM) - Publication No.30, Design Manual for Composite Decks, Form Decks, Roof Decks; Steel Deck Institute; 2001.
- G. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); The Society for Protective Coatings; 2002 (Ed. 2004).
- H. SSPC-Paint 25 - Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel, Type I and Type II; Society for Protective Coatings; 1997 (Ed. 2004).

**1.04 PERFORMANCE REQUIREMENTS**

- A. Select and design metal deck in accordance with SDI Design Manual.
- B. Maximum Vertical Deflection of Floor Deck: 1/360.
- C. Maximum Vertical Deflection of Roof Deck: 1/240.

- D. Maximum Lateral Deflection of Diaphragms: 1/500 of the height of the wall.

#### 1.05 SUBMITTALS

- A. See Section 01300 - Administrative Requirements, for submittals procedures.
- B. Shop Drawings: Indicate deck plan, support locations, projections, openings, reinforcement, pertinent details, and accessories.
- C. Product Data: Provide deck profile characteristics, dimensions, structural properties, and finishes.
- D. Certificates: Certify that meet or exceed specified requirements.
- E. Submit manufacturer's installation instructions.
- F. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within the previous 12 months.

#### 1.06 QUALITY ASSURANCE

- A. Design deck layout, spans, fastening, and joints under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.
- B. Installer Qualifications: Company specializing in performing the work of this Section with minimum five years of experience.

#### 1.07 DELIVERY, STORAGE, AND HANDLING

- A. Cut plastic wrap to encourage ventilation.
- B. Separate sheets and store deck on dry wood sleepers; slope for positive drainage.

### **PART 2 PRODUCTS**

#### 2.01 MANUFACTURERS

- A. Steel Deck:
  - 1. United Steel Deck , Inc: [www.njb-united.com](http://www.njb-united.com).
  - 2. Vulcraft/Nucor Corporation: [www.vulcraft.com](http://www.vulcraft.com).
  - 3. Wheeling Corrugating Co: [www.wheelingcorrugating.com](http://www.wheelingcorrugating.com).
  - 4. Substitutions: See Section 01600 - Product Requirements.

#### 2.02 STEEL DECK

- A. Roof Deck: Non-composite type, fluted steel sheet:
  - 1. Galvanized Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), with G90/Z275 galvanized coating.
    - a. Grade as required to meet performance criteria.
  - 2. Primer: Shop coat of manufacturer's standard primer paint over cleaned and phosphatized substrate.
  - 3. Structural Properties:
    - a. Span Design: Multiple, 3 span minimum.
  - 4. Minimum Metal Thickness, Excluding Finish: 20 gage.
  - 5. Nominal Height: 1-1/2 inch.
  - 6. Profile: Fluted; SDI WR.
  - 7. Formed Sheet Width: 24 inch or 30 inch.



- 8. Side Joints: Screwed as indicated on the drawings.
- 9. End Joints: Screwed as indicated on the drawings.

## 2.03 ACCESSORY MATERIALS

- A. Bearing Plates and Angles: ASTM A 36/A 36M steel, unfinished.
- B. Welding Materials: AWS D1.1.
- C. Fasteners: Galvanized hardened steel, self tapping.
- D. Weld Washers: Mild steel, uncoated, 3/4 inch outside diameter, 1/8 inch thick.
- E. Shop and Touch-Up Primer: SSPC-Paint 25, zinc oxide, complying with VOC limitations of authorities having jurisdiction.
- F. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, complying with VOC limitations of authorities having jurisdiction.
- G. Flute Closures: Closed cell foam rubber, 1 inch thick; profiled to fit tight to the deck.

## 2.04 FABRICATED DECK ACCESSORIES

- A. Sheet Metal Deck Accessories: Metal closure strips, wet concrete stops, cover plates, and cant strips, 22 gage thick sheet steel; of profile and size as indicated; finished same as deck.
- B. Roof Sump Pans: 14 gage sheet steel, flat bottom, sloped sides, recessed 1-1/2 inches below roof deck surface, bearing flange 3 inches wide, sealed watertight.
- C. Floor Drain Pans: 14 gage sheet steel, flat bottom, sloped sides, recessed 1-1/2 inches below floor deck surface, bearing flange 3 inches wide, sealed watertight.

# PART 3 EXECUTION

## 3.01 EXAMINATION

- A. Verify existing conditions prior to beginning work.

## 3.02 INSTALLATION

- A. Erect metal deck in accordance with SDI Design Manual and manufacturer's instructions. Align and level.
- B. On concrete and masonry surfaces provide minimum 4 inch bearing.
- C. On steel supports provide minimum 3 inch bearing.
- D. Fasten deck to steel support members at ends and intermediate supports at 12 inches on center maximum, parallel with the deck flute and at each transverse flute using mechanical fasteners.
  - 1. Welding: Use fusion welds through weld washers.
  - 2. Place and secure special deep fluted sections for integral concrete bridging.
- E. Clinch lock seam side laps.

- F. At mechanically fastened male/female side laps fasten at 24 inches on center maximum.
- G. At welded male/female side laps weld at 18 inches on center maximum.
- H. Weld deck in accordance with AWS D1.3.
- I. At deck openings from 6 inches to 18 inches in size, provide 2 x 2 x 1/4 inch steel angle reinforcement. Place angles perpendicular to flutes; extend minimum two flutes beyond each side of opening and mechanically attach to deck at each flute.
- J. Where deck changes direction, install 6 inch minimum wide sheet steel cover plates, of same thickness as deck. Fusion weld 12 inches on center maximum.
- K. At floor edges, install concrete stops upturned to top surface of slab, to contain wet concrete. Provide stops of sufficient strength to remain stationary without distortion.
- L. At openings between deck and walls, columns, and openings, provide sheet steel closures and angle flashings to close openings.
- M. Close openings above walls and partitions perpendicular to deck flutes with single row of foam cell closures.
- N. Place metal cant strips in position and fusion weld.
- O. Position roof drain pans with flange bearing on top surface of deck. Fusion weld at each deck flute.
- P. Position floor drain pans with flange bearing on top surface of deck. Fusion weld at each deck flute.
- Q. Weld stud shear connectors through steel deck to structural members below.
- R. Immediately after welding deck and other metal components in position, coat welds, burned areas, and damaged surface coating, with touch-up primer.
- S. Insulation Inserts: Wrapped rolls to be given to contractor to be installed by roofing contractor.

### 3.03 CLEANING

- A. Clear debris from deck before concrete is placed.
- B. Upon completion of work, remove all rubbish, debris, and excess materials from project site.

**END OF SECTION 05 31 00**

**SECTION 05 50 00**

**METAL FABRICATIONS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Ledge Angles.
- B. Lintels.
- C. Steel Stairs with Metal Pan Treads and Risers, and Railing as indicated on drawings.
- D. Steel Gates & Stanchion
- E. Ladders

**1.02 RELATED SECTIONS**

- A. Section 03 30 00 - Cast-in-Place Concrete: Placement of metal fabrications in concrete.
- B. Section 04 22 00 - Concrete Unit Masonry: Placement of metal fabrications in masonry.
- C. Section 09 90 00 - Paints and Coatings: Paint finish.

**1.03 REFERENCES**

- A. ANSI A14.3 - American National Standard for Ladders -- Fixed -- Safety Requirements; 2002.
- B. ASTM A 36/A 36M - Standard Specification for Carbon Structural Steel; 2005.
- C. ASTM A 53/A 53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2004a.
- D. ASTM A 123/A 123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2002.
- E. ASTM A 153/A 153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2004.
- F. ASTM A 283/A 283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2003.
- G. ASTM A 325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength; 2004b.
- H. ASTM A 325M - Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Tensile Strength (Metric); 2004b.
- I. ASTM A 500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2003a.
- J. ASTM A 992/A992M - Standard Specification for Structural Steel Shapes; 2004.
- K. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; American Welding Society; 1998.
- L. AWS D1.1/D1.1M - Structural Welding Code - Steel; American Welding Society; 2004 and errata.
- M. SSPC-Paint 15 - Steel Joist Shop Primer; Society for Protective Coatings; 1999 (Ed. 2004).
- N. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); Society for Protective Coatings; 2002 (Ed. 2004).

- O. SSPC-SP 2 - Hand Tool Cleaning; Society for Protective Coatings; 1982 (Ed. 2004).

#### 1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide installation requirements, material lists, and maintenance requirements for Prefab Joist Installation Kit.
- C. Product Data: Provide manufacturer's installation materials, finishes, and maintenance requirements for corner guards.
- D. Architectural and Engineering services include the review of completed and accurate shop drawings. The Architect and/or Engineers will not review any shop drawings which do not meet industry standards for completion and accuracy; and which require excessive changes, corrections, revisions, or completion by the reviewing Architect and/or Engineer. The Architect will notify the Contractor upon the receipt of such sub-standard shop drawings. The Contractor shall then revise and re-submit the shop drawings, or shall opt to pay the Architect/Engineer an hourly rate for additional time spent in review/correction of the original submittals. Payment shall be made before final return of the A/E-corrected sub-standard shop drawings.
- E. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
  - 1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
- F. Welders' Certificates: Submit certification for welders employed on the project, verifying AWS qualification within the previous 12 months.
- G. Submittals for Environmental Performance:
  - 1. Recycled Content:
    - a. Indicate recycled content; indicate percentage of pre-consumer and post-consumer recycled content per unit of product.
  - 2. Local/Regional Materials:
    - a. Sourcing location(s): Indicate location of extraction, harvesting, and recovery; indicate distance between extraction, harvesting, and recovery and the project site.
    - b. Manufacturing location(s): Indicate location of manufacturing facility; indicate distance between manufacturing facility and the project site.

## PART 2 PRODUCTS

### 2.01 MATERIALS - STEEL

- A. Steel Sections: ASTM A 992, Fy = 50 ksi: All W Shapes; ASTM A 36: All other shapes.
- B. Steel Tubing: ASTM A 500, Grade B cold-formed structural tubing.
- C. Plates: ASTM A 283.
- D. Pipe: ASTM A 53/A 53M, Grade B Schedule 40, black and hot-dip galvanized finish, as indicated.
- E. Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, galvanized to ASTM A 153/A 153M where connecting galvanized components.
- F. Welding Materials: AWS D1.1; type required for materials being welded.

- G. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
- H. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.
- I. Powder Coat steel stanchions and posts at exterior guard rails.

## 2.02 FABRICATION

- A. Fit and shop assemble items in largest practical sections, for delivery to site.
- B. Fabricate items with joints tightly fitted and secured.
- C. Continuously seal joined members by continuous welds.
- D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- E. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
- F. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

## 2.03 FABRICATED ITEMS

- A. Ledge Angles, Shelf Angles, Channels, and Plates Not Attached to Structural Framing.
- B. Lintels: As detailed:
  - a. Exterior Lintels – hot dipped galvanized.
  - b. Interior Lintels – prime paint finish.
- C. Steel Stairs with Concrete Tread and Pipe Handrails.
  - 1. Provide complete stair assemblies, including metal framing, hangers, struts, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.
    - a. Join components by welding, unless otherwise indicated. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals. Obtain fusion without undercut or overlap. Remove welding flux immediately. At exposed connections, finish exposed welds smooth and blended.
    - b. Use connections that maintain structural value of joined pieces.
    - c. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges, unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
    - d. Form bent-metal corners to smallest radius possible without impairing work. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Locate joints where least conspicuous.
  - 2. Stair Framing: Fabricate stringers of steel tubes or channels. Construct platforms of steel tube or channel headers and miscellaneous framing members.
    - a. If using bolts, fabricate and join so bolts are not exposed on finished surfaces.
    - b. Where stairs are enclosed by gypsum-board assemblies, provide hanger rods or struts to support landings from floor construction above or below.
    - c. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.
  - 3. Metal-Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements but not less than 0.0677 inch.
    - a. At Contractor's option, provide stair assemblies with metal-pan subtreads filled with reinforced concrete during fabrication.

- b. Provide epoxy-resin-filled treads, reinforced with glass fibers, with slip-resistant, abrasive surface.
- 4. Abrasive-Coating-Finished, Formed-Metal Stairs: Form risers, treads, and platforms from steel sheet of thickness needed to comply with performance requirements but not less than 0.0966 inch. Finish tread and platform surfaces with manufacturer's standard epoxy-bonded abrasive finish.
- 5. Metal Floor Plate Stairs: Form treads and platforms from rolled-steel floor plate of thickness needed to comply with performance requirements but not less than 1/8 inch. Form treads with integral nosing and back edge stiffener. Weld steel supporting brackets to stringers and weld treads to brackets.

## 2.04 FINISHES - STEEL

- A. Prime paint all steel items.
  - 1. Exceptions: Galvanize items to be embedded in concrete or masonry.
  - 2. Exceptions: Do not prime surfaces in direct contact with concrete, and where field welding is required.
- B. Prepare surfaces to be primed in accordance with SSPC-SP2.
- C. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- D. Prime Painting: One coat.
- E. Galvanizing of Non-structural Items: Galvanize after fabrication to ASTM A 123/A 123M requirements.

## 2.05 FABRICATION TOLERANCES

- A. Squareness: 1/8 inch maximum difference in diagonal measurements.
- B. Maximum Offset Between Faces: 1/16 inch.
- C. Maximum Misalignment of Adjacent Members: 1/16 inch.
- D. Maximum Bow: 1/8 inch in 48 inches.
- E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.

### 3.02 PREPARATION

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Supply setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

### 3.03 INSTALLATION

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- C. Field weld components indicated on drawings.

- D. Perform field welding in accordance with AWS D1.1.
- E. Obtain approval prior to site cutting or making adjustments not scheduled.
- F. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.
- G. Prefab Joist Installation Kit: Install in compliance with manufacturer's written instructions.
  - 1. Align eyebolt with plane of ceiling.

#### 3.04 ERECTION TOLERANCES

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

**END OF SECTION 05 50 00**

**SECTION 06 10 00**  
**ROUGH CARPENTRY**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Preservative treatment of wood.
- B. Fire retardant treatment of wood.
- C. Telephone and electrical panel boards.
- D. Wood nailers and curbs for roofing and items installed on roof.
- E. Concealed wood blocking for support of toilet and bath accessories, wall cabinets, and wood trim.
- F. Miscellaneous wood nailers and furring strips.

**1.02 RELATED SECTIONS**

- A. Section 04 22 00 – Concrete Unit Masonry
- B. Section 05 12 00 - Structural Steel Framing
- C. Section 05 50 00 - Metal Fabrications
- D. Section 08 40 00 – Entrances, Storefronts and Curtain Walls
- E. Section 12 32 16 – Plastic Laminate Clad Casework

**1.03 REFERENCES**

- A. ASTM A 153/A 153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2004.
- B. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2005.
- C. AWPA C2 - Lumber, Timber, Bridge Ties and Mine Ties -- Preservative Treatment by Pressure Processes; American Wood-Preservers' Association; 2002.
- D. AWPA C9 - Plywood -- Preservative Treatment by Pressure Processes; American Wood-Preservers' Association; 2003.
- E. AWPA C20 - Structural Lumber -- Fire Retardant Treatment by Pressure Processes; American Wood-Preservers' Association; 2002.
- F. AWPA C27 - Plywood -- Fire-Retardant Treatment by Pressure Processes; American Wood-Preservers' Association; 2002.
- G. AWPA U1 - Use Category System: User Specification for Treated Wood; American Wood-Preservers' Association; 2005.
- H. PS 1 - Construction and Industrial Plywood; National Institute of Standards and Technology (Department of Commerce); 1995.
- I. PS 20 - American Softwood Lumber Standard; National Institute of Standards and Technology (Department of Commerce); 2005.
- J. SPIB (GR) - Grading Rules; Southern Pine Inspection Bureau, Inc.; 2002.

**1.04 QUALITY ASSURANCE**

- A. Lumber: Comply with PS 20 and approved grading rules and inspection agencies.
- C. Fire-Retardant Treated Wood: Mark each piece of wood with producer's stamp indicating compliance with specified requirements.



- C. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWPA standards.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.
- B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, or installation.

### PART 2 PRODUCTS

#### 2.01 GENERAL REQUIREMENTS

- A. Lumber fabricated from old growth timber is not permitted.

#### 2.02 DIMENSION LUMBER

- A. Grading Agency: Southern Pine Inspection Bureau, Inc. (SPIB).
- B. Sizes: Nominal sizes as indicated on drawings, S4S.
- C. Moisture Content: S-dry or MC19.
- D. Miscellaneous Blocking, Furring, and Nailers:
  - 1. Lumber: S4S, No. 2 or Standard Grade.
  - 2. Boards: Standard or No. 3.

#### 2.03 CONSTRUCTION PANELS

- A. Wall Sheathing: Plywood, PS 1, Grade FRT - Fire-Retardant-Treated plywood.
  - 1. Class A rated; ASTM E 84.
  - 2. Flame spread Rating: 25, maximum.
  - 3. Smoke development Rating: 80, maximum.
- B. Other Applications:
  - 1. Concealed Plywood: PS 1, C-C Plugged, exterior grade.
  - 2. Exposed Plywood: PS 1, A-D, interior grade.
  - 3. Electrical Component Mounting: APA rated sheathing, fire retardant treated.

#### 2.04 ACCESSORIES

- A. Fasteners and Anchors:
  - 1. Metal and Finish: Hot-dipped galvanized steel per ASTM A 153/A 153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
  - 2. Anchors: Toggle bolt type for anchorage to hollow masonry.
- B. Die-Stamped Connectors: Hot dipped galvanized steel, sized to suit framing conditions.

#### 2.05 FACTORY WOOD TREATMENT

- A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
- B. Fire Retardant Treatment:
  - 1. Manufacturers:
    - a. Arch Wood Protection, Inc: [www.wolmanizedwood.com](http://www.wolmanizedwood.com).
    - b. Hoover Treated Wood Products, Inc: [www.frtw.com](http://www.frtw.com).

- c. Osmose, Inc: [www.osmose.com](http://www.osmose.com).
  - d. Substitutions: See Section 01600 - Product Requirements.
- 2. Interior Type A: AWP A Use Category UCFA, Commodity Specification H (Treatment C20 for lumber and C27 for plywood), low temperature (low hygroscopic) type, chemically treated and pressure impregnated; capable of providing a maximum flame spread rating of 25 when tested in accordance with ASTM E 84, with no evidence of significant combustion when test is extended for an additional 20 minutes.
  - a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
  - b. Treat rough carpentry items as indicated.
  - c. Do not use treated wood in applications exposed to weather or where the wood may become wet.
- C. Preservative Treatment:
  - 1. Manufacturers:
    - a. Arch Wood Protection, Inc: [www.wolmanizedwood.com](http://www.wolmanizedwood.com).
    - b. Chemical Specialties, Inc: [www.treatedwood.com](http://www.treatedwood.com).
    - c. Osmose, Inc: [www.osmose.com](http://www.osmose.com).
    - d. Substitutions: See Section 01600 - Product Requirements.
- D. Preservative Pressure Treatment of Lumber Above Grade: AWP A Use Category UC3B, Commodity Specification A (Treatment C2) using waterborne preservative to 0.25 lb/cu ft retention.
  - 1. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
  - 2. Treat lumber in contact with flashing.
  - 3. Treat lumber in contact with masonry or concrete.
  - 4. Treat lumber less than 18 inches above grade.
    - a. Treat lumber in other locations as indicated.
  - 5. Preservative Pressure Treatment of Plywood Above Grade: AWP A Use Category UC2 and UC3B, Commodity Specification F (Treatment C9) using waterborne preservative to 0.25 lb/cu ft retention.
    - a. Kiln dry plywood after treatment to maximum moisture content of 19 percent.
    - b. Treat plywood in contact with roofing, flashing, or waterproofing.
    - c. Treat plywood in contact with masonry or concrete.
    - d. Treat plywood less than 18 inches above grade.
    - e. Treat plywood in other locations as indicated.

## **PART 3 EXECUTION**

### **3.01 FRAMING INSTALLATION**

- A. Set structural members level, plumb, and true to line. Discard pieces with defects that would lower required strength.
- B. Install structural members full length without splices.
- C. Comply with member sizes, spacing, and configurations indicated, and fastener size and spacing indicated, but not less than required by applicable codes.
- D. Frame openings with two or more studs at each jamb; support headers on cripple studs.
- E. Provide miscellaneous members as indicated or as required to support finishes, fixtures, specialty items, and trim.

### **3.02 INSTALLATION OF ACCESSORIES AND MISCELLANEOUS WOOD**

- A. Curb roof openings except where prefabricated curbs are provided. Form corners by alternating lapping side members.

### 3.03 SITE APPLIED WOOD TREATMENT

- A. Apply preservative treatment compatible with factory applied treatment at site-sawn cuts, complying with manufacturer's instructions.
- B. Allow preservative to dry prior to erecting members.

### 3.04 TOLERANCES

- A. Framing Members: 1/4 inch from true position, maximum.
- B. Variation from Plane (Other than Floors): 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

**END OF SECTION 06 10 00**

**SECTION 06 41 19**  
**COUNTERTOPS AND SILLS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Countertops for custom cabinets.
- B. Countertops for manufactured casework.
- C. Wall-hung counters and vanity tops.
- D. Window Sills.

**1.02 RELATED SECTIONS**

- A. Section 06 40 00 – Architectural Woodwork.

**1.03 REFERENCES**

- A. ANSI A208.1 - American National Standard for Particleboard; 1999.
- B. ANSI A208.2 - American National Standard for Medium Density Fiberboard for Interior Use; 2002.
- C. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2005.
- D. AWI/AWMAC (QSI) - Quality Standard Illustrated; Architectural Woodwork Institute and Architectural Woodwork Manufacturers Association of Canada; 2003.
- E. ISSFA-2 - Classification and Standards for Solid Surfacing Material; International Solid Surface Fabricators Association; 2001 (2002)
- F. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
- G. PS 1 - Construction and Industrial Plywood; 1995.

**1.04 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Specimen warranty.
- C. Shop Drawings: Complete details of materials and installation; combine with shop drawings of cabinets and casework specified in other sections.
  - 1. Field verify existing conditions and dimensions, indicate on shop drawings.
  - 2. Identify countertop splice joint locations on shop drawings.
- D. Verification Samples: For each finish product specified, minimum size 6 inches square, representing actual product, color, and patterns.
- E. Test Reports: Chemical resistance testing, showing compliance with specified requirements.
- F. Installation Instructions: Manufacturer's installation instructions and recommendations.
- G. Maintenance Data: Manufacturer's instructions and recommendations for maintenance and repair of countertop surfaces.

### 1.05 QUALITY ASSURANCE

- A. Fabricator Qualifications: Same fabricator as for cabinets on which tops are to be installed.
- B. All wood products designated as "FSC certified" in this specification shall be certified according to the rules of the Forest Stewardship Council ([www.fscus.org](http://www.fscus.org)).

### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

### 1.07 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

## PART 2 PRODUCTS

### 2.01 COUNTERTOP ASSEMBLIES

- A. General Requirements :
  - 1. Lumber fabricated from old growth timber is not permitted.
  - 2. Certification: Forest Stewardship Council (FSC) Certified.
- B. Solid Surface Countertops and Window Sills: Solid surfacing sheet or plastic resin casting self-supporting over structural members.
  - 1. Flat Sheet Thickness: 1/2 inch.
  - 2. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISSFA-2 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
    - a. Surface Burning Characteristics: Flame spread 25, maximum; smoke developed 450, maximum; when tested in accordance with ASTM E 84.
    - b. Finish on Exposed Surfaces: Matte, gloss rating of 5 to 20.
    - c. Color and Pattern: As selected by architect from manufacturer's full range. Basis of design: Corian price group C.
    - d. Manufacturers:
      - 1) Dupont: [www.corian.com](http://www.corian.com).
      - 2) Formica Corporation: [www.formica.com](http://www.formica.com).
      - 3) Wilsonart International, Inc: [www.wilsonart.com](http://www.wilsonart.com).
      - 4) Substitutions: See Section 01 60 00 - Product Requirements.
  - 3. Countertop Exposed Edge Treatment: Built up to 1 1/4" thick.
  - 4. Window Sill Exposed Edge Treatment: Built up to minimum 1 1/4" thick; radiused edge.

### 2.02 ACCESSORY MATERIALS

- A. Plywood for Supporting Substrate: PS 1 Exterior Type, AC veneer grade, minimum 5-ply; minimum 3/4 inch thick; join lengths using metal splines.

- B. Particleboard for Supporting Substrate: ANSI A208.1 Grade 2-M-2, 45 pcf minimum density; minimum 3/4 inch thick; join lengths using metal splines.
- C. Medium Density Fiberboard for Supporting Substrate: ANSI A208.2.
- D. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined. Low VOC, low odor, solvent-free, water-based contact adhesives meeting the requirements set forth in the applicable LEED Reference Guide. See the applicable LEED Reference Guide for the most current VOC limits for adhesives, paints, and coatings.
- E. Joint Sealant: Mildew-resistant silicone sealant, clear.

## 2.03 FABRICATION

- A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
  - 1. Join lengths of tops using best method recommended by manufacturer.
  - 2. Fabricate to overhang fronts and ends of cabinets 1 inch except where top butts against cabinet or wall.
  - 3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.
- B. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
  - 1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
  - 2. Height: 4 inches, unless otherwise indicated.
- C. Solid Surfacing: Fabricate tops up to 144 inches long in one piece; join pieces with adhesive sealant in accordance with manufacturer's recommendations and instructions.
- D. Wall-Mounted Counters: Provide brackets and braces as indicated on drawings.

## PART 3 EXECUTION

### 3.01 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. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

### 3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

### 3.03 INSTALLATION

- A. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.

- B. Attach plastic laminate countertops using screws with minimum penetration into substrate board of 5/8 inch.
- C. Adhere full height backsplash material to substrate, seal exposed edges.
- D. Seal joint between back and end splashes, window sills and vertical surfaces.

#### 3.04 CLEANING AND PROTECTION

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

#### 3.05 COORDINATION AND VERIFICATION

- A. The contractor shall verify and coordinate the use of all wood products specified as FSC certified.

**END OF SECTION 06 41 19**

**SECTION 07 10 00**  
**DRAINAGE BOARD**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes: Prefabricated Drainage Composite.
  - 1. Types of Prefabricated Drainage Composites include:
    - a) Prefabricated drainage composite for below-grade, vertical wall applications.
    - b) Prefabricated drainage composite for below-grade, horizontal applications.
- B. Related Sections:
  - 1. Cast-in-Place Concrete: Refer to Division 03
  - 2. Structural precast concrete: Refer to Division 03
  - 3. Masonry: Refer to Division 04
  - 4. Earthwork: Refer to Division 30
  - 5. Landscaping: Refer to Division 30

**1.2 REFERENCES (INDUSTRY STANDARDS)**

- A. General: Refer to Division 1 References Section.

**1.3 SUBMITTALS**

- A. Product Data: Submit manufacturer's product data certificates of compliance for drainage composites specified. Submit specimen copy of warranty specified herein.
- B. Shop Drawings: Submit shop drawings showing layout, profiles, and product components, including accessories for drainage composites.
- C. Samples: Submit verification samples for prefabricated drainage composites.
- D. Quality Assurance/Control Submittals
  - 1. The specified properties of drainage panels must be supported by test results from an independent laboratory, documenting the specified flow rate in the plane of the core and creep performance of the polymer core. The testing conditions shall comply with ASTM D-4716 as follows:
    - a) Hydraulic Gradient: 1.0 for vertical installations and 0.05 for horizontal installations.
    - b) Normal Pressure (pressure imposed perpendicular to the plane of the core): Equal to 3600 psf.
    - c) Creep: Model long-term compression of the prefabricated drainage composite system and determine if the drain product flow channels become restricted with time. Long-term creep/drainage performance shall be determined by measuring flow after 300 continuous hours under the above referenced normal pressure. The test method shall utilize a loading system that models the soil/drainage product interaction.



- d) Flow Direction: Flow shall be measured on only one side of the core. Where the core geometry differs in principal directions, flow shall be measured in both directions, simulating water flowing vertically down a wall and horizontally across the face of the wall to accurately determine maximum flow rate in critical principal direction.

#### 1.4 QUALITY ASSURANCE

- A. Qualifications:
  - 1. Installer Qualifications: Installer experienced to perform work of this section, who has specialized in the installation of work similar to that required for this project, who can comply with manufacturer's warranty requirements, and who is an authorized applicator as determined by drainage manufacturer.
  - 2. Manufacturer Qualifications: Manufactured at an ISO 9001:2000 Facility.
- B. Pre-Installation Meetings: Conduct pre-installation meeting to verify project requirements, substrate conditions, manufacturer's installation instructions and manufacturer's warranty requirements.
- C. Pre-Installation Testing: In accordance with manufacturer's recommendations and warranty requirements, conduct pre-installation testing of substrates to receive drainage composites.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packing, Shipping, Handling and Unloading: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact. Schedule deliveries to avoid construction delays but minimize jobsite storage.

#### 1.6 PROJECT CONDITIONS/SITE CONDITIONS

- A. When CCW MiraDRAIN is installed in conjunction with a waterproofing product, the CCW MiraDRAIN must be compatible with the waterproofing product and installed by methods acceptable to the waterproofing product manufacturer.
- B. The outfall for any drainage pipe used with the drainage panels shall be coordinated with the site drainage.

#### 1.7 WARRANTY

- A. Upon completion and acceptance of the work required by this section, the manufacturer will issue a warranty agreeing to promptly replace defective materials for a period of 5 years.
- B. The formation or presence of mold or fungi in a building is dependent upon a broad range of factors including, but not limited to, the presence of spores and nutrient sources, moisture, temperatures, climatic conditions, relative humidity, and heating/ventilating systems and their maintenance and operating capabilities. These factors are beyond the control of Carlisle and Carlisle shall not be responsible for any claims, repairs, restoration, or damages relating to the presence of any irritants, contaminants, vapors, fumes, molds, fungi, bacteria, spores, mycotoxins, or the like in any building or in the air, land, or water serving the building.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Prefabricated Drainage Composite: CCW MiraDRAIN, a 3-dimensional dimpled core and geotextile fabric, by Carlisle Coatings & Waterproofing Incorporated, 900 Hensley Lane, Wylie, Texas 75098, Phone: (800) 527-7092 Fax: (972) 442-0076.
2. CCW MiraDRAIN 6000 for use over waterproofing membranes and lagging, underslab and retaining wall applications.
3. Substitutions: See Section 01 60 00 - Product Requirements.

B. Prefabricated Drainage Composite:  
Geocomposite Sheet Drain Physical Properties Chart:

CCW MiraDRAIN Property	Test Method	Unit	2000	6000/6200	6000XL/6200XL
<u>Core</u> -----Typical Values -----					
Thickness	ASTM D 1777	in (mm)	0.25 (6.35)	0.40 (10.16)	0.40 (10.16)
Compressive Strength	ASTM D 1621	psf (kN/m <sup>2</sup> )	10,800 (517)	15,000 (719)	16,500 (790)
Maximum Flow Rate <sup>1</sup>	ASTM D 4716	gpm/ft (l/min/m)	12.5 (155)	12.5 (155)	12.5 (155)
Installed Vertically <sup>2</sup>	ASTM D 4716				
gpm/ft (l/min/m)			8.5 (106)	14.5 (180)	Installed
Horizontally <sup>3</sup>	ASTM D 4716	gpm/ft (l/min/m)	\$	\$	\$
<u>Fabric</u>					
Apparent Opening Size	ASTM D 4751	US Std Sieve (mm)	70 (0.21)	40 (0.42)	40 (0.42)
Water Flow Rate	ASTM D 4491	gpm/ft <sup>2</sup>			
Grab Tensile Strength					
ASTM D 4632	lbs (N)		100 (445)	80 (356)	160 (712)
Grab Elongation	ASTM D 4632	%	50	60	50
CBR Puncture Resistance	ASTM D 6241	lbs (N)	250 (1,113)	250 (1,113)	250 (1,113)
System Performance Index *			N/A	14,050	14,050
			18,250	24,100	

CCW MiraDRAIN Property	Test Method	Unit	8000	9000	9800
<u>9900</u> -----Typical Values -----					
<u>Core</u>					
Thickness	ASTM D 1777	in (mm)	0.40 (10.16)	0.40 (10.16)	0.40 (10.16)
Compressive Strength	ASTM D 1621	psf (kN/m <sup>2</sup> )	18,000 (862)	18,000 (862)	18,000 (862)
Maximum Flow Rate <sup>1</sup>	ASTM D 4716	gpm/ft (l/min/m)	17.5 (219)	13 (161)	13 (161)
Installed Vertically <sup>2</sup> †	ASTM D 4716	gpm/ft (l/min/m)	18.5 (230)	18.5 (230)	18.5 (230)
Installed Horizontally <sup>3</sup> †	ASTM D 4716	gpm/ft (l/min/m)	15.5 (193)	15.5 (193)	15.5 (193)
gpm/ft (l/min/m)			3.8 (47)	3.8 (47)	3.8 (47)
Apparent Opening Size	ASTM D 4751	US Std Sieve (mm)	40 (0.42)	40 (0.42)	40 (0.42)
Water Flow Rate	ASTM D 4491	gpm/ft <sup>2</sup> (l/min/m <sup>2</sup> )	145 (5,907)	145 (5,907)	145 (5,907)
Grab Tensile Strength	ASTM D 4632	lbs. (N)	365 (1,624)	365 (1,624)	365 (1,624)
Grab Elongation	ASTM D 4632	%	24	24	24
CBR Puncture Resistance	ASTM D 6241	lbs. (N)	675 (3,004)	675 (3,004)	675 (3,004)
System Performance Index			27,198	27,198	27,198
			27,198	31,325	42,198
<u>Fabric</u>					
Apparent Opening Size	ASTM D 4751	US Std Sieve (mm)	40 (0.42)	40 (0.42)	40 (0.42)
Water Flow Rate	ASTM D 4491	gpm/ft <sup>2</sup> (l/min/m <sup>2</sup> )	145 (5,907)	95 (3,870)	145 (5,907)
Grab Tensile Strength	ASTM D 4632	lbs. (N)	365 (1,624)	205 (912)	365 (1,624)
Grab Elongation	ASTM D 4632	%	24	50	24
CBR Puncture Resistance	ASTM D 6241	lbs. (N)	675 (3,004)	675 (3,004)	675 (3,004)
System Performance Index			27,198	27,198	27,198
			27,198	31,325	42,198

CCW MiraDRAIN Property	Test Method	Unit	HC DRAIN
<u>GR9400</u> -----Typical Values -----			
<u>Core</u>			
Thickness	ASTM D 1777	in (mm)	1.0 (25.4)
Compressive Strength	ASTM D 1621	psf (kN/m <sup>2</sup> )	9,500 (455)
Maximum Flow Rate <sup>1</sup>	ASTM D 4716	gpm/ft (l/min/m)	\$
Installed Vertically <sup>2</sup> †	ASTM D 4716	gpm/ft (l/min/m)	82 (1,300)
Installed Horizontally <sup>3</sup> †	ASTM D 4716	gpm/ft (l/min/m)	21 (260)

	<i>Fabric</i>	<i>140NC</i>	<i>Retention</i>
Apparent Opening Size	ASTM D 4751	US Std Sieve (mm) 70 (0.21)	100
(0.149)	Flow Rate	ASTM D 4491	gpm/ft <sup>2</sup> (l/min/m <sup>2</sup> ) 140 (5,704)
	75	(3,055)	Grab Tensile Strength ASTM D 4632
	lbs. (N)	100 (4451)	300 (1,330) Grab Elongation
	ASTM D 4632	%	50
	CBR Puncture Resistance	ASTM D 6241	lbs. (N)
	250 (1,113)	175 (780)	System Performance
Index	*	N/A	N/A

All flow rates were tested at 3600 psf.

<sup>1</sup>In plane flow rate @ gradient of 1.0 <sup>2</sup>Installed flow rate with soil overburden @ vertical gradient of 1.0

<sup>2</sup>†Installed flow rate with concrete overburden @ vertical gradient of 1.0 <sup>3</sup>Installed flow rate with soil overburden @ horizontal gradient of 0.05 <sup>3</sup>†Installed flow rate with concrete overburden @ horizontal gradient of 0.05 \* Drainage Performance Index is a function of ASTM D 4833, D 4632 and D 1621 § Contact Carlisle Coatings & Waterproofing for performance values in these applications.

## **PART 3-EXECUTION**

### **3.1 EXAMINATION**

- A. Site Verification of Conditions: Verify substrate conditions (which have been previously installed under other sections) are acceptable for product installation in accordance with manufacturer's instructions. Do not proceed with drainage installation until substrate conditions are acceptable for compliance with manufacturer's warranty requirements.

### **3.2 PREPARATION**

- A. Adjacent Surfaces Protection: Protect adjacent work areas and finish surfaces from damage during installation operations.
- B. Concrete Surface Preparation: Prepare concrete surfaces to receive drainage composite.  
Surfaces shall be smooth, free of depressions, voids, protrusions, clean and free of other surface contaminants that may impair the performance of drainage and manufacturer's warranty requirements.
  - 1. Cast-in-Place Concretes: Decks shall be monolithic, smooth, free of voids, spalled areas, laitance, honeycombs, and sharp protrusions. Refer to Division 3 Concrete Section for concrete strength, density, finish, curing methods and other concrete requirements.
  - 2. Precast Concrete Decks: Decks shall be mechanically secured to minimize differential movement and each joint between precast units shall have an installed backer rod. Grout precast units as recommended by manufacturer.
  - 3. Shotcrete: Surface shall be monolithic and smooth with no undulations, irregularities or exposed wire mesh.
- C. Substrate Cleaning: Clean substrate that is to receive drainage. Remove loose debris and other harmful contaminants that will affect performance of drainage composite.

### **3.3 DRAINAGE COURSE INSTALLATION**

- A. Vertical Surfaces: CCW MiraDRAIN 6000
  - 1. Completed Walls: Position the panel with the flat side against the wall and filter fabric toward the soil/drainage side. CCW Cav-GRIP, CCW Contact Adhesive or SecurTape may be used to attach the panel over CCW Waterproofing Membranes.
  - 2. Shoring Systems or Vertical Soil Excavations: Position the panel with the fabric facing the shoring or soil. Fasteners with washers compatible with the substrate should be used to pin the panel directly against the shoring or soil. The fabric should lay flat against the shoring or soil to minimize voids. Concrete or shotcrete may be placed directly against the backside of the CCW MiraDRAIN.
  - 3. Buttress Drainage and Landslide Repair: CCW MiraDRAIN should be rolled out fabric side down onto the properly prepared subgrade. A "chimney" drain type drain pattern should be formed.
    - a) Spacing between CCW MiraDRAIN chimney drains will be dictated by the engineer. Chimney drains should be connected to the continuous horizontal collector panel by overlapping a minimum of 12" (30 cm) into the collector panel.

- b) CCW MiraDRAIN panels may be secured to the subgrade by ballasting with soil or nailing through the CCW MiraDRAIN panel into the underlying hillside. Fabric flaps must be folded over onto the core and secured with duct tape or soil ballast.
- 4. Edge Drain or Trench Drain:
  - a) CCW MiraDRAIN should be laid out in 50 to 500 foot lengths adjacent to the previously cut/excavated trench.
  - b) Panel end laps may be connected by overlapping the panels and applying locking clips or buttoning of the dimples. Flexible, corrugated polyethylene  
or rigid PVC pipe, which has been wrapped with filter fabric, should be placed in the bottom of the trench. The CCW MiraDRAIN panel should be lowered into the trench beside the pipe and temporarily secured to the trench wall by nailing or propping. The fabric side of the panel must face the direction from which the water is flowing. Fabric overlaps on the top of the CCW MiraDRAIN panels should be draped over the back of the core and if there is insufficient fabric, the core shall be cut out from the fabric by a depth of 3 dimples to provide excess fabric for wrapping the core. Backfilling should be completed immediately.
- 5. Connecting Adjacent Panels: Connect adjacent panels at the longitudinal edge by pulling the filter fabric back to expose the flange. The panel edge should be butted to the edge of the adjacent panel dimple to dimple or the edge of the next panel may overlap onto the next panel. Panel ends are to be attached in the same manner. Connections should be completed in shingle fashion so that moisture will flow with the overlap and not against it. Overlap fabric in the direction of water flow. Cover all terminal edges with the filter fabric flap by tucking in behind the core and if there is insufficient fabric, the core shall be cut out from the fabric by a depth of 3 dimples to provide excess fabric for wrapping the core.

### 3.4 DISCHARGE CONNECTIONS

- A. Drainage:
  - a) Install CCW MiraDRAIN HC prefabricated drainage collection system at the base of the wall with the bottom edge flush with top of footing. Adhere CCW MiraDRAIN HC to the substrate using CCW Cav-GRIP, CCW Contact Adhesive or SecurTape. Install CCW MiraDRAIN in shingle fashion by butting the MiraDRAIN flange to the MiraDRAIN HC and extend the filter of the CCW MiraDRAIN over the MiraDRAIN HC. Cover all terminal edges of the core with the fabric flap by tucking it behind the core.  
*Discharge Connection Installation:* Leaving the filter fabric in place, slide the CCW HC Connector outlet over the horizontal portion of the CCW QuickDRAIN and wrap with filter fabric.
  - b) Where drainpipe is indicated, place the drainpipe next to the core. Wrap the drainpipe or rock-pipe drain combination with an auxiliary piece of filter fabric.
- B. Weep holes: Cut a hole in the core corresponding to the size and location of the weep hole.  
Avoid cutting a hole in the fabric by cutting the backside of the core between the

dimples. A four dimple square area cut between the dimples (2 ½ square inch) should be sufficient for most applications.

- C. Terminal Connections and Protrusions: Cover all terminal edges with the integral fabric flap by tucking it around the edge of the core and securing it. At protrusions, cut the core around the protrusion, cut an "X" in the fabric, and tape the fabric around the protrusion. Dirt and concrete must not infiltrate the core.

### 3.5 CLEANING AND PROTECTION

- A. Cleaning: Remove temporary coverings and protection of adjacent work areas. Repair or replace damaged installed products. Clean installed products in accordance with manufacturer's instructions prior to owner's acceptance. Remove construction debris from project site and legally dispose of debris.
- B. Protection: Protection installed products finished surfaces from damage during construction.

**END OF SECTION**

**SECTION 07 11 13**  
**BITUMINOUS DAMPPROOFING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Bituminous Dampproofing.

**1.02 RELATED SECTIONS**

- A. Section 31 23 50 - Earthwork.
- B. Section 03 33 00 – Cast-in-Place Concrete
- C. Section 04 22 00 – Concrete Unit Masonry

**1.03 REFERENCES**

- A. ASTM D 41 - Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing; 2005.
- B. ASTM D 449 - Standard Specification for Asphalt Used in Dampproofing and Waterproofing; 2003.
- C. ASTM D 2822 - Standard Specification for Asphalt Roof Cement; 1991 (Reapproved 1997).
- D. NRCA ML104 - The NRCA Roofing and Waterproofing; National Roofing Contractors Association; Fifth Edition.

**1.04 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide properties of primer, bitumen, and mastics.
- C. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

**1.05 QUALITY ASSURANCE**

- A. Perform work in accordance with NRCA Roofing and Waterproofing Manual.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum three years experience.

**1.06 ENVIRONMENTAL REQUIREMENTS**

- A. Maintain ambient temperatures above 40 degrees F for 24 hours before and during application until dampproofing has cured.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. W.R. Meadows, Inc; Product Spray-Mastic: [www.wrmeadows.com](http://www.wrmeadows.com).
- B. Other Acceptable Manufacturers:
  - 1. Karnak Chemical Corp; Product 83AF Fibered Dampproofing: [www.karnakcorp.com](http://www.karnakcorp.com).
  - 2. Mar-Flex Systems, Inc; Product Cavity Wall and Foundation Coating: [www.mar-flex.com](http://www.mar-flex.com).

3. Substitutions: See Section 01 60 00 - Product Requirements.

## 2.02 MATERIALS

- A. Bitumen: ASTM D 449, Type I, asphalt, asbestos-free.
- B. Primer: ASTM D 41, compatible with substrate.
- C. Sealing Mastic: Asphalt roof cement, ASTM D 2822, Type I.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify substrate surfaces are durable, free of matter detrimental to adhesion or application of dampproofing system.
- C. Verify items which penetrate surfaces to receive dampproofing are securely installed.

### 3.02 PREPARATION

- A. Protect adjacent surfaces not designated to receive dampproofing.
- B. Clean and prepare surfaces to receive dampproofing in accordance with manufacturer's instructions.
- C. Do not apply dampproofing to surfaces unacceptable to manufacturer.
- D. Apply mastic to seal penetrations, small cracks, or minor honeycomb in substrate.

### 3.03 APPLICATION

- A. Prime surfaces in accordance with manufacturer's instructions.
- B. Apply bitumen by spray application and in accordance with manufacturer's written instructions.
- C. Apply bitumen at a temperature limited by equiviscous temperature (EVT) plus or minus 25 degrees F; do not exceed finish blowing temperature for four hours.
- D. Apply from 2 inches below finish grade elevation down to top of footings.
- E. Seal items projecting through dampproofing surface with mastic. Seal watertight.
- F. Immediately backfill against dampproofing to protect from damage.

### 3.04 SCHEDULE

- A. Foundation Wall: Two coatings of asphalt dampproofing.

**END OF SECTION 07 11 13**



**SECTION 07 17 13**  
**BENTONITE PANEL WATERPROOFING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

The general provision of the Contract, including General and Supplementary Conditions and General Requirements, apply to the work specified in this section.

**1.2 DESCRIPTION OF WORK**

The extent of Geotextile/Bentonite Clay waterproofing membrane is shown on the drawing and/or as specified herein.

**1.3 RELATED SECTIONS**

- A. Section 03 10 00 – Concrete Forming and Accessories
- B. Section 03 20 00 – Concrete Reinforcing
- C. Section 03 30 00 – Cast-In-Place Concrete
- D. Section 04 22 00 – CMU - Concrete Unit Masonry
- E. Section 31 23 00 – Excavation and Fill
- F. Section 31 20 00 – Earth Moving

**1.4 REFERENCE STANDARDS**

- A. ASTM D751 Standard Test Methods for Coated Fabrics
- B. ASTM D903 Standard Test Method for Peel or Stripping Strength of Adhesive Bonds
- C. ASTM D1970 Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection (Low Temperature Flexibility)
- D. ASTM D4632 Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
- E. ASTM D5261 Standard Test Method for Measuring Mass per Unit Area of Geotextiles
- F. ASTM D5887 Standard Test Method for Measurement of Index Flux Through Saturated Geosynthetic Clay Liner Specimens Using a Flexible Wall Permeameter
- G. ASTM D5890 Standard Test Method for Swell Index of Clay Mineral Component of Geosynthetic Clay Liners
- H. ASTM D5891 Standard Test Method for Fluid Loss of Clay Component of Geosynthetic Clay Liners
- I. ASTM D5993 Standard Test Method for Measuring Mass per Unit Area of Geosynthetic Clay Liners
- J. ASTM D4643 Standard Test Method for Determination of Water Content of Soil and Rock by Microwave Oven Heating
- K. ASTM D6243 Standard Test Method for Determining the Internal and Interface Shear Strength of Geosynthetic Clay Liner by

- the Direct Shear Method
- L. ASTM D6496 Standard Test Method for Determining Average Bonding Peel Strength Between Top and Bottom Layers of Needle-Punched Geosynthetic Clay Liners
- M. ASTM D6768 Standard Test Method for Tensile Strength of Geosynthetic Clay Liners

#### 1.5 QUALITY ASSURANCE

- A. Manufacturer: Provide Geotextile/Bentonite Clay waterproofing membrane produced by a manufacturer with a minimum of 5 years experience in the waterproofing industry.
- B. Installer: A firm with a minimum of 2 years experience in installing bentonite clay or other related waterproofing products.
- C. MiraCLAY Waterproofing System must be installed by a Carlisle Coatings & Waterproofing Inc. Approved Applicator in compliance with shop drawings approved by Carlisle Coatings & Waterproofing Inc. There must be no deviations made from Carlisle's specifications or the approved drawings without the prior approval from Carlisle Coatings & Waterproofing Inc.
- D. The project Geotechnical Report and Environmental Study shall be provided to Carlisle Coatings & Waterproofing Inc. for review and approval at time of Approved Applicator's bid.
- E. A pre-installation meeting should be coordinated by the General Contractor and attended by an Owner's Representative, the Waterproofing Consultant, the waterproofing applicator and membrane manufacturer's representative. Any trade having relevant or adjacent work to the Blindside System before, during and after installation should also be present and properly represented by a Project Manager and Job Foreman. These trades include but are not limited to the Foundation Contractor, the Concrete Contractor, the Steel Reinforcement Contractor, the Mechanical Contractor, the Electrical Contractor and the Plumbing Contractor. The purpose of this meeting is to discuss the necessity of ensuring proper waterproofing membrane protection during all phases of installation and to review other applicable requirements or unusual field conditions.
- F. Upon request by the Approved Applicator, an inspection will be conducted by a Carlisle Coatings & Waterproofing Inc. representative to ensure that the waterproofing membrane has been installed according to Carlisle Coatings & Waterproofing Inc. specifications and details. This inspection shall be coordinated such that access to the membrane is not impaired.
- G. An in-progress inspection may be scheduled after the initial inspection (after the membrane installation is completed) to ensure proper protection procedures are being followed to prevent possible damage to the membrane during the installation of above membrane components.

#### 1.6 SUBMITTALS

- A. General: Submit in accordance with Section 01 33 00.
- B. Product Data: Submit manufacturer's product literature and installation instructions.
- C. Subcontractor's approval by manufacturer: Submit document stating manufacturer's acceptance of subcontractor as an Approved Applicator for the specified materials.
- D. Water Sample Test Result: A water sample (2 liters) is required on projects that

have ground water and should be submitted to the waterproofing manufacturer to test for contamination and compatibility with waterproofing membrane. Submit to architect a letter of compatibility recommending which formulation to use.

- E. Warranties: Submit sample warranties identifying the terms and conditions stated in Section 1.7

#### 1.7 WARRANTY

- A. Upon completion and acceptance of the work required by this section, the manufacturer will issue a warranty agreeing to promptly replace defective materials for a period of 5 years.
- B. The formation or presence of mold or fungi in a building is dependent upon a broad range of factors including, but not limited to, the presence of spores and nutrient sources, moisture, temperatures, climatic conditions, relative humidity, and heating/ventilating systems and their maintenance and operating capabilities. These factors are beyond the control of Carlisle and Carlisle shall not be responsible for any claims, repairs, restoration, or damages relating to the presence of any irritants, contaminants, vapors, fumes, molds, fungi, bacteria, spores, mycotoxins, or the like in any building or in the air, land, or water serving the building.

#### 1.8 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in original manufacturer's packaging and store materials in strict accordance with manufacturer's instructions.
- B. Remove and replace products that have been prematurely exposed to moisture.

#### 1.9 PROJECT CONDITIONS

- A. Coordination between various trades is essential to avoid unnecessary traffic to prevent damage to the membrane. Heavily traveled areas must be protected by placing temporary protection courses to prevent damage to the membrane.
- B. Coordinate waterproofing work with other trades. The applicator shall have sole right of access to the specified areas for the time needed to complete the application.
- C. Protect adjoining surfaces not to be waterproofed against damage or soiling. Protect plants, vegetation and animals which might be affected by waterproofing operations.
- D. Wear applicable protective clothing and respiratory protection gear.
- E. Maintain work area in a neat and orderly condition, removing empty containers, rags, and rubbish daily from the site.

### **PART 2 - PRODUCTS**

#### 2.1 WATERPROOFING SYSTEM

- A. Provide products manufactured and supplied by Carlisle Coatings & Waterproofing Inc., 900 Hensley Lane, Wylie Texas 75098, phone (800) 527-7098, fax (972) 442-0076.
- B. The components of this system are to be products of Carlisle Coatings & Waterproofing Inc. The installation, performance or integrity of products by

others is not the responsibility of Carlisle Coatings & Waterproofing Inc. and is expressly disclaimed by the warranty.

## 2.2 MEMBRANE

- A. Bentonite panel sheet membrane: Shall be CCW MiraCLAY Bentonite Clay Waterproofing Membrane
- B. Bentonite panel sheet membrane for saltwater and contaminated groundwater: Shall be CCW MiraCLAY EF Bentonite Clay Waterproofing Membrane

## 2.3 RELATED ACCESSORY PRODUCTS

- A. Sealant: Shall be CCW MiraCLAY Sealant used for detailing at terminations and penetrations, to fill minor voids in concrete, and as a fillet in angle changes
- B. Granules: Shall be CCW MiraCLAY Granules used for horizontal to vertical transitions and for detailing at seams and slab penetrations
- C. Pre-formed, high-impact resistant, heavy-duty thermoplastic tie-back cover: Shall be CCW Tie-Back Cover for protecting the MiraCLAY integrity at soil retention tie-back systems
- D. Swellable Sealant: Shall be MiraSTOP SS for use in non-moving joints to create watertight concrete joints and as an adhesive for CCW MiraSTOP waterstop strips
- E. Pre-formed Bentonite hydrophilic waterstop strip: Shall be CCW MiraSTOP BW for use in non-moving joints to create watertight concrete joints
- F. Pre-formed Non-Bentonite hydrophilic waterstop strip: Shall be CCW MiraSTOP NBW for use in non-moving joints to create watertight concrete joints
- G. Injectable waterstop (grout tube): Shall be MiraSTOP IW for use as an injectable waterstop for use in non-moving joints to create watertight concrete joints
- H. Chemical grout: Shall be MiraSTOP CG-F and for use with the MiraSTOP IW
- I. Miscellaneous products: accessory products approved by Carlisle Coatings & Waterproofing Inc.
- J. Membrane to Substrate Fasteners: Fasteners, of the type and length suitable for the substrate, shall be used in conjunction with washers, of at least 1" diameter to attach the bentonite membrane to the substrate.
- K. Membrane to Membrane Fasteners: Mechanically fasten membrane sheets together with a box stapler or similar device for horizontal applications.
- L. The Geotextile/Bentonite membrane shall consist of geotextile panels of sodium bentonite clay sandwiched between two layers of needle-punched woven and non-woven polypropylene fabrics.
- M. Drainage Composite: Shall be CCW MiraDRAIN as recommended by the manufacturer for each condition
- N. Perimeter Drainage System: Shall be CCW MiraDRAIN HC

## 2.4 PHYSICAL PROPERTIES FOR MiraCLAY

Property	Method	Unit	Value
Thickness	-	In.	0.25
Bentonite Mass/Unit Area	ASTM D5993	lb/ft <sup>2</sup> MARV (kg/m <sup>2</sup> MARV)	0.893 (0.123)
Nonwoven	ASTM D5261	oz/yd <sup>2</sup> MARV (g/m <sup>2</sup> MARV)	6.0 (200)
Woven	ASTM D5261	oz/yd <sup>2</sup> MARV (g/m <sup>2</sup> MARV)	3.1 (105)
Swell Index, Minimum	ASTM D5890	-	24 ml (2 g)

Moisture Content	ASTM D4643	%, maximum	12
Fluid Loss	ASTM D5891	ml, maximum	18
Tensile Strength	ASTM D6768	lb/in MARV (kN/m MARV)	30 (5)
Peel Strength	ASTM D6496	lbs/in MARV (N/m MARV)	3.5 (610)
Permeability, Maximum	ASTM D5887	m/s	$5 \times 10^{-9}$
Index Flux, Maximum	ASTM D5887	$\text{m}^3/\text{m}^2/\text{s}$	$1 \times 10^{-8}$
Internal Shear Strength	ASTM D6243	psf (kPa)	500 (24)
Elongation	ASTM D4632	%	150
Low Temperature Low Temperature	ASTM D1970	@ -25°F (-32°C)	Unaffected
Hydrostatic Head Pressure	ASTM D751	ft (meter)	228 (69.49)
Adhesion to Concrete	ASTM D903	lb/in (kg/cm)	17.7 (8)

\*@ 12% moisture content

### PART 3 - EXECUTION

#### 3.1 INSPECTION

- A. Examine substrate and condition under which waterproofing will be installed. Do not proceed with the work until unsatisfactory conditions have been corrected.

#### 3.2 SURFACE PREPARATION

- A. The substrate must be relatively even without noticeable high spots or depressions, relatively smooth, free of protrusions, debris, sharp edges or foreign materials and must be free of accumulated water, ice and snow. Earth, crushed stone, or soil shall be compacted to a minimum of 85% modified Proctor.
- B. Before any waterproofing work is started the waterproofing applicator shall thoroughly examine all surfaces for any deficiencies. Should any deficiencies exist, the architect, owner, or general contractor shall be notified in writing and corrections made.
- C. All surface preparation shall be performed in accordance with Carlisle-CCW application instructions which include but are not limited to:
  1. Subbase/Grade Substrates (concrete, earth, or crushed stone)
    - i. Concrete working slab/mud slab/rat slab must be relatively even without noticeable high spots or depressions, relatively smooth, free of protrusions, debris, sharp edges, or foreign materials.
      - a. Honeycombing, voids and aggregate pockets exceeding 1" in diameter or have a depth greater than  $\frac{3}{4}$ " should be filled with a non-shrink cementitious grout.
    - ii. Earth and stone substrates should be compacted to a minimum 85% modified Proctor.
      - a. Crushed stone should not be larger than  $\frac{3}{4}$ " (18 mm) in size.
  2. Support of Excavation, S.O.E. (Wood Lagging, Concrete Caissons, Sheet Piling, Shotcrete, etc.)
    - i. All soil retention substrates shall be relatively smooth and even.

- ii. Gaps or voids greater than 1.0 in. (25mm) shall be filled or covered with CCW approved material.
  - iii. Remove projections greater than  $\frac{3}{4}$ " (20 mm).
  - iv. CCW MiraDRAIN Composites by Carlisle Coatings and Waterproofing is an acceptable substrate and is installed before the MiraCLAY.
    - a. Install CCW MiraDRAIN with the fabric side facing the soil retention system.
- 3. Concrete Foundation Wall:
  - i. The substrate must be properly prepared to receive the MiraCLAY waterproofing membrane.
  - ii. All honeycombs, form-tie cavities and indentations should be filled with MiraCLAY Sealant or filled with latex Portland Cement.
  - iii. Substrate must be smooth and uniform removing any protrusions over  $\frac{1}{2}$ " (12 mm) from the surface.
  - iv. Apply CCW MiraCLAY Sealant to all construction joints at a minimum of  $\frac{1}{4}$ " (7 mm) thickness and a 3" (8 cm) minimum width.
  - v. Footings must be free of soil, rocks or debris to provide a suitable substrate to receive the MiraCLAY waterproofing membrane.

### 3.3 INSTALLATION

- A. Underslab Application: (Structural concrete slab shall be reinforced and have a minimum thickness of 4" (10 cm)).
  - 1. Install CCW MiraCLAY with the white non-woven side up, facing the installer.
  - 2. Overlap edges a minimum of 4" (10 cm).
  - 3. Protect CCW MiraCLAY from damage caused by rebar chairs with sharp edges or points by placing a patch of CCW MiraCLAY under the rebar chair.
  - 4. Staple joints often enough to prevent excessive movement.
  - 5. Pour CCW MiraCLAY Granules or trowel CCW MiraCLAY Sealant around all penetrations and press in "cut-to-fit" collars of CCW MiraCLAY.
  - 6. Extend the installation of CCW MiraCLAY 12" (31 cm) up or beyond the perimeter slab forms.
  - 7. Inspect and repair any damaged material before concrete pour.
- B. Pre-Applied (i.e. Blindside) Application for Foundation Wall against S.O.E.:
  - 1. Install MiraCLAY with the white non-woven side facing the installer.
  - 2. Secure the MiraCLAY into position with fasteners and 1" (25 mm) washers.
    - i. Use the appropriate fasteners for the type of substrate used to receive the MiraCLAY.
  - 3. Install succeeding courses of MiraCLAY by overlapping the previous course a minimum of 4" (100 mm).
    - i. Install in shingle fashion so that the upper roll of MiraCLAY overlaps the lower roll.
    - ii. Stagger the seams a minimum of 24" (600 mm).
  - 4. Fasten membrane once every 18" (45 cm) on seams or as required

- to prevent blousing.
- 5. Extend waterproofing membrane to 6" below grade and fasten membrane to the substrate to maintain constant compression using a 1/8" x 1" (3 x 25 mm) minimum termination bar.
- 6. Embed the top edge of MiraCLAY and termination bar with a thick bead of CCW MiraCLAY Sealant 2" (50 mm) wide by 1/2" (12 mm) thick
- C. Concrete Foundation Wall Application (i.e. post-applied):
  - 1. The MiraCLAY waterproofing membrane should be installed with the white non-woven side facing the applicator.
  - 2. Create a cant at any vertical to horizontal transition by applying a 1 1/2" (39 mm) to 2" (50 mm) of CCW MiraCLAY Granules or CCW MiraCLAY Sealant along that junction.
  - 3. At the base of the foundation wall where the vertical wall meets the horizontal footing, install MiraCLAY in a horizontal manner extending out onto the footing a minimum of 12" (300 mm).
  - 4. Fasten the MiraCLAY in place with concrete fasteners and 1" (25 mm) washers.
  - 5. Install succeeding courses of MiraCLAY by overlapping the previous course a minimum of 4" (100 mm).
    - i. Install in shingle fashion so that the upper roll of MiraCLAY overlaps the lower roll.
    - ii. Stagger the seams a minimum of 12" (300 mm).
  - 6. Fasten membrane once every 18" (45 cm) to 3' (90 cm) on seams or as required to prevent blousing.
  - 7. At grade line, terminate MiraCLAY with a rigid termination bar or fasten 12" (300 mm) on center.
    - i. Embed the top edge of MiraCLAY and termination bar with a thick bead of MiraCLAY sealant 2" (50 mm) wide by 1/2" (12 mm) thick.
  - 8. Backfill must be compactible soils free of construction debris
    - i. Backfill should be placed in 6-12" lifts
    - ii. Each lift should be uniformly compacted to a minimum 85% modified Proctor.
- D. Detail Conditions
  - 1. For standard installation details, follow the MiraCLAY detail drawings.
  - 2. For non-standard installation instructions, contact your local Carlisle Coatings & Waterproofing representative

### 3.4 PROTECTION AND DRAINAGE

- A. Prevent geotextile/bentonite clay waterproofing membrane from hydrating before being covered with overburden.
  - 1. When threat of rain is imminent or backfill is not immediate, geotextile/bentonite clay waterproofing membrane should be covered with polyethylene sheeting.
- B. Protect waterproofing as per manufacturer's recommendations until concrete or backfill placement.
- C. For underslab applications, inspect waterproofing for damage after steel reinforcement placement and just prior to concrete placement.
- D. Repair waterproofing as per manufacturer's recommendations

- E. Protect the geotextile/bentonite clay waterproofing membrane with CCW MiraDRAIN Drainage Composite.
- F. Install the CCW MiraDRAIN Drainage Composite according to the detailed drawings for the specific installation requirements of the project.

**END OF SECTION**



**SECTION 07 21 13**  
**BOARD INSULATION**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Board insulation at perimeter foundation wall and underside of floor slabs.

**1.02 RELATED SECTIONS**

- A. Section 04 22 00 - Concrete Unit Masonry.
- B. Section 03 33 00 – Cast-in-Place Concrete

**1.03 REFERENCES**

- A. ASTM C 578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2004a.
- B. ASTM C 665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2001.
- C. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2005.
- D. ASTM E 136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace At 750 Degrees C; 2004.

**1.04 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on product characteristics.
- C. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

**1.05 ENVIRONMENTAL REQUIREMENTS**

- A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

**1.06 SEQUENCING**

- A. Sequence work to ensure fireproofing and firestop materials are in place before beginning work of this section.

**PART 2 PRODUCTS**

**2.01 BOARD INSULATION MATERIALS**

- A. Extruded Polystyrene Board Insulation: ASTM C 578, Type IV; Extruded polystyrene board with natural skin surfaces; with the following characteristics:
  - 1. Board Size: 48 x 96 inch.
  - 2. Board Thickness: 2 inches.
  - 3. Board Edges: Square.
  - 4. Board Density: 1.6 lb/cu ft.
  - 5. Water Absorption, maximum: 0.1 percent, volume.
  - 6. Manufacturers:
    - a. Dow Chemical Co.; Product StyroFoam SE: [www.dow.com](http://www.dow.com).
    - b. Owens Corning Corp: [www.owenscorning.com](http://www.owenscorning.com).
    - c. Pactiv Building Products: [www.pactiv.com/green-guard/](http://www.pactiv.com/green-guard/).
  - 7. Substitutions: See Section 01 60 00 - Product Requirements.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation and adhesive.
- B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

#### **3.02 BOARD INSTALLATION AT FOUNDATION PERIMETER**

- A. Apply adhesive to back of boards:
  - 1. Three continuous beads per board length.
  - 2. Full bed 1/8 inch thick.
- B. Install boards horizontally on foundation perimeter.
  - 1. Place boards to maximize adhesive contact.
  - 2. Butt edges and ends tightly to adjacent boards and to protrusions.
- C. Extend boards over expansion joints, unbonded to foundation on one side of joint.
- D. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

#### **3.03 BOARD INSTALLATION UNDER CONCRETE SLABS**

- A. Place insulation under slabs on grade after base for slab has been compacted.
- B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.
- C. Prevent insulation from being displaced or damaged while placing vapor retarder and placing slab.

#### **3.04 PROTECTION OF FINISHED WORK**

- A. Do not permit installed insulation to be damaged prior to its concealment.

**END OF SECTION 07 21 00**

## **SECTION 07 21 16**

### **BATT & BLANKET INSULATION**

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Batt Insulation
- B. Acoustic Batt Insulation
- C. Mineral Wool Insulation

##### **1.02 RELATED SECTIONS**

- A. Section 03 30 00 – Cast-in-Place Concrete
- B. Section 05 40 00 – Cold Formed Metal Framing
- C. Section 06 10 00 – Rough Carpentry
- D. Section 07 84 00 - Firestopping.
- E. Section 09 21 16 - Gypsum Board Assemblies.

##### **1.03 REFERENCES**

- A. ASTM C 578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2004a.
- B. ASTM C 665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2001.
- C. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2005.
- D. ASTM E 136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace At 750 Degrees C; 2004.

##### **1.04 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on product characteristics.
- C. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

##### **1.05 ENVIRONMENTAL REQUIREMENTS**

- A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

##### **1.06 SEQUENCING**

- A. Sequence work to ensure fireproofing and firestop materials are in place before beginning work of this section.

## PART 2 PRODUCTS

### 2.01 BATT INSULATION MATERIALS

- A. Batt Insulation: ASTM C 665; preformed glass fiber batt; friction fit, conforming to the following:
  - 1. Surface Burning Characteristics: Flame spread index of 25 or less; smoke developed index of 450 or less, when tested in accordance with ASTM E 84.
  - 2. Combustibility: Non-combustible when tested in accordance with ASTM E 136, except for facing, if any.
  - 3. Provide insulation made without formaldehyde.
  - 4. Thickness: As indicated on the drawings.
- B. Sound Attenuation Blankets: ASTM C 665, Type I. Lightweight, unfaced fiber glass, conforming to the following:
  - 1. Surface Burning Characteristics: Fire Hazard Classification (FHC) of 25/50 when tested in accordance with ASTM E-84.
  - 2. Combustibility: Non-combustible.
  - 3. Provide insulation made without formaldehyde.
  - 4. Thickness: As indicated on the drawings.
- C. Manufacturers:
  - 1. CertainTeed Corporation: [www.certainteed.com](http://www.certainteed.com)
  - 2. Johns Manville Corporation: [www.jm.com](http://www.jm.com)
  - 3. Owens Corning Corp: [www.owenscorning.com](http://www.owenscorning.com)
- D. Substitutions: See Division 1 for Substitution Requests.

### 2.02 MINERAL WOOL

- 1. Manufacturer:
  - a. ROCKWOOL™ (Basis of Design), [www.rockwool.com](http://www.rockwool.com).
  - b. Johns Manville, TempControl
  - a. Substitutions: See Division 1 for Substitution Requests.
- 2. Description: Non-combustible, lightweight, mineral wool batt insulation to, ASTM C665 Type 1, that provides fire resistance to ASTM E136 and sound control to ASTM C423.
- A. Acoustical and fire batt insulation for walls and floors to ASTM C665, Type 1.
  - 1. Fire performance:
    - a. Non-combustibility: To ASTM E136.
    - b. Surface Burning Characteristics: To ASTM E84.
      - 1) Flame spread: 0.
      - 2) Smoke developed: 0.
  - 2. Acoustical Performance:
    - a. Airborne sound transmission loss: To ASTM E90.
    - b. Rating sound insulation: To ASTM E413.
    - c. Sound absorption co-efficients: To ASTM C423.

### 2.05 ACCESSORIES

- A. Sheet Vapor Retarder: Clear polyethylene film, 4 mil thick.

- B. Tape: Polyester self-adhering type, mesh reinforced, 2 inch wide.
- C. Insulation Fasteners:
  - 1. Thermafiber Impasse Vertical/Horizontal Hangers securely fasted to frame where occurs at aluminum curtainwall and/or storefront system. Impasse GS Hangers are available for locations where face of frame is inaccessible.
  - 2. Impaling clip of unfinished steel with washer retainer and clips, to be adhered to surface to receive insulation, length to suit insulation thickness and substrate, capable of securely and rigidly fastening insulation in place.
- D. Wire Mesh: Galvanized steel, knitted wire mesh.
- E. Adhesive: Type recommended by insulation manufacturer for application.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation and adhesive.
- B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

#### **3.02 BOARD INSTALLATION AT FOUNDATION PERIMETER**

- A. Apply adhesive to back of boards:
  - 1. Three continuous beads per board length.
  - 2. Full bed 1/8 inch thick.
- B. Install boards horizontally on foundation perimeter.
  - 1. Place boards to maximize adhesive contact.
  - 2. Butt edges and ends tightly to adjacent boards and to protrusions.
- C. Extend boards over expansion joints, unbonded to foundation on one side of joint.
- D. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

#### **3.03 BOARD INSTALLATION UNDER CONCRETE SLABS**

- A. Place insulation under slabs on grade after base for slab has been compacted.
- B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.
- C. Prevent insulation from being displaced or damaged while placing vapor retarder and placing slab.

#### **3.04 BATT INSTALLATION**

- A. Install insulation and vapor retarder in accordance with manufacturer's instructions.
- B. Install in exterior wall spaces without gaps or voids. Do not compress insulation.
- C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.
- E. Retain insulation batts in place with wire mesh secured to framing members.

- F. Tape seal butt ends, lapped flanges, and tears or cuts in membrane.
- G. At metal framing, place vapor retarder on warm side of insulation; lap and seal sheet retarder joints over member face.
- H. Tape seal tears or cuts in vapor retarder.
- I. Extend vapor retarder tightly to full perimeter of adjacent window and door frames and other items interrupting the plane of the membrane. Tape seal in place.
- J. Coordinate work of this section with construction of air and moisture barrier specified in Section 07 25 00.

### 3.05 SPRAY-IN FOAM INSULATION AND SPRAY-IN FIBERGLASS INSULATION

- A. Per Manufacturer's Installation Instructions by professional installer with 5 years' experience, min.

### 3.06 PROTECTION OF FINISHED WORK

- A. Do not permit installed insulation to be damaged prior to its concealment.

**END OF SECTION 07 21 00**

## **SECTION 07 84 00**

### **FIRESTOPPING**

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Firestopping materials.
- B. Firestopping of all penetrations and interruptions to fire rated assemblies, whether indicated on drawings or not, and other openings indicated.

##### **1.02 RELATED SECTIONS**

- A. Section 01 70 00 - Execution Requirements: Cutting and patching.
- B. Section 09 21 16 - Gypsum Board Assemblies: Gypsum wallboard fireproofing.
- C. Division 23 Sections: Firestopping of Mechanical Work.
- D. Division 26 Sections: Firestopping of Electrical Work.

##### **1.03 REFERENCES**

- A. ASTM E 119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2000a.
- B. ASTM E 814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops; 2002.
- C. ITS (DIR) - Directory of Listed Products; Intertek Testing Services NA, Inc.; current edition.
- D. FM P7825 - Approval Guide; Factory Mutual Research Corporation; current edition.
- E. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.

##### **1.04 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Schedule of Firestopping: List each type of penetration.
- C. Product Data: Provide data on product characteristics, performance ratings, and limitations.
- D. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Certificate from authority having jurisdiction indicating approval of materials used.

##### **1.05 QUALITY ASSURANCE**

- A. Fire Testing: Provide firestopping assemblies of designs which provide the specified fire ratings when tested in accordance with methods indicated, ASTM E 814, and ASTM E 119.
  - 1. Listing in the current-year classification or certification books of UL, FM, or ITS (Warnock Hersey) will be considered as constituting an acceptable test report.
  - 2. Current evaluation reports published by CABO, ICBO, or BOCA will be considered as constituting an acceptable test report.
  - 3. Submission of actual test reports is required for assemblies for which none of the above substantiation exists.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

- C. Installer Qualifications: Company specializing in performing the work of this section and:
  - 1. Approved by Factory Mutual Research under FM Standard 4991, Approval of Firestop Contractors, or meeting any two of the following requirements:.
  - 2. With minimum 3 years documented experience installing work of this type.
  - 3. Able to show at least 5 satisfactorily completed projects of comparable size and type.
  - 4. Licensed by authority having jurisdiction.
  - 5. Approved by firestopping manufacturer.

#### 1.06 ENVIRONMENTAL REQUIREMENTS

- A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation. Maintain minimum temperature before, during, and for 3 days after installation of materials.
- B. Provide ventilation in areas where solvent-cured materials are being installed.

### PART 2 PRODUCTS

#### 2.01 FIRESTOPPING ASSEMBLIES

- A. Firestopping: Manufactured device.
  - 1. Fire Ratings: Use any system listed by UL or tested in accordance with ASTM E 814 that has F Rating equal to fire rating of penetrated assembly and minimum T Rating Equal to F Rating and that meets all other specified requirements.

#### 2.02 MATERIALS

- A. Elastomeric Silicone Firestopping: Single component silicone elastomeric compound and compatible silicone sealant; conforming to the following:
  - 1. Durability and Longevity: Permanent.
  - 2. Manufacturers:
    - a. A/D Fire Protection Systems Inc: [www.adfire.com](http://www.adfire.com).
    - b. 3M Fire Protection Products: [www.3m.com/firestop](http://www.3m.com/firestop).
    - c. Specified Technologies, Inc: [www.stifirestop.com](http://www.stifirestop.com).
- B. Foam Firestoppping: Single component foam compound; conforming to the following:
  - 1. Durability and Longevity: Permanent.
  - 2. Manufacturers:
    - a. 3M Fire Protection Products: [www.3m.com/firestop](http://www.3m.com/firestop).
    - b. Specified Technologies, Inc: [www.stifirestop.com](http://www.stifirestop.com).
- C. Fibered Compound Firestopping: Formulated compound mixed with incombustible non-asbestos fibers; conforming to the following:
  - 1. Durability and Longevity: Permanent.
  - 2. Manufacturers:
    - a. A/D Fire Protection Systems Inc: [www.adfire.com](http://www.adfire.com).
    - b. USG: [www.usg.com](http://www.usg.com).
- D. Fiber Firestopping: Mineral fiber insulation used in conjunction with elastomeric surface sealer forming airtight bond to opening; conforming to the following:
  - 1. Durability and Longevity: Permanent.
  - 2. Manufacturers:
    - a. A/D Fire Protection Systems Inc: [www.adfire.com](http://www.adfire.com).
    - b. Pecora Corporation: [www.pecora.com](http://www.pecora.com).
    - c. USG: [www.usg.com](http://www.usg.com).



- E. Firestop Devices - Wrap Type: Mechanical device with incombustible filler and sheet stainless steel jacket, collar, and flanged stops, intended to be installed after penetrating item has been installed; conforming to the following:
  - 1. Durability and Longevity: Permanent.
  - 2. Manufacturers:
    - a. Grace Construction Products: [www.na.graceconstruction.com](http://www.na.graceconstruction.com).
    - b. 3M Fire Protection Products: [www.3m.com/firestop](http://www.3m.com/firestop).
    - c. Specified Technologies, Inc: [www.stifirestop.com](http://www.stifirestop.com).
- F. Intumescent Putty: Compound which expands on exposure to surface heat gain; conforming to the following:
  - 1. Durability and Longevity: Permanent.
  - 2. Manufacturers:
    - a. Grace Construction Products: [www.na.graceconstruction.com](http://www.na.graceconstruction.com).
    - b. 3M Fire Protection Products: [www.3m.com/firestop](http://www.3m.com/firestop).
    - c. Specified Technologies, Inc: [www.stifirestop.com](http://www.stifirestop.com).
- G. Reusable Firestopping: Removable intumescent compressible shapes, pillows, or blocks specifically tested in removable configuration; conforming to the following:  
Durability and Longevity: Permanent.
  - 1. Manufacturers:
    - a. Grace Construction Products: [www.na.graceconstruction.com](http://www.na.graceconstruction.com).
    - b. Nelson Firestop Products: [www.nelsonfirestop.com](http://www.nelsonfirestop.com).
    - c. Specified Technologies, Inc: [www.stifirestop.com](http://www.stifirestop.com).
- H. Substitutions: See Section 01 60 00 - Product Requirements.
- I. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Type required for tested assembly design.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify openings are ready to receive the work of this section.

#### **3.02 PREPARATION**

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter which may affect bond of firestopping material.
- B. Remove incompatible materials which may affect bond.
- C. Install backing materials to arrest liquid material leakage.

#### **3.03 INSTALLATION**

- A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.
- B. Do not cover installed firestopping until inspected by authority having jurisdiction.
- C. Install labelling required by code.

#### **3.04 CLEANING AND PROTECTION**

- A. Clean adjacent surfaces of firestopping materials.
- B. Protect adjacent surfaces from damage by material installation.

**END OF SECTION 07 84 00**

## **SECTION 07 90 00**

### **JOINT SEALERS**

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Sealants and joint backing.
- B. Precompressed foam sealers.
- C. Hollow gaskets.

##### **1.02 RELATED SECTIONS**

- A. Section 07 84 00 - Firestopping: Firestopping sealants.
- B. Section 08 80 00 - Glazing: Glazing sealants and accessories.
- C. Section 09 21 16 - Gypsum Board Assemblies: Acoustic sealant.

##### **1.03 REFERENCES**

- A. ASTM C 834 - Standard Specification for Latex Sealants; 2000.
- B. ASTM C 919 - Standard Practice for Use of Sealants in Acoustical Applications; 2002.
- C. ASTM C 920 - Standard Specification for Elastomeric Joint Sealants; 2002.
- D. ASTM C 1193 - Standard Guide for Use of Joint Sealants; 2005.
- E. ASTM D 1056 - Standard Specification for Flexible Cellular Materials--Sponge or Expanded Rubber; 2000.
- F. ASTM C 1247 - Standard Test Method for Durability of Sealants Exposed to Continuous Immersion in Liquids; 2004.
- G. ASTM C 1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants; 2004.
- H. BAAQMD 8-51 - Bay Area Air Quality Management District Regulation 8, Rule 51, Adhesive and Sealant Products; [www.baaqmd.gov](http://www.baaqmd.gov); current edition.
- I. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168; current edition; [www.aqmd.gov](http://www.aqmd.gov).
- J. ASTM E 90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2004.

##### **1.04 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data indicating sealant chemical characteristics.
- C. Samples: Submit two samples, 6 x 6 inch in size illustrating sealant colors for selection.
- D. Manufacturer's Installation Instructions: Indicate special procedures, surface preparation, and perimeter conditions requiring special attention.

### 1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum 3 years documented experience.
- B. Applicator Qualifications: Company specializing in performing the work of this section with minimum 3 years experience.

### 1.06 ENVIRONMENTAL REQUIREMENTS

- A. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

### 1.07 COORDINATION

- A. Coordinate the work with all sections referencing this section.

### 1.08 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective work within a 1 year period after Date of Substantial Completion.
- C. Warranty: Include coverage for installed sealants and accessories which fail to achieve airtight seal and watertight seal, exhibit loss of adhesion or cohesion, or do not cure.
  - 1. Period: Two years from date of Substantial Completion.

## **PART 2 PRODUCTS**

### 2.01 MATERIALS

- A. Compatibility: Comply with ASTM C 1193; Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application.
- B. Colors of exposed joint materials: As selected by Architect from manufacturer's full range.
- C. Comply with ASTM C 920 for each sealant specified, including classifications for type, grade, class, and uses related to exposure and joint substrates.
- D. Stain-Test-Response Characteristics: Comply with ASTM C 1248 for nonstaining sealants required for porous substrates.
- E. Suitability for Immersion in Liquids: Comply with ASTM C 1247 for sealants required for continuous liquid emersion, length of exposure as referenced in ASTM C 920, Class 1 or 2.
- F. Suitability for Contact with Food: Comply with 21 CFR 177.2600 for sealants that will come in repeated contact with food.
- G. Acoustical: Comply with ASTM C 834 to reduce airborne sound transmission through perimeter joints and openings as demonstrated by testing representative assemblies according to ASTM E 90.
- H. Preformed Joint Sealants: Manufacturer's standard system consisting of precured low-modulus silicone extrusion, in sizes to fit joint widths indicated, combined with a neutral-curing silicone sealant for bonding extrusions to substrates.
- I. Preformed Compressible Foam Sealers: Manufacturer's standard mildew-resistant, nonmigratory, nonstaining, preformed, precompressed, open-cell foam sealant;

manufactured from high-density urethane foam impregnated with a nondrying, water-repellent agent.

## 2.02 MANUFACTURERS

- A. Silicone Sealants:
  - 1. GE Silicones: [www.gesilicones.com](http://www.gesilicones.com).
  - 2. Dow Corning Corporation; [www.dowcorning.com](http://www.dowcorning.com).
  - 3. Sonneborn, Division of ChemRex Inc.; [www.chemrex.com](http://www.chemrex.com).
  - 4. Tremco; [www.tremcosealants.com](http://www.tremcosealants.com).
  - 5. Polymeric Systems Inc.; [www.polymericsystems.com](http://www.polymericsystems.com).
  - 6. Schnee-Moorehead Inc.; [www.trustsm.com](http://www.trustsm.com).
  - 7. Pecora Corporation: [www.pecora.com](http://www.pecora.com).
- B. Polyurethane Sealants:
  - 1. Sonneborn, Division of ChemRex Inc.; [www.chemrex.com](http://www.chemrex.com).
  - 2. Tremco; [www.tremcosealants.com](http://www.tremcosealants.com).
  - 3. Sika Corporation, Inc.; [www.sikaconstruction.com](http://www.sikaconstruction.com)
- C. Polysulfide Sealants:
  - 1. Meadow, W. R., Inc.; [www.wrmeadows.com](http://www.wrmeadows.com).
  - 2. Pacific Polymers, Inc.; [www.pacpoly.com](http://www.pacpoly.com).
- D. Acoustical Sealants:
  - 1. United States Gypsum Co.; [www.usg.com](http://www.usg.com)
  - 2. Pecora CorporationNone; [www.pecora.com](http://www.pecora.com).
- E. Substitutions: See Section 01 60 00 - Product Requirements.

## 2.03 SEALANTS

- A. Sealants and Primers - General: Provide only products having lower volatile organic compound (VOC) content than required by the more stringent of the South Coast Air Quality Management District Rule No.1168.
- B. Acrylic Emulsion Latex Sealants: Comply with ASTM C 834, Type O P, Grade NF.
  - 1. Pecora Corporation; Product AC-20+: [www.pecora.com](http://www.pecora.com).
  - 2. Sonneborn, Division of ChemRex Inc.; Product Sonolac: [www.chemrex.com](http://www.chemrex.com).
  - 3. Tremco; Product Tremflex 834: [www.tremcosealants.com](http://www.tremcosealants.com).
- C. Preformed Joint Sealants and Products:
  - 1. Tremco; Product Spectrem Ez Seal: [www.tremcosealants.com](http://www.tremcosealants.com).
  - 2. Pecora Corporation; Product Sil-Span: [www.pecora.com](http://www.pecora.com).
  - 3. GE Silicones; Product UltraSpan US1100: [www.gesilicones.com](http://www.gesilicones.com).
  - 4. Dow Corning Corporation; Product 123 Silicone Seal: [www.dowcorning.com](http://www.dowcorning.com).
- D. Preformed Compressible Foam Sealers:
  - 1. Emseal Joint Systems, Ltd; Product Emseal 25V: [www.emseal.com](http://www.emseal.com).
  - 2. Sandell Manufacturing Company, Inc; Product Polyseal: [www.sandellmfg.com](http://www.sandellmfg.com).
  - 3. illbruck Sealant Systems, Inc.; Product Universal Foam Sealant: [www.illbruck.com](http://www.illbruck.com)
  - 4. Polytite Manufacturing Corporation; Products Polytite B, Polytite Standard: [www.polytite.com](http://www.polytite.com)
- E. Acoustical Sealant: Butyl or acrylic sealant; ASTM C 834, Grade NS, Class 12-1/2, Uses M and A; single component, solvent release curing, non-skinning.
  - 1. Product: AC-20 FTR Acoustical and Insulation Sealant manufactured by Pecora.
  - 2. Product: Sheetrock Acoustical Sealant manufactured by United States Gypsum.
  - 3. Applications: Use for concealed locations only:

- a. Sealant bead between top stud runner and structure and between bottom stud track and floor.
- F. Acrylic Emulsion Latex: ASTM C 834, single component, non-staining, non-bleeding, non-sagging.
  - 1. Color: Colors as selected, Type OP (opaque).
  - 2. Product: AC-20+ manufactured by Pecora Corporation.
  - 3. Product: Sonolac manufactured by Sonneborn, Division of ChemRex Inc.
  - 4. Product: Tremflex 834 manufactured by Tremco.
- G. Self-Leveling Polysulfide Sealant: ASTM C 920, Grade P, Class 25, Uses T, I, M, A, O; two component, chemical curing, non-staining, non-bleeding, capable of continuous water immersion, self-leveling type.
  - 1. Product: Deck-O-Seal manufactured by W. R. Meadows, Inc..
  - 2. Product: Elastoseal 227, Type 1 manufactured by Pacific Polymers, Inc..
  - 3. Movement Capability: Plus and minus 25 percent.
- H. Nonsag Polyurethane Sealant: ASTM C 920, Grade NS, Class 25, Uses T, NT, M, A, O; single component, chemical curing, non-staining, non bleeding, non-sagging type.
  - 1. Product: Sikaflex - 1a manufactured by Sika corporation, Inc..
  - 2. Product: Ultra manufactured by Sonneborn, Division of ChemRex Inc..
  - 3. Product: NP 1 manufactured by Sonneborn, Division of ChemRex Inc..
  - 4. Product: Vulkem 116 manufactured by Tremco.
- I. Nonsag Polyurethane Sealant: ASTM C 920, Grade NS, Class 100/50, Uses NT, M, A, O; single component, chemical curing, non-staining, non bleeding, non-sagging type.
  - 1. Product: Sikaflex-15 LM manufactured by Sika corporation, Inc..
  - 2. Product: Vulkem 921 manufactured by Tremco.
- J. Self-Leveling Polyurethane Sealant: ASTM C 920, Grade P, Class 25, Uses T, NT, M, A, O; single component, chemical curing, non staining, non bleeding, self-leveling type.
  - 1. Product: Sikaflex-1C SL manufactured by Sika Corporation, Inc..
  - 2. Product: Sonolastic SL 1 manufactured by Sonneborn, Division of ChemRex Inc..
- K. Silicone Sealant: ASTM C 920, Grade NS, Class 50, Uses NT, A, M, G, O; single component, neutral curing, and non-staining to porous substrates per ASTM C 1248.
  - 1. Product: SilPruf LM SCS2700 manufactured by GE Silicones.
  - 2. Product: Omniseal manufactured by Sonneborn, Division of ChemRex Inc..
  - 3. Product: Spectrem 1 manufactured by Tremco.
  - 4. Product: 790 manufactured by Dow Corning.
  - 5. Product: 791 manufactured by Dow Corning.
  - 6. Product: 795 manufactured by Dow Corning.
- L. Silicone Sealant: ASTM C 920, Grade NS, Class 25, Uses NT, A, G; single component, neutral curing, and non-sagging.
  - 1. Product: 799 manufactured by Dow Corning.
  - 2. Product: UltraGlaze SSG 4000 manufactured by GE Silicones.
  - 3. Product: UltraGlaze SSG 4000AC manufactured by GE Silicones.
  - 4. Product: PSI-631 manufactured by Polymeric Systems Inc..
  - 5. Product: SM 5731 Poly-Glaze Plus manufactured by Schnee-Morehead, Inc..
  - 6. Product: Proglaze SG manufactured by Tremco.
  - 7. Product: Tremsil 600 manufactured by Tremco.
- M. Silicone Sealant: ASTM C 920, Grade NS, Class 25, Uses NT, A, G, O; single component, neutral curing, and mildew and fungus resistant,.
  - 1. Product: 898 manufactured by Pecora Corporation.
  - 2. Product: Tremsil 600 White manufactured by Tremco.

## 2.04 ACCESSORIES

- A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.
- B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.
- C. Joint Backing: Round foam rod compatible with sealant and non-staining; ASTM D 1056, sponge or expanded rubber; oversized 30 to 50 percent larger than joint width.
- D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.
- E. Masking Tape: Non-staining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.
- B. Verify that joint backing and release tapes are compatible with sealant.

### 3.02 PREPARATION

- A. Ensure proper joint design practices are followed allowing for a 2:1 width to depth ratio.
- B. Joint dimensions should allow for ¼" (6.35 mm) minimum and ½" (12.7 mm) maximum thickness for sealant.
- C. Remove loose materials, foreign matter, incompressibles, and free water which might impair adhesion of sealant. Concrete joints must be clean and dry.
- D. Clean and prime joints in accordance with manufacturer's instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- E. Install backer rod or joint filler to control depth of joint sealant per depth ratio requirements.
- F. Perform preparation in accordance with manufacturer's instructions and ASTM C 1193.
- G. Protect elements surrounding the work of this section from damage or disfigurement.
- H. Masking Tape: Use masking tape to prevent contact of sealant with adjoining surfaces that would be permanently stained or damaged by contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

### 3.03 INSTALLATION

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Perform installation in accordance with ASTM C 1193.
- C. Perform acoustical sealant application work in accordance with ASTM C 919.
- D. Install bond breaker where joint backing is not used.
- E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
- F. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

- G. Tool joints to match existing or concave per Figure 5A in ASTM C 1193.
- H. Precompressed Foam Sealant: Do not stretch; avoid joints except at corners, ends, and intersections; install with face 1/8 to 1/4 inch below adjoining surface. ....
- I. Compression Gaskets: Avoid joints except at ends, corners, and intersections; seal all joints with adhesive; install with face 1/8 to 1/4 inch below adjoining surface.

### 3.04 CLEANING

- A. Clean adjacent soiled surfaces as the work progresses in compliance with the sealant manufacturers written instructions.

### 3.05 PROTECTION OF FINISHED WORK

- A. Protect sealants until cured.

### 3.06 SEALANT APPLICATION SCHEDULE

- A. Exterior vertical and horizontal nontraffic construction joints in cast-in-place concrete.
  - 1. Joint Sealant: Single-component nonsag polyurethane sealant.
- B. Exterior horizontal isolation and contraction and where indicated at joints in cast-in-place concrete slabs.
  - 1. Joint Sealant: Single-component pourable polyurethane sealant.
- C. Exterior vertical control and expansion joints in unit masonry.
  - 1. Joint Sealant: Single-component nonsag polyurethane sealant.
- D. Exterior butt joints between metal panels.
  - 1. Joint Sealant: Single-component nonsag polyurethane sealant.
- E. Exterior perimeter joints between masonry and frames of doors windows and louvers and other metal frames.
  - 1. Joint Sealant: Single-component nonsag polyurethane sealant.
- F. Exterior control and expansion joints in ceilings and other overhead surfaces.
  - 1. Joint Sealant: Single-component nonsag polyurethane sealant.
- G. Vertical control and expansion joints on exposed interior surfaces of exterior walls.
  - 1. Joint Sealant: Latex sealant.
- H. Interior perimeter joints of exterior openings.
  - 1. Joint Sealant: Latex sealant.
- I. Interior joints between plumbing fixtures and adjoining walls, floors, and counters.
  - 1. Joint Sealant: Single-component mildew-resistant neutral-curing silicone sealant.
- J. Vertical joints on exposed surfaces of interior unit masonry walls.
  - 1. Joint Sealant: Single-component nonsag polyurethane sealant
- K. Vertical joints on exposed surfaces of interior unit masonry walls.
  - 1. Joint Sealant: Single-component nonsag polyurethane sealant

- L. Perimeter joints between interior wall surfaces and frames of interior doors windows.
  - 1. Joint Sealant: Latex sealant.
- M. Perimeter joints between interior unit masonry walls and concrete slab.
  - 1. Joint Sealant: Single-component Low VOC nonsag polyurethane sealant, approved for interior use

**END OF SECTION 07 90 00**



## **SECTION 08 11 13**

### **HOLLOW METAL DOORS AND FRAMES**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

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

##### **1.2 SUMMARY**

- A. Section Includes:

- 1. Standard and custom hollow metal doors and frames.
- 2. Steel sidelight, borrowed lite and transom frames.
- 3. Louvers installed in hollow metal doors.
- 4. Light frames and glazing installed in hollow metal doors.

- B. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

- 1. ANSI/SDI A250.8 - Recommended Specifications for Standard Steel Doors and Frames.
- 2. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frames Anchors and Hardware Reinforcing.
- 3. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.
- 4. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
- 5. ANSI/SDI A250.11 - Recommended Erection Instructions for Steel Frames.
- 6. ASTM A1008 - Standard Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
- 7. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- 8. ASTM A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
- 9. ASTM C 1363 - Standard Test Method for Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus.
- 10. ANSI/BHMA A156.115 - Hardware Preparation in Steel Doors and Frames.
- 11. ANSI/SDI 122 - Installation and Troubleshooting Guide for Standard Steel Doors and Frames.
- 12. ANSI/NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association.
- 13. ANSI/NFPA 105: Standard for the Installation of Smoke Door Assemblies.
- 14. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association.
- 15. UL 10C - Positive Pressure Fire Tests of Door Assemblies.
- 16. UL 1784 - Standard for Air Leakage Tests of Door Assemblies.

### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, hardware reinforcements, profiles, anchors, fire-resistance rating, and finishes.
- B. Door hardware supplier is to furnish templates, template reference number and/or physical hardware to the steel door and frame supplier in order to prepare the doors and frames to receive the finish hardware items.
- C. Shop Drawings: Include the following:
  - 1. Elevations of each door design.
  - 2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
  - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
  - 4. Locations of reinforcement and preparations for hardware.
  - 5. Details of anchorages, joints, field splices, and connections.
  - 6. Details of accessories.
  - 7. Details of moldings, removable stops, and glazing.
  - 8. Details of conduit and preparations for power, signal, and control systems.
- D. Samples for Verification:
  - 1. Samples are only required by request of the architect and for manufacturers that are not current members of the Steel Door Institute.

### 1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain hollow metal doors and frames through one source from a single manufacturer wherever possible.
- B. Quality Standard: In addition to requirements specified, furnish SDI-Certified manufacturer products that comply with ANSI/SDI A250.8, latest edition, "Recommended Specifications for Standard Steel Doors and Frames".
- C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to UL10C (neutral pressure at 40" above sill) or UL 10C.
  - 1. Oversize Fire-Rated Door Assemblies Construction: For units exceeding sizes of tested assemblies, attach construction label certifying doors are built to standard construction requirements for tested and labeled fire rated door assemblies except for size.
  - 2. Temperature-Rise Limit: Where indicated and at vertical exit enclosures (stairwell openings) and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.
  - 3. Smoke Control Door Assemblies: Comply with NFPA 105.
    - a. Smoke "S" Label: Doors to bear "S" label, and include smoke and draft control gasketing applied to frame and on meeting stiles of pair doors.
- D. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257. Provide labeled glazing material.

- E. Pre-Submittal Conference: Conduct conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier, Installer, and Contractor to review proper methods and procedures for installing hollow metal doors and frames and to verify installation of electrical knockout boxes and conduit at frames with electrified or access control hardware.

## 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project site storage. Do not use non-vented plastic.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch high wood blocking. Do not store in a manner that traps excess humidity.
  - 1. Provide minimum 1/4-inch space between each stacked door to permit air circulation. Door and frames to be stacked in a vertical upright position.

## 1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

## 1.7 COORDINATION

- A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.
- B. Building Information Modeling (BIM) Support: Utilize designated BIM software tools and obtain training needed to successfully participate in the Project BIM processes. All technical disciplines are responsible for the product data integration and data reliability of their Work into the coordinated BIM applications.

## 1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
- B. Warranty includes installation and finishing that may be required due to repair or replacement of defective doors.

# PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide steel doors and frames from a SDI Certified manufacturer:

1. CECO Door Products (C).
2. Curries Company (CU).

## 2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.
- C. Frame Anchors: ASTM A 653/A 653M, Commercial Steel (CS), Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

## 2.3 HOLLOW METAL DOORS

- A. General: Provide 1-3/4 inch doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8 and ANSI/NAAMM HMMA 867.
- B. Exterior Doors (Energy Efficient): Face sheets fabricated of commercial quality hot-dipped zinc coated steel that complies with ASTM A924 A60. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model, ANSI/SDI A250.4 for physical performance level, and HMMA 867 for door construction.
  1. Design: Flush panel.
  2. Core Construction: Foamed in place polyurethane and steel stiffened laminated core with no stiffener face welds, in compliance with HMMA 867 "Laminated Core".
    - a. Provide 22 gauge steel stiffeners at 6 inches on-center internally welded at 5" on-center to integral core assembly, foamed in place polyurethane core chemically bonded to all interior surfaces. No stiffener face welding is permitted.
    - b. Thermal properties to rate at a fully operable minimum U-Factor 0.37 and R-Value 2.7, including insulated door, thermal-break frame and threshold.
    - c. Kerf Type Frames: Thermal properties to rate at a fully operable minimum U-Factor 0.38 and R-Value 2.6, including insulated door, kerf type frame, and threshold.
  3. Level/Model: Level 3 and Physical Performance Level A (Extra Heavy Duty), Minimum 16 gauge (0.053 inch - 1.3-mm) thick steel, Model 2.
  4. Vertical Edges: Vertical edges to be mechanically interlocked with hairline seam. Beveled Lock Edge, 1/8 inch in 2 inches (3 mm in 50 mm).
  5. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet. Doors with an inverted top channel to include a steel closure channel, screw attached, with the web of the channel flush with the face sheets of the door. Plastic or composite channel fillers are not acceptable.
  6. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9".
  7. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.
- C. Interior Doors: Face sheets fabricated of commercial quality cold rolled steel that complies with ASTM A 1008/A 1008M. Provide doors complying with requirements indicated below by

referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:

1. Design: Flush panel.
  - a. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.
2. Level/Model: Level 2 and Physical Performance Level B (Heavy Duty), Minimum 18 gauge (0.042-inch - 1.0-mm) thick steel, Model 2.
3. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet.
4. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9" or minimum 14 gauge continuous channel with pierced holes, drilled and tapped.
5. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

D. Manufacturers Basis of Design:

1. Curries Company (CU) - Polystyrene Core - 707 Series.
2. Curries Company (CU) - Energy Efficient - 777 Trio-E Series.

## 2.4 HOLLOW METAL FRAMES

- A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.
- B. Thermal Break Frames: Subject to the same compliance standards and requirements as standard hollow metal frames. Tested for thermal performance in accordance with NFRC 102, and resistance to air infiltration in accordance with NFRC 400. Where indicated provide thermally broken frame profiles available for use in both masonry and drywall construction. Fabricate with 1/16" positive thermal break and integral vinyl weatherstripping.
- C. Exterior Frames: Fabricated of hot-dipped zinc coated steel that complies with ASTM A 653/A 653M, Coating Designation A60.
  1. Fabricate frames with mitered or coped corners. Profile as indicated on drawings.
  2. Frames: Minimum 14 gauge (0.067-inch -1.7-mm) thick steel sheet.
  3. Manufacturers Basis of Design:
    - a. Curries Company (CU) – Thermal Break TQ Series.
- D. Interior Frames: Fabricated from cold-rolled steel sheet that complies with ASTM A 1008/A 1008M.
  1. Fabricate frames with mitered or coped corners. Profile as indicated on drawings.
  2. Frames: Minimum 16 gauge (0.053-inch -1.3-mm) thick steel sheet.
  3. Manufacturers Basis of Design:
    - a. Curries Company (CU) - CM Series.
    - b. Curries Company (CU) - M Series.
- E. Fire rated frames: Fabricate frames in accordance with NFPA 80, listed and labeled by a qualified testing agency, for fire-protection ratings indicated.

- F. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 Table 4 with reinforcement plates from same material as frames.

## 2.5 FRAME ANCHORS

- A. Jamb Anchors:
  - 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, formed from A60 metallic coated material, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
  - 2. Stud Wall Type: Designed to engage stud and not less than 0.042 inch thick.
- B. Floor Anchors: Floor anchors to be provided at each jamb, formed from A60 metallic coated material, not less than 0.042 inches thick.
- C. Mortar Guards: Formed from same material as frames, not less than 0.016 inches thick.

## 2.6 LIGHT OPENINGS AND GLAZING

- A. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints at fabricator's shop. Fixed and removable stops to allow multiple glazed lites each to be removed independently. Coordinate frame rabbet widths between fixed and removable stops with the type of glazing and installation indicated.
- B. Moldings for Glazed Lites in Doors and Loose Stops for Glazed Lites in Frames: Minimum 20 gauge thick, fabricated from same material as door face sheet in which they are installed.
- C. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch (16 mm) high unless otherwise indicated. Provide fixed frame moldings and stops on outside of exterior and on secure side of interior doors and frames.
- D. Preformed Metal Frames for Light Openings: Manufacturer's standard frame formed of 0.048-inch-thick, cold rolled steel sheet; with baked enamel or powder coated finish; and approved for use in doors of fire protection rating indicated. Match pre-finished door paint color where applicable.

## 2.7 ACCESSORIES

- A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.
- B. Grout Guards: Formed from same material as frames, not less than 0.016 inches thick.

## 2.8 FABRICATION

- A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. When shipping limitations so dictate, frames for large openings are to be fabricated in sections for splicing or splining in the field by others.
- B. Tolerances: Fabricate hollow metal work to tolerances indicated in ANSI/SDI A250.8.

C. Hollow Metal Doors:

1. Exterior Doors: Provide optional weep-hole openings in bottom of exterior doors to permit moisture to escape where specified.
2. Glazed Lites: Factory cut openings in doors with applied trim or kits to fit. Factory install glazing where indicated.
3. Astragals: Provide overlapping astragals as noted in door hardware sets in Division 08 Section "Door Hardware" on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted.
4. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge strap for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".

D. Hollow Metal Frames:

1. Shipping Limitations: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
2. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
  - a. Welded frames are to be provided with two steel spreaders temporarily attached to the bottom of both jambs to serve as a brace during shipping and handling. Spreader bars are for bracing only and are not to be used to size the frame opening.
3. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
4. High Frequency Hinge Reinforcement: Provide high frequency hinge reinforcements at door openings 48-inches and wider with mortise butt type hinges at top hinge locations.
5. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge straps for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".
6. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated for removable stops, provide security screws at exterior locations.
7. Mortar Guards: Provide guard boxes at back of hardware mortises in frames at all hinges and strike preps regardless of grouting requirements.
8. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
9. Jamb Anchors: Provide number and spacing of anchors as follows:
  - a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
    - 1) Two anchors per jamb up to 60 inches high.
    - 2) Three anchors per jamb from 60 to 90 inches high.
    - 3) Four anchors per jamb from 90 to 120 inches high.
    - 4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.
  - b. Stud Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
    - 1) Three anchors per jamb up to 60 inches high.

- 2) Four anchors per jamb from 60 to 90 inches high.
    - 3) Five anchors per jamb from 90 to 96 inches high.
    - 4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
    - 5) Two anchors per head for frames above 42 inches wide and mounted in metal stud partitions.
  10. Door Silencers: Except on weatherstripped or gasketed doors, drill stops to receive door silencers. Silencers to be supplied by frame manufacturer regardless if specified in Division 08 Section "Door Hardware".
  11. Bituminous Coating: Where frames are fully grouted with an approved Portland Cement based grout or mortar, coat inside of frame throat with a water based bituminous or asphaltic emulsion coating to a minimum thickness of 3 mils DFT, tested in accordance with UL 10C and applied to the frame under a 3rd party independent follow-up service procedure.
- E. Hardware Preparation: Factory prepare hollow metal work to receive template mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."
1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
  2. Reinforce doors and frames to receive non-template, mortised and surface mounted door hardware.
  3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
  4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.
- 2.9 STEEL FINISHES
- A. Prime Finishes: Doors and frames to be cleaned, and chemically treated to insure maximum finish paint adhesion. Surfaces of the door and frame exposed to view to receive a factory applied coat of rust inhibiting shop primer.
1. Shop Primer: Manufacturer's standard, fast-curing, lead and chromate free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; and compatible with substrate and field-applied coatings.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. General Contractor to verify the accuracy of dimensions given to the steel door and frame manufacturer for existing openings or existing frames (strike height, hinge spacing, hinge back set, etc.).
- C. Proceed with installation only after unsatisfactory conditions have been corrected.



### 3.2 PREPARATION

- A. Remove welded in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Prior to installation, adjust and securely brace welded hollow metal frames for square, level, twist, and plumb condition.
- C. Tolerances shall comply with SDI-117 "Manufacturing Tolerances Standard Steel Doors and Frames."
- D. Drill and tap doors and frames to receive non-template, mortised, and surface-mounted door hardware.

### 3.3 INSTALLATION

- A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.
- B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11 and NFPA 80 at fire rated openings.
  - 1. Set frames accurately in position, plumbed, leveled, aligned, and braced securely until permanent anchors are set. After wall construction is complete and frames properly set and secured, remove temporary braces, leaving surfaces smooth and undamaged. Shim as necessary to comply with installation tolerances.
  - 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.
  - 3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar.
  - 4. Grout Requirements: Do not grout head of frames unless reinforcing has been installed in head of frame. Do not grout vertical or horizontal closed mullion members.
- C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.
  - 1. Non-Fire-Rated Standard Steel Doors:
    - a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
    - b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
    - c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
    - d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.
  - 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
- D. Field Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.

### 3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow metal work immediately after installation.
- C. Prime-Coat and Painted Finish Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat, or painted finishes, and apply touchup of compatible air drying, rust-inhibitive primer, zinc rich primer (exterior and galvanized openings) or finish paint.

### 3.5 FIELD QUALITY CONTROL

- A. Field Inspection (Punch Report): Reference Division 01 Sections "Closeout Procedures". Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.
  - 1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

**END OF SECTION**

**08 11 13**

**SECTION 08 14 16**  
**FLUSH WOOD DOORS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Flush wood doors; flush and flush glazed configuration; fire rated and non-rated.

**1.02 RELATED SECTIONS**

- A. Section 08 11 13 - Hollow Metal Doors and Frames.
- B. Section 08 71 00 - Door Hardware.
- C. Section 08 80 00 - Glazing.

**1.03 REFERENCES**

- A. AWI/AWMAC (QSI) - Architectural Woodwork Quality Standards Illustrated; Architectural Woodwork Institute and Architectural Woodwork Manufacturers Association of Canada; 2003.
- B. ITS (DIR) - Directory of Listed Products; Intertek Testing Services NA, Inc.; current edition.
- C. NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association; 1999.
- D. UL (BMD) - Building Materials Directory; Underwriters Laboratories Inc.; current edition.
- E. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; 1998.
- F. WDMA NWWDA I.S.1-A - Architectural Wood Flush Doors; Window and Door Manufacturers Association (formerly NWWDA); 2004.

**1.04 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.
- C. Shop Drawings: Illustrate door opening criteria, elevations, sizes, types, swings, undercuts required, special beveling, special blocking for hardware, factory machining criteria, factory finishing criteria, identify cutouts for glazing and louvers.
- D. Samples: Submit two samples of door veneer, 12 x 12 inch in size illustrating wood grain, stain color, and sheen.
- E. Manufacturer's Installation Instructions: Indicate special installation instructions.
- F. Submittals for Environmental Performance:
  - 1. VOC data:
    - a. Adhesives: Submit manufacturer's product data for adhesives. Indicate VOC limits of the product. Submit MSDS highlighting VOC limits. Submit Green Seal Certification to GS-36 and description of the basis for certification.
    - b. Engineered Wood Products: Provide documentation that composite wood and agrifiber products contain no added urea-formaldehyde resins.

## 1.05 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
- B. Installed Fire Rated Door and Transom Panel Assembly: Conform to NFPA 80 for fire rated class as indicated.
- C. Sustainably Harvested Wood: Certification Organizations shall be accredited by the Forest Stewardship Council (FSC).

## 1.06 DELIVERY, STORAGE, AND PROTECTION

- A. Deliver, store, and handle products as required to prevent damage or deterioration. Conform to manufacturer's recommendations, requirements of referenced standard, and recommendations of NWWDA I.S.1, Appendix, "How to Store, Handle, Finish, Install, and Maintain Wood Doors."
- B. Clearly label each door with opening number where door will be installed. Use removable labels or mark on door surface in area that will be concealed from view after installation.
  - 1. Coordinate door identification with shop drawing designations.
- C. Package, deliver and store doors in accordance with specified quality standard.
- D. Accept doors on site in manufacturer's packaging. Inspect for damage.
- E. Protect doors with resilient packaging sealed with heat shrunk plastic. Do not store in damp or wet areas; or in areas where sunlight might bleach veneer. Seal top and bottom edges with tinted sealer if stored more than one week. Break seal on site to permit ventilation.

## 1.07 PROJECT CONDITIONS

- A. Coordinate the work with door opening construction, door frame and door hardware installation.

## 1.08 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Provide warranty for the following term:
  - 1. Interior Doors: Life of installation.
- C. Include coverage for delimitation of veneer, warping beyond specified installation tolerances, defective materials, telegraphing core construction, and labor to remove and replace defective doors.

# PART 2 PRODUCTS

## 2.01 MANUFACTURERS

- A. Wood Veneer Faced Doors:
  - 1. VT Industries: [www.vtindustries.com](http://www.vtindustries.com).
  - 2. Haley Brothers: [www.haleybros.com](http://www.haleybros.com).
  - 3. Marshfield Door Systems, Inc: [www.marshfielddoors.com](http://www.marshfielddoors.com).
  - 4. Oshkosh Architectural Door Company: [www.oshkoshdoor.com](http://www.oshkoshdoor.com)
  - 5. Algoma Hardwoods, Inc.: [www.algomahardwoods.com](http://www.algomahardwoods.com)
  - 6. Substitutions: See Section 01 60 00 - Product Requirements.

## 2.02 DOORS AND PANELS

- A. All Doors: See drawings for locations and additional requirements.
  - 1. Quality Standard: AWI/AWMAC Architectural Woodwork Quality Standards Illustrated, Section 1300, Premium Grade.
  - 2. Wood Veneer Faced Doors: 5-ply unless otherwise indicated.
- B. Interior Doors: 1-3/4 inches thick unless otherwise indicated; flush construction.
  - 1. Provide solid core doors at all locations.
  - 2. Fire Rated Doors: Tested to ratings indicated on drawings in accordance with UL 10C or UBC Standard 7-2-97 ("positive pressure"), category A; UL or WH (ITS) labeled without any visible seals when door is closed.
  - 3. Maple veneer facing, stain as selected by Architect from manufacturer's available standard finishes, with factory transparent finish.

## 2.03 DOOR AND PANEL CORES

- A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies and faces as indicated above.
- B. Fire Rated Doors: Mineral core, Type FD, plies and faces as indicated above.
- C. Lumber for Core, Stile and Rail, and Wood Veneer:
  - 1. Resource Management:
    - a. Virgin Lumber: Lumber fabricated from old growth timber is not permitted. Provide sustainably harvested; certified or labeled in accordance with FSC guidelines.
- D. Engineered Wood Products: Products shall contain no added urea-formaldehyde

## 2.04 DOOR FACINGS

- A. Wood Veneer Facing for Transparent Finish: Species as specified above, veneer grade as specified by quality standard, plain sliced, book veneer match, balance assembly match; unless otherwise indicated.
  - 1. Vertical Edges: Same species as face veneer.
  - 2. Pairs: Pair match each pair; set match pairs within 10 feet of each other when doors are closed.
- A. Facing Adhesive: Type II - water resistant; types recommended by flooring manufacturer. Low VOC, low odor, solvent-free, water-based adhesives.

## 2.05 ACCESSORIES

- A. Glazing Stops, Non-fire rated Doors: Wood, of same species as door facing, mitered corners; prepared for countersink style tamper proof screws.
- B. Glazing Stops, Fire rated Doors: Rolled steel channel shape, mitered corners; prepared for countersink style tamper proof screws.

## 2.06 DOOR CONSTRUCTION

- A. Fabricate doors in accordance with door quality standard specified.
- B. Cores Constructed with Stiles and Rails:

- C. Fabricate fire rated doors in accordance with UL requirements. Attach fire rating label to door.
- D. Astragals for Non-Rated Double Doors: Steel, T shaped, overlapping and recessed at face edge.
- E. Astragals for Fire Rated Double Doors: Steel, T shaped, overlapping and recessed at face edge, specifically for double doors.
- F. Provide solid blocks at lock edge and top of door for closer for hardware reinforcement.
  - 1. Provide solid blocking for other through-bolted hardware.
- G. Fit door edge trim to edge of stiles after applying veneer facing.
- H. Vertical Exposed Edge of Stiles - Veneer Faces: Of same species as veneer facing.
- I. Fit door edge trim to edge of stiles after applying veneer facing.
- J. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.
- K. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.
  - 1. Exception: Doors to be field finished.
- L. Provide edge clearances in accordance with AWI Quality Standards Illustrated Section 1700.

## 2.07 FACTORY FINISHING - WOOD VENEER DOORS

- A. Factory finish doors in accordance with specified quality standard:
  - 1. Transparent catalyzed polyurethane, Premium quality, matte sheen.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

### 3.02 INSTALLATION

- A. Install doors in accordance with manufacturer's instructions and specified quality standard.
  - 1. Install fire-rated doors in accordance with NFPA 80 requirements.
- B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.
- C. Use machine tools to cut or drill for hardware.
- D. Coordinate installation of doors with installation of frames and hardware.
- E. Prefit Doors: Minimize field fitting to procedures that are necessary to complete in the field and that provide trouble free operation. Do not attempt of field modify doors to conditions which were not originally scheduled or intended. Doors prepared incorrectly for openings shall be replaced, not modified.
- F. Coordinate installation of glazing.

- G. Install door louvers plumb and level.

### 3.03 INSTALLATION TOLERANCES

- A. Conform to specified quality standard for fit and clearance tolerances.
- B. Conform to specified quality standard for maximum diagonal distortion.
- C. Maximum Diagonal Distortion (Warp): 1/8 inch measured with straight edge or taut string, corner to corner, over an imaginary 36 by 84 inches surface area.
- D. Maximum Vertical Distortion (Bow): 1/8 inch measured with straight edge or taut string, top to bottom, over an imaginary 36 by 84 inches surface area.
- E. Maximum Width Distortion (Cup): 1/8 inch measured with straight edge or taut string, edge to edge, over an imaginary 36 by 84 inches surface area.

### 3.04 ADJUSTING

- A. Adjust doors and hardware for smooth and balanced door movement in coordination with hardware.
- B. Replace doors that cannot be properly adjusted.
- C. Restore door finishes damaged during installation, in a manner which results in the door showing no evidence of the restoration. If refinished door cannot be made to match other doors, refinished door will be replaced at the contractor's expense.
- D. Adjust closers for full closure.

**END OF SECTION 08 14 16**

**SECTION 08 17 43**  
**FRP FLUSH DOORS**

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Fiberglass reinforced polyester (FRP) flush doors with thermally-broken aluminum frames.

1.2 RELATED SECTIONS

- A. Section 08 71 00 - Door Hardware.
- B. Section 08 80 00 - Glazing

1.3 REFERENCES

- A. AAMA 1503-98 - Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections.
- B. ANSI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors and Hardware Reinforcings.
- C. ASTM B 117 - Operating Salt Spray (Fog) Apparatus.
- D. ASTM B 209 - Aluminum and Aluminum-Alloy Sheet and Plate.
- E. ASTM B 221 - Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- F. ASTM D 256 - Determining the Pendulum Impact Resistance of Notched Specimens of Plastics.
- G. ASTM D 543 - Evaluating the Resistance of Plastics to Chemical Reagents.
- H. ASTM D 570 - Water Absorption of Plastics.
- I. ASTM D 638 - Tensile Properties of Plastics.
- J. ASTM D 790 - Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
- K. ASTM D 1308 - Effect of Household Chemicals on Clear and Pigmented Organic Finishes.
- L. ASTM D 1621 - Compressive Properties of Rigid Cellular Plastics.
- M. ASTM D 1623 - Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics.
- N. ASTM D 2126 - Response of Rigid Cellular Plastics to Thermal and Humid Aging.
- O. ASTM D 2583 - Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.
- P. ASTM D 5420 - Impact Resistance of Flat Rigid Plastic Specimens by Means of a Falling Weight.
- Q. ASTM D 6670-01 - Standard Practice for Full-Scale Chamber Determination of Volatile Organic Emissions from Indoor Materials/Products.
- R. ASTM E 84 - Surface Burning Characteristics of Building Materials.
- S. ASTM E 90 - Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.
- T. ASTM E 283 - Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
- U. ASTM E 330 - Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
- V. ASTM E 331 - Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.
- W. ASTM F 476 - Security of Swinging Door Assemblies.
- X. ASTM F 1642-04 - Standard Test Method for Glazing Systems Subject to Air blast Loading.
- Y. NWWDA T.M. 7-90 - Cycle Slam Test Method
- Z. SFBC PA 201 - Impact Test Procedures.



- AA. SFBC PA 203 - Criteria for Testing Products Subject to Cyclic Wind Pressure Loading.
- AB. SFBC 3603.2 (b)(5) - Forced Entry Resistance Test.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. General: Provide door assemblies that have been designed and fabricated to comply with specified performance requirements, as demonstrated by testing manufacturer's corresponding standard systems.
- B. Air Infiltration: For a single door 3'-0" x 7'-0", test specimen shall be tested in accordance with ASTM E 283 at pressure differential of 6.27 psf. Door shall not exceed 0.58 cfm/ft<sup>2</sup>.
- C. Water Resistance: For a single door 3'-0" x 7'-0", test specimen shall be tested in accordance with ASTM E 331 at pressure differential of 7.50 psf. Door shall not have water leakage.
- D. Indoor air quality testing per ASTM D 6670-01: GREENGUARD Environmental Institute Certified including GREENGUARD for Children and Schools Certification.
- E. Swinging Door Cycle Test, Doors and Frames, ANSI A250.4: Minimum of 25,000,000 cycles.
- F. Cycle Slam Test Method, NWWDA T.M. 7-90: Minimum 5,000,000 Cycles.
- G. Salt Spray, Exterior Doors and Frames, ASTM B 117: Minimum of 500 hours.
- H. Sound Transmission, Exterior Doors, STC, ASTM E 90: Minimum of 25.
- I. Thermal Transmission, Exterior Doors, U-Value, AAMA 1503-98: Maximum of 0.29 BTU/hr x sf x degrees F. Minimum of 55 CRF value.
- J. Surface Burning Characteristics, FRP Doors and Panels, ASTM E 84:
  - 1. Flame Spread: Maximum of 200, Class C.
  - 2. Smoke Developed: Maximum of 450, Class C.
- K. Surface Burning Characteristics, Class A Option On Interior Faces of FRP Exterior Panels and Both Faces of FRP Interior Panels, ASTM E 84:
  - 1. Flame Spread: Maximum of 25.
  - 2. Smoke Developed: Maximum of 450.
- L. Impact Strength, FRP Doors and Panels, Nominal Value, ASTM D 256: 14.0 foot-pounds per inch of notch.
- M. Tensile Strength, FRP Doors and Panels, Nominal Value, ASTM D 638: 13,000 psi.
- N. Flexural Strength, FRP Doors and Panels, Nominal Value, ASTM D 790: 21,000 psi.
- O. Water Absorption, FRP Doors and Panels, Nominal Value, ASTM D 570: 0.20 percent after 24 hours.
- P. Indentation Hardness, FRP Doors and Panels, Nominal Value, ASTM D 2583: 55.
- Q. Gardner Impact Strength, FRP Doors and Panels, Nominal Value, ASTM D 5420: 120 in-lb.
- R. Abrasion Resistance, Face Sheet, Taber Abrasion Test, 25 Cycles at 1,000 Gram Weight with CS-17 Wheel: Maximum of 0.029 average weight loss percentage.
- S. Stain Resistance, ASTM D 1308: Face sheet unaffected after exposure to red cabbage, tea, and tomato acid. Stain removed easily with mild abrasive or FRP cleaner when exposed to crayon and crankcase oil.
- T. Chemical Resistance, ASTM D 543. Excellent rating.
  - 1. Acetic acid, Concentrated.
  - 2. Ammonium Hydroxide, Concentrated.
  - 3. Citric Acid, 10%.
  - 4. Formaldehyde.
  - 5. Hydrochloric Acid, 10%
  - 6. Sodium hypochlorite, 4 to 6 percent solution.
- U. Compressive Strength, Foam Core, Nominal Value, ASTM D 1621: 79.9 psi.

- V. Compressive Modulus, Foam Core, Nominal Value, ASTM D 1621: 370 psi.
- W. Tensile Adhesion, Foam Core, Nominal Value, ASTM D 1623: 45.3 psi.
- X. Thermal and Humid Aging, Foam Core, Nominal Value, 158 Degrees F and 100 Percent Humidity for 14 Days, ASTM D 2126: Minus 5.14 percent volume change.

#### 1.5 SUBMITTALS

- A. See Division 1 for Submittal Procedures.
- B. Product Data: Submit manufacturer's product data, including description of materials, components, fabrication, finishes, and installation.
- C. Shop Drawings: Submit manufacturer's shop drawings, including elevations, sections, and details, indicating dimensions, tolerances, materials, fabrication, doors, panels, framing, hardware schedule, and finish.
- D. Samples:
  - 1. Door: Submit manufacturer's sample of door showing face sheets, core, framing, and finish.
  - 2. Aluminum Frame: Submit manufacturer's Samples of Aluminum Door Frame, Sidelight and Transom.
  - 3. Color: Submit manufacturer's samples of standard colors of doors and frames.
- E. Test Reports: Submit certified test reports from qualified independent testing agency indicating doors comply with specified performance requirements.
- F. Manufacturer's Project References: Submit list of successfully completed projects including project name and location, name of architect, and type and quantity of doors manufactured.
- G. Maintenance Manual: Submit manufacturer's maintenance and cleaning instructions for doors, including maintenance and operating instructions for hardware.
- H. Warranty: Submit manufacturer's standard warranty.

#### 1.6 QUALITY ASSURANCE

- A. Manufacturer's Qualifications:
  - 1. Continuously engaged in manufacturing of doors of similar type to that specified, with a minimum of 25 years successful experience.
  - 2. Door and frame components from same manufacturer.
  - 3. Evidence of a compliant documented quality management system.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying opening door mark and manufacturer.
- B. Storage: Store materials in clean, dry area indoors in accordance with manufacturer's instructions.
- C. Handling: Protect materials and finish from damage during handling and installation.

#### 1.8 WARRANTY

- A. Warrant doors, frames, and factory hardware against failure in materials and workmanship, including excessive deflection, faulty operation, defects in hardware installation, and deterioration of finish or construction in excess of normal weathering.
- B. Warranty Period: Ten years starting on date of shipment. In addition, a limited lifetime (while the door is in its specified application in its original installation) warranty covering: failure of corner joinery, core deterioration, delamination or bubbling of door skin.

## PART 2 PRODUCTS

### 2.1 MANUFACTURER

- A. Basis of Design: Special-Lite, Inc., PO Box 6, Decatur, Michigan 49045. Toll Free (800) 821-6531. Phone (269) 423-7068. Fax (800) 423-7610. Web Site [www.special-lite.com](http://www.special-lite.com). E-Mail [info@special-lite.com](mailto:info@special-lite.com).

### 2.2 FRP FLUSH DOORS

- A. Model.  
1. [AF-100 Smooth Pultruded Fiberglass Door](#)
- B. Door Opening Size.  
1. See Drawings
- C. Construction.  
1. Door Thickness.  
a. 1-3/4".  
2. Pultruded as one monolithic panel with integral stiles.  
3. Stiles.  
a. Seamless 9/16" thick solid FRP.  
4. Top Rail.  
a. 6" pultruded tube profile designed to fit flush and be chemically welded inside of door cavity.  
5. Bottom Rail.  
a. Standard pultruded inverted U channel designed to fit flush and be chemically welded inside the door which allows doors to be field trimmed.  
b. Optional closed bottom rail.  
6. Core.  
a. Polyurethane foam.  
b. Minimum 6 pcf density.  
7. Face Sheet.  
a. Smooth, pultruded FRP integral to construction of door.  
b. Attachment of face sheet.  
1. Door to be pultruded as one monolithic panel.  
8. Cutouts.  
a. Manufacture doors with cutouts for required vision lites, louvers, and panels.  
9. Hardware.  
a. Pre-machine doors in accordance with templates from specified hardware manufacturers.  
b. Surface mounted closures will be reinforced for but not prepped or installed at factory.  
10. Reinforcements.

### 2.3 PERFORMANCE

- A. Pultruded Fiberglass Skin.  
1. Surface Burning, ASTM-E84: Flame Spread  $\leq$  25, Smoke Developed  $\leq$  450.  
2. Tensile Strength, ASTM-D638: 12,300 psi.  
3. Percent Fiberglass: Minimum 50%.
- B. Pultruded Structural Shapes.  
1. Tensile Strength, ASTM-D638: Minimum 30,000 psi.  
2. Compressive Strength, ASTM-D695: Minimum 30,000 psi.  
3. Flexural Strength, ASTM-D790: Minimum 30,000 psi.  
4. Tensile Strength, ASTM-D638: Minimum psi.  
5. Flexural Modulus, ASTM-D790: Minimum  $1.6 \times 10^6$  psi.

6. Short Beam Shear, ASTM-D2344: Minimum 4,500 psi.
7. Impact, Notched, ASTM-D256: Minimum 25 ft-lb/in.
8. Thermal Expansion, ASTM-D696: Maximum  $8.0 \times 10^{-6}$  psi.
9. Surface Burning, ASTM-E84: Flame Spread  $\leq 25$ , Smoke Developed  $\leq 450$ .
- C. Stiles & Rails.
  1. Fastener Withdrawal, ASTM-D1761: 894 lbs.
- D. Door Core.
  1. Surface Burning, ASTM-E84: Flame Spread  $\leq 25$ , Smoke Developed  $\leq 450$ .
  2. Density, ASTM-D1622: 6.0 pcf.
  3. Compressive Strength, ASTM-D1621: 139 psi.
  4. Compressive Modulus = 4,527 psi.
  5. Shear Strength, ASTM-C273: 84 psi.
  6. Shear Modulus, ASTM-C273: 788 psi.
  7. Tensile Modulus, ASTM-D1623: 136 psi.
  8. Flexural Strength, ASTM-C203: 204 psi.
  9. Flexural Modulus, ASTM-C203: 4,767 psi.
  10. K-Factor, ASTM-C518: 0.16 Btu-in/hr-ft<sup>2</sup>·°F.
  11. R-Factor, ASTM-C518: 6.25 hr-ft<sup>2</sup>·°F/Btu.
  12. Water Absorption, ASTM-C272: < 0.7% by volume.
- E. Door Panel.
  1. Thermal Transmittance, ASTM-C1363-11: U-Factor = 0.13 Btu/hr-ft<sup>2</sup>·°F, R-Value = 7.42 hr-ft<sup>2</sup>·°F/Btu.
- F. AF-150 Framing.
  1. Tensile Strength, ASTM-D638: Minimum 30,000 psi.
  2. Compressive Strength, ASTM-D695: Minimum 30,000 psi.
  3. Flexural Strength, ASTM-D790: Minimum 30,000 psi.
  4. Tensile Strength, ASTM-D638: Minimum psi.
  5. Flexural Modulus, ASTM-D790: Minimum  $1.6 \times 10^6$  psi.
  6. Short Beam Shear, ASTM-D2344: Minimum 4,500 psi.
  7. Impact, Notched, ASTM-D256: Minimum 25 ft-lb/in.
  8. Thermal Expansion, ASTM-D696: Maximum  $8.0 \times 10^{-6}$  psi.
  9. Surface Burning, ASTM-E84: Flame Spread  $\leq 25$ , Smoke Developed  $\leq 450$ .
  10. Fastener Withdrawal, ASTM-D1761: 924 lbs.
  11. Percent Fiberglass: Minimum 50%.
- G. Door and 3-Sided AF-150 Frame Assembly.
  1. Physical Endurance, AAMA 920-11: 2,000,000 Cycles, No Damage.
  2. Thermal Transmittance, NFRC 100.
    - a. Opaque Swinging Door (< than 50% glass)
      1. U-Factor = 0.23 Btu/hr-ft<sup>2</sup>·°F.
    - b. Commercially Glazed Swinging Entrance Door (> than 50% glass)
      1. U-Factor = 0.41 Btu/hr-ft<sup>2</sup>·°F.
  3. Air Leakage, NFRC 400, ASTM-E283.
    - a. Opaque Swinging Door (< than 50% glass)
      1. 0.03 cfm/sqft @ 1.57 psf.
      2. 0.06 cfm/sqft @ 6.24 psf.
    - b. Commercially Glazed Swinging Entrance Door (> than 50% glass)
      1. 0.02 cfm/sqft @ 1.57 psf.
      2. 0.05 cfm/sqft @ 6.24 psf.
  4. STC and OITC, ASTM-E90: STC = 30, OITC = 28.
  5. Structural Performance, ASTM E-330.
    - a. Single Door, 3'0" x 7'0" overall size, mortise lock and deadbolt.
      1.  $\pm 180$  psf design pressure, pass.
  6. Structural Performance, ASTM E-330.
    - a. Single Door, 3'0" x 7'0" overall size, mortise lock and deadbolt.

1.  $\pm 100$  psf design pressure, pass.
7. Impact and Cycle Test, ASTM-E1886.
  - a. Single Door, 3'0" x 7'0" overall size, mortise lock and deadbolt.
    1. 9 lbs. missile @ 50 fps, minimum 2 impacts, no rips, tears, or penetrations.
    2.  $\pm 100$  psf design pressure, pass.
8. Forced Entry, AAMA 1304.
  - a. Single Door, 3'0" x 7'0" overall size, mortise lock and deadbolt.
    1. 300lb Pull Test, pass.
9. Blast Test, ASTM-F1642.
  - a. 6.9 psi @ 48 psi-msec, no hazard, GSA performance condition 2.
10. 20-min. (without hose) Positive Pressure Category B, UL10C and NFPA 252 Fire Door Assembly.
  - a. Must be used with Special-Lite AF-150 Listed Fiberglass Frame.
  - b. Maximum Size.
    1. Maximum Width: 3'0".
    2. Maximum Height: 7'0".
    3. Category G Edge Sealing System supplied by manufacturer and field applied.
  - c. No metallic reinforcements will be allowed.

## 2.4 MATERIALS

- A. A. Fiberglass.
  1. Face Sheet.
    - a. See 2.04.A.
  2. Stiles & Rails.
    - a. See 2.04.B.
  3. Framing
    - a. See 2.04.C.
- B. Fasteners.
  1. All exposed fasteners will have a finish to match material being fastened.
  2. 410 stainless steel or other non-corrosive metal.
  3. Must be compatible with items being fastened.

## 2.5 FABRICATION

- A. Sizes and Profiles: Required sizes for door and frame units, and profile requirements shall be as indicated on the Drawings.
- B. All Aluminum Frames are to be thermally broken – SL 450 TB
- C. Coordination of Fabrication: Field measure before fabrication and show recorded measurements on shop drawings.
- D. Assembly:
  1. Complete cutting, fitting, forming, drilling, and grinding of metal before assembly.
  2. Remove burrs from cut edges.
- E. Welding: Welding of doors or frames is not acceptable.
- F. Fit:
  1. Maintain continuity of line and accurate relation of planes and angles.
  2. Secure attachments and support at mechanical joints with hairline fit at contacting members.

## 2.6 HARDWARE

- A. Premachine doors in accordance with templates from specified hardware manufacturers and hardware schedule.
- B. Hardware Schedule: As specified in Sections 08 71 00 + 08 71 01

## 2.7 VISION LITES

- A. Factory Glazing: 1-inch glass insulating units.
- B. Lites in Exterior Doors: Allow for thermal expansion.

# PART 3 EXECUTION

## 3.1 EXAMINATION

- A. Examine areas to receive doors. Notify Architect of conditions that would adversely affect installation or subsequent use. Do not proceed with installation until unsatisfactory conditions are corrected.

## 3.2 PREPARATION

- A. Ensure openings to receive frames are plumb, level, square, and in tolerance.

## 3.3 INSTALLATION

- A. Install doors in accordance with manufacturer's instructions.
- B. Install doors plumb, level, square, true to line, and without warp or rack.
- C. Anchor frames securely in place.
- D. Separate aluminum from other metal surfaces with bituminous coatings or other means approved by Architect.
- E. Set thresholds in bed of mastic and backseal.
- F. Install exterior doors to be weathertight in closed position.
- G. Repair minor damages to finish in accordance with manufacturer's instructions and as approved by Architect.
- H. Remove and replace damaged components that cannot be successfully repaired as determined by Architect.

## 3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services: Manufacturer's representative shall provide technical assistance and guidance for installation of doors.

## 3.5 ADJUSTING

- A. Adjust doors, hinges, and locksets for smooth operation without binding.

## 3.6 CLEANING

- A. Clean doors promptly after installation in accordance with manufacturer's instructions.
- B. Do not use harsh cleaning materials or methods that would damage finish.

3.7 PROTECTION

- A. Protect installed doors to ensure that, except for normal weathering, doors will be without damage or deterioration at time of substantial completion.

**END OF SECTION 08 11 13**

## **SECTION 08 40 00**

### **ALUMINUM ENTRANCES & STOREFRONTS**

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Interior Aluminum-Framed Storefront.
- B. Exterior Aluminum-Framed Storefront.
- C. Aluminum framing members.
- D. Storefront doors.

##### **1.02 RELATED SECTIONS**

- A. Section 07 90 00 - Joint Sealers: Perimeter sealant and back-up materials.
- B. Section 08 71 00 - Door Hardware: Hardware items other than specified in this section.
- C. Section 08 80 00 - Glazing: Glass and glazing accessories.

##### **1.03 REFERENCES**

- A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; American Architectural Manufacturers Association; 2004.
- B. AAMA 501.2 - Field Check of Metal Storefronts, Curtain Walls, and Sloped Glazing Systems for Water Leakage; American Architectural Manufacturers Association; 2003 (part of AAMA 501).
- C. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; American Architectural Manufacturers Association; 1998.
- D. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels; 2005.
- E. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; American Society of Civil Engineers; 2002.
- F. ASTM A 36/A 36M - Standard Specification for Carbon Structural Steel; 2005.
- G. ASTM A 123/A 123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2002.
- H. ASTM B 209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2004.
- I. ASTM B 209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2004.
- J. ASTM B 221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2004a.
- K. ASTM B 221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2004.



- L. ASTM E 283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004.
- M. ASTM E 330 - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2002.
- N. ASTM E 331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000.
- O. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); Society for Protective Coatings; 2002 (Ed. 2004).

#### 1.04 PERFORMANCE REQUIREMENTS

- A. Design and size components to withstand the following load requirements without damage or permanent set, when tested in accordance with ASTM E 330, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
  - 1. Design Wind Loads: Comply with requirements of ASCE 7.
  - 2. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
- B. Movement: Accommodate movement between storefront and perimeter framing and deflection of lintel, without damage to components or deterioration of seals.
- C. Air Infiltration: Limit air infiltration through assembly to 0.06 cu ft/min/sq ft of wall area, measured at a reference differential pressure across assembly of 6.24 psf as measured in accordance with ASTM E 283.
- D. Condensation Resistance Factor: CRF of 64 or greater when measured in accordance with AAMA 1502.7-1981.
- E. Water Leakage: None, when measured in accordance with ASTM E 331 with a test pressure difference of 8.00 lbf/sq ft.
- F. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
- G. Air and Vapor Seal: Maintain continuous air barrier and vapor retarder throughout assembly, primarily in line with inside pane of glass and inner sheet of infill panel and heel bead of glazing compound.
- H. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.

#### 1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide component dimensions; describe components within assembly, anchorage and fasteners, glass and infill, door hardware, internal drainage details and finish.
- C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work, expansion and contraction joint location and details, and field welding required.

- D. Design Data: Provide framing member structural and physical characteristics, dimensional limitations.
- E. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.
- F. Report of field testing for water leakage.
- G. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

#### 1.06 QUALITY ASSURANCE

- A. Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed at the State in which the Project is located.
- B. Manufacturer and Installer: Company specializing in manufacturing aluminum glazing systems with minimum three years of documented experience.

#### 1.07 PRE-INSTALLATION MEETING

- A. Convene one week before starting work of this section.

#### 1.08 DELIVERY, STORAGE, AND PROTECTION

- A. Handle products of this section in accordance with AAMA CW-10.
- B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings which bond to aluminum when exposed to sunlight or weather.

#### 1.09 PROJECT CONDITIONS

- A. Coordinate the work with installation of air barrier and vapor retarder components or materials.

#### 1.10 ENVIRONMENTAL REQUIREMENTS

- A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

#### 1.11 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a one year period after Date of Substantial Completion.
- C. Provide five year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.
- D. Provide five year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

### **PART 2 PRODUCTS**

#### 2.01 MANUFACTURERS

- A. Kawneer Company, Inc; [www.kawneer.com](http://www.kawneer.com) (Basis of Design)
- B. Tubelite Company, Inc.; [www.tubelite.com](http://www.tubelite.com)

- B. United States Aluminum Corp: [www.usalum.com](http://www.usalum.com)
- C. EFCO Corporation; [www.efcocorp.com](http://www.efcocorp.com)
- D. Substitutions: See Section 01 60 00 - Product Requirements.

## 2.02 COMPONENTS

- A. Interior Aluminum Framed Storefronts: Factory fabricated, factory finished aluminum framing members, including perimeter trims, stools, accessories, shims, anchors, clips and sealing of storefront units.
  - a. Basis of Design: Kawneer Trifab 450, 1 ¾" x 4 ½" nominal dimension, non-thermal system.
- B. Exterior Aluminum Framed Storefronts and Window Openings: Factory fabricated, factory finished aluminum framing members with infill and related flashing, anchorage and attachment devices including all specialized clips necessary to attach the system to the openings and/or structure to meet the design criteria.
  - a. Basis of Design: Kawneer Trifab VersaGlaze 451T Thermal Storefront System, 1 ¾" x 4 ½" nominal dimension system.
  - b. Structurally Reinforced members: Formed sheet aluminum with internal reinforcement of structural steel members.
- D. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
  - 1. Framing members for interior applications need not be thermally broken.
  - 2. Glazing stops: Applied.
  - 3. Structurally Reinforced Members: Formed sheet aluminum with internal reinforcement of structural steel member.
- E. Storefront Doors:
  - 1. Glazed aluminum
    - a. Manufacturer: Kawneer Company Inc.
    - b. 500 Standard Entrances
    - c. Wide Stile
    - d. Top Rail: 5 inches wide.
    - e. Vertical Stiles: 5 inches wide, Wide Stile.
    - f. Bottom Rail: 6 1/2 inches wide.
    - g. Depth: 1 ¾"
    - h. Glazing Stops: Square.
    - i. Finish: Same as storefront.

## 2.03 MATERIALS

- A. Extruded Aluminum: ASTM B 221 (ASTM B 221M).
- B. Sheet Aluminum: ASTM B 209 (ASTM B209M).
- C. Structural Steel Sections: ASTM A 36/A 36M; galvanized in accordance with requirements of ASTM A 123/A 123M.
- D. Fasteners: Stainless steel.
- E. Exposed Flashings: 0.032 inch thick aluminum sheet; finish to match framing members.
- F. Concealed Flashings: 0.018 inch thick aluminum.
- G. Perimeter Sealant: Type as specified in Section 07 90 00.
- H. Glass: As specified in Section 08 80 00.

- I. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.
- J. Glazing Accessories: As specified in Section 08 80 00.
- K. Touch-Up Primer for Galvanized Steel Surfaces: SSPC-Paint 20, zinc rich.

#### 2.04 FINISHES

- A. Kawneer Clear Anodized 14, AA-M10C21A44, (0.7 mils minimum coating thickness), AAMA 611, Architectural Class I Color Anodic Coating  
Color selected by architect from manufacturers standard colors
- B. Touch-Up Materials: As recommended by coating manufacturer for field application.

#### 2.05 HARDWARE

- A. Door Hardware: As specified in Section 08 71 00.
- B. Weatherstripping: Wool pile, continuous and replaceable; provide on all exterior doors.
- C. Threshold: Extruded aluminum, one piece per door opening, ribbed surface; provide on all exterior doors.

#### 2.06 FABRICATION

- A. Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.
- B. Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.
- C. Prepare components to receive anchor devices. Fabricate anchors.
- D. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
- E. Arrange fasteners and attachments to conceal from view.
- F. Reinforce components internally for door hardware and door operators.
- G. Reinforce framing members for imposed loads.
- H. Finishing: Apply factory finish to all surfaces that will be exposed in completed assemblies.
  - 1. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.

### **PART 3 EXECUTION**

#### 3.01 EXAMINATION

- A. Verify dimensions, tolerances, and method of attachment with other work.
- B. Verify that wall openings and adjoining air and vapor seal materials are ready to receive work of this section.

#### 3.02 INSTALLATION

- A. Install wall system in accordance with manufacturer's instructions.
- B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- C. Provide alignment attachments and shims to permanently fasten system to building structure.

- D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- E. Provide thermal isolation where components penetrate or disrupt building insulation.
- F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form watertight dam.
- G. Coordinate attachment and seal of perimeter air and vapor barrier materials.
- H. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- I. Install operating sash.
- J. Set thresholds in bed of mastic and secure.
- K. Install glass in accordance with Section 08 80 00, using glazing method required to achieve performance criteria.
- L. Install perimeter sealant in accordance with Section 07 90 00.

### 3.03 ERECTION TOLERANCES

- A. Maximum Variation from Plumb: 0.06 inches every 3 ft non-cumulative or 1/16 inches per 10 ft, whichever is less.
- B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

### 3.04 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for independent testing and inspection requirements. Inspection will monitor quality of installation and glazing.
- B. Test installed storefront for water leakage in accordance with AAMA 501.2.
  - 1. Field test areas as directed by the Architect.

### 3.05 ADJUSTING

- A. Adjust operating hardware and sash for smooth operation.

### 3.06 CLEANING AND PROTECTION

- A. Remove protective material from pre-finished aluminum surfaces.
- B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.
- C. Remove excess sealant by method acceptable to sealant manufacturer.
- D. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.
- E. Protect finished work from damage.

**END OF SECTION 08 40 00**

## **SECTION 08 71 00**

### **DOOR HARDWARE**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

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

##### **1.2 SUMMARY**

- A. This Section includes commercial door hardware for the following:
  - 1. Swinging doors.
  - 2. Sliding doors.
  - 3. Other doors to the extent indicated.
- B. Door hardware includes, but is not necessarily limited to, the following:
  - 1. Mechanical door hardware.
  - 2. Electromechanical door hardware.
  - 3. Automatic operators.
  - 4. Cylinders specified for doors in other sections.
- C. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
  - 1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
  - 2. ICC/IBC - International Building Code.
  - 3. NFPA 70 - National Electrical Code.
  - 4. NFPA 80 - Fire Doors and Windows.
  - 5. NFPA 101 - Life Safety Code.
  - 6. NFPA 105 - Installation of Smoke Door Assemblies.
  - 7. UL/ULC and CSA C22.2 - Standards for Automatic Door Operators Used on Fire and Smoke Barrier Doors and Systems of Doors.
  - 8. State Building Codes, Local Amendments.
- D. Standards: All hardware specified herein shall comply with the following industry standards as applicable. Any undated reference to a standard shall be interpreted as referring to the latest edition of that standard:
  - 1. ANSI/BHMA Certified Product Standards - A156 Series.
  - 2. UL10C - Positive Pressure Fire Tests of Door Assemblies.

3. ANSI/UL 294 - Access Control System Units.
4. UL 305 - Panic Hardware.
5. ANSI/UL 437- Key Locks.

### 1.3 SUBMITTALS

- A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.
- B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
  1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
  2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
  3. Content: Include the following information:
    - a. Type, style, function, size, label, hand, and finish of each door hardware item.
    - b. Manufacturer of each item.
    - c. Fastenings and other pertinent information.
    - d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
    - e. Explanation of abbreviations, symbols, and codes contained in schedule.
    - f. Mounting locations for door hardware.
    - g. Door and frame sizes and materials.
    - h. Warranty information for each product.
  4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.
- C. Shop Drawings: Details of electrified access control hardware indicating the following:
  1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:

- a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
    - b. Complete (risers, point-to-point) access control system block wiring diagrams.
    - c. Wiring instructions for each electronic component scheduled herein.
  2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.
- D. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.
- E. Informational Submittals:
1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.
- F. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Procedures.

#### 1.4 QUALITY ASSURANCE

- A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.
- B. Certified Products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).
- C. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- D. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.
- E. Automatic Operator Supplier Qualifications: Power operator products and accessories are required to be supplied and installed through the Norton Preferred Installer (NPI) program. Suppliers are to be factory trained, certified, and a direct purchaser of the specified power



operators and be responsible for the installation and maintenance of the units and accessories indicated for the Project.

- F. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.
  - 1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
  - 2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.
- G. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.
- H. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:
  - 1. Function of building, purpose of each area and degree of security required.
  - 2. Plans for existing and future key system expansion.
  - 3. Requirements for key control storage and software.
  - 4. Installation of permanent keys, cylinder cores and software.
  - 5. Address and requirements for delivery of keys.
- I. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.
  - 1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
  - 2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
  - 3. Review sequence of operation narratives for each unique access controlled opening.
  - 4. Review and finalize construction schedule and verify availability of materials.
  - 5. Review the required inspecting, testing, commissioning, and demonstration procedures
- J. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

- B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.
- C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

#### 1.6 COORDINATION

- A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.
- B. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

#### 1.7 WARRANTY

- A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:
  - 1. Structural failures including excessive deflection, cracking, or breakage.
  - 2. Faulty operation of the hardware.
  - 3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
  - 4. Electrical component defects and failures within the systems operation.
- C. Warranty Period: Unless otherwise indicated, warranty shall be one year from date of Substantial Completion.

#### 1.8 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

## **PART 2 - PRODUCTS**

### **2.1 SCHEDULED DOOR HARDWARE**

- A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.
- B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:
  - 1. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.
- C. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

### **2.2 HANGING DEVICES**

- A. Hinges: ANSI/BHMA A156.1 butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.
  - 1. Quantity: Provide the following hinge quantity:
    - a. Two Hinges: For doors with heights up to 60 inches.
    - b. Three Hinges: For doors with heights 61 to 90 inches.
    - c. Four Hinges: For doors with heights 91 to 120 inches.
    - d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.
  - 2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
    - a. Widths up to 3'0": 4-1/2" standard or heavy weight as specified.
    - b. Sizes from 3'1" to 4'0": 5" standard or heavy weight as specified.
  - 3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:
    - a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
    - b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.
  - 4. Hinge Options: Comply with the following:

- a. Non-removable Pins: With the exception of electric through wire hinges, provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the all out-swinging lockable doors.
5. Manufacturers:
  - a. Ives (IV) - 5BB Series, 5 knuckle.
  - b. McKinney (MK) - TA/T4A Series, 5 knuckle.
- B. Continuous Geared Hinges: ANSI/BHMA A156.26 Grade 1-600 continuous geared hinge. with minimum 0.120-inch thick extruded 6063-T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Factory trim hinges to suit door height and prepare for electrical cut-outs.
  1. Manufacturers:
    - a. Ives (IV).
    - b. Pemko (PE).

## 2.3 POWER TRANSFER DEVICES

- A. Concealed Quick Connect Electric Power Transfers: Provide concealed wiring pathway housing mortised into the door and frame for low voltage electrified door hardware. Furnish with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.
  1. Manufacturers:
    - a. Securitron (SU) - EL-CEPT Series.
    - b. Von Duprin (VD) - EPT-10 Series.
- B. Electric Door Wire Harnesses: Provide electric/data transfer wiring harnesses with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number and type of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and from hinge to junction box above the opening. Wire nut connections are not acceptable. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified opening.
  1. Provide one each of the following tools as part of the base bid contract:
    - a. McKinney (MK) - Electrical Connecting Kit: QC-R001.
    - b. McKinney (MK) - Connector Hand Tool: QC-R003.
  2. Manufacturers:
    - a. McKinney (MK) - QC-C Series.

- b. Schlage (SC) - Connect.
- c. Von Duprin (VD) - Connect.

## 2.4 DOOR OPERATING TRIM

### A. Flush Bolts and Surface Bolts: Provide products conforming to ANSI/BHMA A156.3 and A156.16, Grade 1.

1. Flush bolts to be furnished with top rod of sufficient length to allow bolt retraction device location approximately six feet from the floor.
2. Furnish dust proof strikes for bottom bolts.
3. Surface bolts to be minimum 8" in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable.
4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.
5. Manufacturers:
  - a. Rockwood (RO).
  - b. Trimco (TC).

### B. Door Push Plates and Pulls: ANSI/BHMA A156.6 door pushes and pull units of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.

1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.
3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
4. Pulls, where applicable, shall be provided with a 10" clearance from the finished floor on the push side to accommodate wheelchair accessibility.
5. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets.
6. Manufacturers:
  - a. Rockwood (RO).
  - b. Trimco (TC).

## 2.5 CYLINDERS AND KEYING

### A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.

1. Manufacturers:

- a. Sargent Manufacturing (SA).
  - b. No Substitution.
- B. Cylinder Types: Original manufacturer cylinders able to supply the following cylinder formats and types:
  - 1. Threaded mortise cylinders with rings and cams to suit hardware application.
  - 2. Rim cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
  - 3. Bored or cylindrical lock cylinders with tailpieces as required to suit locks.
  - 4. Tubular deadlocks and other auxiliary locks.
  - 5. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
  - 6. Keyway: Match Facility Standard.
- C. Keying System: Each type of lock and cylinders to be factory keyed.
  - 1. Supplier shall conduct a "Keying Conference" to define and document keying system instructions and requirements.
  - 2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
  - 3. Existing System: Field verify and key cylinders to match Owner's existing system.
- D. Key Quantity: Provide the following minimum number of keys:
  - 1. Change Keys per Cylinder: Two (2)
  - 2. Master Keys (per Master Key Level/Group): Five (5).
- E. Key Registration List (Bitting List):
  - 1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
  - 2. Provide transcript list in writing or electronic file as directed by the Owner.

## 2.6 MECHANICAL LOCKS AND LATCHING DEVICES

- A. Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed. Locksets are to be manufactured with a corrosion resistant steel case and be field-reversible for handing without disassembly of the lock body.
  - 1. Manufacturers:
    - a. Sargent Manufacturing (SA) - 8200 Series.
    - b. No Substitution.

## 2.7 LOCK AND LATCH STRIKES

- A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:
1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
  2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
  3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
  4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.
- B. Standards: Comply with the following:
1. Strikes for Mortise Locks and Latches: BHMA A156.13.
  2. Strikes for Bored Locks and Latches: BHMA A156.2.
  3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
  4. Dustproof Strikes: BHMA A156.16.

## 2.8 ELECTROMAGNETIC LOCKING DEVICES

- A. Surface Electromagnetic Locks (Heavy Duty): Electromagnetic locks to be surface mounted type conforming to ANSI A156.23, Grade 2 with minimum holding force strength of 1,200 pounds. Locks to be capable of accepting between 12 to 24 volts direct current and be UL listed for use on fire rated door assemblies. Electromagnetic coils are to consume no more than 1.5W during normal operation. Locks are to have an integrated door position switch, tamper switch, and lock bond sensor. Locks are to have integrated motion sensor and/or security camera as indicated in the hardware sets. Locks to be capable of detecting door prop conditions and entering low power mode. Provide mounting accessories as needed to suit opening conditions. Power supply to be by the same manufacturer as the lock with combined products having a lifetime replacement warranty.
1. Manufacturers:
    - a. Securitron (SU) - M680E Series.

## 2.9 ELECTRIC STRIKES

- A. Standard Electric Strikes: Electric strikes conforming to ANSI/BHMA A156.31, Grade 1, for use on non-rated or fire rated openings. Strikes shall be of stainless steel construction tested to a minimum of 1500 pounds of static strength and 70 foot-pounds of dynamic strength with a minimum endurance of 1 million operating cycles. Provide strikes with 12 or 24 VDC capability, fail-secure unless otherwise specified. Where specified provide latchbolt and latchbolt strike monitoring indicating both the position of the latchbolt and locked condition of the strike.
1. Manufacturers:

a. HES (HS) - 1500/1600 Series.

- B. Provide electric strikes with in-line power controller and surge suppressor by the same manufacturer as the strike with the combined products having a five year warranty.

## 2.10 CONVENTIONAL EXIT DEVICES

- A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:

1. Exit devices shall have a five-year warranty.
2. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.
3. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer's catalog and template book for specific requirements.
4. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.
5. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.
6. Flush End Caps: Provide flush end caps made of architectural metal in the same finish as the devices as in the Hardware Sets. Plastic end caps will not be acceptable.
7. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.
  - a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
  - b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.
8. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.
9. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2" wide stiles.
10. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.



11. Rail Sizing: Provide exit device rails factory sized for proper door width application.
  12. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.
- B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Exit device latch to be stainless steel, pullman type, with deadlock feature.
1. Manufacturers:
    - a. Corbin Russwin Hardware (RU) - ED4000 / ED5000 Series.
    - b. Sargent Manufacturing (SA) - 80 Series.
    - c. Von Duprin (VD) - 35A/98 XP Series.
- C. Extruded Aluminum Removable Mullions: ANSI/BHMA A156.3 anodized, removable mullions with malleable-iron top and bottom retainers. Mullions to be provided standard with stabilizers and imbedded weatherstrip.
1. Manufacturers:
    - a. Same as exit device manufacturer.
- D. Tube Steel Removable Mullions: ANSI/BHMA A156.3 removable steel mullions with malleable-iron top and bottom retainers and a primed paint finish.
1. Provide keyed removable feature where specified in the Hardware Sets.
  2. Provide stabilizers and mounting brackets as required.
  3. Provide electrical quick connection wiring options as specified in the hardware sets.
  4. Manufacturers:
    - a. Same as exit device manufacturer.

## 2.11 ELECTROMECHANICAL EXIT DEVICES

- A. Electromechanical Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed panic and fire exit hardware devices subject to same compliance standards and requirements as mechanical exit devices. Electrified exit devices to be of type and design as specified below and in the hardware sets.
1. Energy Efficient Design: Provide devices which have a holding current draw of 15mA maximum, and can operate on either 12 or 24 volts. Locks are to be field configurable for fail safe or fail secure operation.
  2. Where conventional power supplies are not sufficient, include any specific controllers required to provide the proper inrush current.

3. Motorized Electric Latch Retraction: Devices with an electric latch retraction feature must use motors which have a maximum current draw of 600mA. Solenoid driven latch retraction is not acceptable.
4. Manufacturers:
  - a. Corbin Russwin Hardware (RU) - ED5000 Series.
  - b. Sargent Manufacturing (SA) - 80 Series.
  - c. Von Duprin (VD) - 35A/98 XP Series.

## 2.12 DOOR CLOSERS

### A. All door closers specified herein shall meet or exceed the following criteria:

1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers.
2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
3. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the Americans with Disabilities Act, provide units complying with ANSI ICC/A117.1.
4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
5. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.

### B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Certified Products Directory (CPD) listed surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.

1. Heavy duty surface mounted door closers shall have a 30-year warranty.
2. Manufacturers:
  - a. LCN Closers (LC) - 4040 Series.
  - b. Norton Rixson (NO) - 7500 Series.
  - c. Sargent Manufacturing (SA) - 351 Series.

## 2.13 ELECTROHYDRAULIC DOOR OPERATORS

- A. General: Provide low energy operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; and for compliance with UL 325. Coordinate operator mechanisms with door operation, hinges, and activation devices.
  - 1. Fire-Rated Doors: Provide door operators for fire-rated door assemblies that comply with NFPA 80 for fire-rated door components and are listed and labeled by a qualified testing agency.
- B. Standard: Conforming to ANSI/BHMA A156.19.
- C. Performance Requirements:
  - 1. Opening Force if Power Fails: Not more than 15 lbf required to release a latch if provided, not more than 30 lbf required to manually set door in motion, and not more than 15 lbf required to fully open door.
  - 2. Entrapment Protection: Not more than 15 lbf required to prevent stopped door from closing or opening.
- D. Configuration: Surface mounted or in-ground as required. Door operators to control single swinging and pair of swinging doors.
- E. Operation: Power opening and spring closing operation capable of meeting ANSI A117.1 accessibility guideline. Provide time delay for door to remain open before initiating closing cycle as required by ANSI/BHMA A156.19. When not in automatic mode, door operator to function as manual door closer with fully adjustable opening and closing forces, with or without electrical power.
- F. Features: Operator units to have full feature adjustments for door opening and closing force and speed, backcheck, motor assist acceleration from 0 to 30 seconds, time delay, vestibule interface delay, obstruction recycle, and hold open time from 0 up to 30 seconds.
- G. Provide outputs and relays on board the operator to allow for coordination of exit device latch retraction, electric strikes, magnetic locks, card readers, safety and motion sensors and specified auxiliary contacts.
- H. Brackets and Reinforcements: Manufacturer's standard, fabricated from aluminum with nonferrous shims for aligning system components.
- I. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. LCN Closers (LC) - 4640 Series.
  - 2. Norton Rixson (NO) - 6000 Series.

## 2.14 SURFACE MOUNTED CLOSER HOLDERS

- A. Electromagnetic Door Holders: ANSI A156.15 electromagnetic door holder/releases with a minimum 20 to 40 pounds holding power and single coil construction able to

accommodate.12VDC, 24VAC, 24VDC and 120VAC. Coils to be independently wound, employing an integral fuse and armatures to include a positive release button.

1. Manufacturers:
  - a. LCN Door Closers (LC) - SEM7800 Series.
  - b. Norton Rixson (RF) - 980/990 Series.
  - c. Sargent Manufacturing (SA) - 1560 Series.

## 2.15 ARCHITECTURAL TRIM

### A. Door Protective Trim

1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1" LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.
3. Where plates are applied to fire rated doors with the top of the plate more than 16" above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer's catalog and template book for specific requirements for size and applications.
4. Protection Plates: ANSI/BHMA A156.6 protection plates (kick, armor, or mop), fabricated from the following:
  - a. Stainless Steel: 300 grade, .050-inch thick.
5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.
6. Manufacturers:
  - a. Rockwood (RO).
  - b. Trimco (TC).

## 2.16 DOOR STOPS AND HOLDERS

- A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.
- B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.

1. Manufacturers:

- a. Rockwood (RO).
- b. Trimco (TC).

C. Overhead Door Stops and Holders: ANSI/BHMA A156.8, Grade 1 Certified Products Directory (CPD) listed overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.

1. Manufacturers:

- a. Norton Rixson (RF).
- b. Rockwood (RO).
- c. Sargent Manufacturing (SA).

2.17 ARCHITECTURAL SEALS

A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.

B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.

1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.

C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.

1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NPFA 252, Standard Methods of Fire Tests of Door Assemblies.

D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.

E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

F. Manufacturers:

- 1. National Guard Products (NG).
- 2. Pemko (PE).

## 2.18 ELECTRONIC ACCESSORIES

- A. Key Switches: Key switches furnished standard with stainless steel single gang face plate with a 12/24VDC bi-color LED indicator. Integral backing bracket permits integration with any 1 1/4" or 1 1/2" mortise type cylinder. Key switches available as momentary or maintained action and in narrow face plate options.
1. Manufacturers:
    - a. Alarm Controls (AK) - MCK Series.
    - b. Securitron (SU) - MK Series.
- B. Door Position Switches: Door position magnetic reed contact switches specifically designed for use in commercial door applications. On recessed models the contact and magnetic housing snap-lock into a 1" diameter hole. Surface mounted models include wide gap distance design complete with armored flex cabling. Provide SPDT, N/O switches with optional Rare Earth Magnet installation on steel doors with flush top channels.
1. Manufacturers:
    - a. Sargent Manufacturing (SA) - 3280 Series.
    - b. Security Door Controls (SD) - DPS Series.
    - c. Securitron (SU) - DPS Series.
- C. Intelligent Switching Power Supplies: Provide power supplies with single, dual or multi-voltage configurations at 12 and/or 24VDC. Power Supply shall have battery backup function with an integrated battery charging circuit. The power supply shall have a standard, integrated Fire Alarm Interface (FAI). The power supply shall provide capability for secondary voltage, power distribution, direct lock control and network monitoring through add on modules. The power supply shall be expandable up to 16 individually protected outputs. Output modules shall provide individually protected, continuous outputs and/or individually protected, relay controlled outputs. Network modules shall provide remote monitoring functions such as status reporting, fault reporting and information logging.
1. Provide the least number of units, at the appropriate amperage level, sufficient to exceed the required total draw for the specified electrified hardware and access control equipment.
  2. Manufacturers:
    - a. Securitron (SU) - AQL Series.

## 2.19 FABRICATION

- A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

## 2.20 FINISHES

- A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.
- B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware
- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

### 3.2 PREPARATION

- A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.
- B. Wood Doors: Comply with ANSI/DHI A115-W series.

### 3.3 INSTALLATION

- A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
  - 1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.
- B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
  - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
  - 2. DHI TDH-007-20: Installation Guide for Doors and Hardware.

3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
  4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.
- C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
- D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."
- E. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

### 3.4 FIELD QUALITY CONTROL

- A. Field Inspection (Punch Report): Reference Division 01 Sections "Closeout Procedures". Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.
1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

### 3.5 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

### 3.6 CLEANING AND PROTECTION

- A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.
- B. Clean adjacent surfaces soiled by door hardware installation.



- C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

### 3.7 DEMONSTRATION

- A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

### 3.8 DOOR HARDWARE SETS

- A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.
  - 1. Quantities listed are for each pair of doors, or for each single door.
  - 2. The supplier is responsible for handing and sizing all products.
  - 3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.
  - 4. At existing openings with new hardware the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.
- B. See Door Hardware Sets on Next Page

**Hardware Set 01**

Doors: 308C, S101A, S101E, S102A, S102E

Each to receive:

3	EA	Hinge, Full Mortise, Hvy Wt	5BB1HW 4-1/2" x 4-1/2" 652	Ives
1	EA	Fire Rated Rim Exit	99.LBE.F .626 .996L-BE	Von Duprin
1	EA	Surface Closer	4011 .REGARM .689	LCN Closers
1	EA	Kick Plate	8400 12" x 34" US32D	Ives
1	EA	Wall Stop	WS402CVX 626	Ives

**Hardware Set 02**

Doors: 308A, S101B, S101C, S101D

Each to receive:

3	EA	Hinge, Full Mortise, Hvy Wt	5BB1HW 4-1/2" x 4-1/2" 652	Ives
1	EA	Fire Rated Rim Exit	99.LNL.F .626 .996L-NL	Von Duprin
1	EA	Cylinder	20-757 .626	Schlage
1	EA	Electric Strike	9600 630	HES
1	EA	SMART Pac Bridge Rectifier	2005M3	HES
1	EA	Surface Closer	4111 .EDA .689	LCN Closers
1	EA	Kick Plate	8400 12" x 34" US32D	Ives
1	EA	Wall Stop	WS402CVX 626	Ives
1	EA	Position Switch	679-05HM	Schlage Electronic
1	EA	Reader	MT15-485 .BL	Schlage Electronic

**Hardware Set 03**

Doors: S102B

Each to receive:

1	EA	Electric Strike	9600 630	HES
1	EA	SMART Pac Bridge Rectifier	2005M3	HES
1	EA	Position Switch	679-05HM	Schlage Electronic
1	EA	Reader	MT15-485 .BL	Schlage Electronic

**Hardware Set 04**

Doors: 182C, S102C

Each to receive:

1	EA	Alarm	99 ALK .628	Von Duprin
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**Hardware Set 05**

Doors: 108A

Each to receive:

3	EA	Hinge, Full Mortise, Hvy Wt	5BB1HW 4-1/2" x 4-1/2" 652	Ives
1	EA	Mortise Lock	L9010 .17.A .626	Schlage
1	EA	Surface Closer	4111 .EDA .689	LCN Closers
1	EA	Kick Plate	8400 12" x 34" US32D	Ives
1	EA	Wall Stop	WS402CVX 626	Ives

**Hardware Set 06**

Doors: 107B, 120C, 121C

Each to receive:

3	EA	Hinge, Full Mortise, Hvy Wt	5BB1HW 4-1/2" x 4-1/2" 652	Ives
1	EA	Mortise Lock	L9040 .17.A .626 .OS-OCC	Schlage
1	EA	Overhead Holder/Stop Overhead Stop	104S 630	Glynn-Johnson
1	EA	Kick Plate	8400 12" x 34" US32D	Ives

**Hardware Set 07**

Doors: 111, 114, 119

Each to receive:

3	EA	Hinge, Full Mortise, Hvy Wt	5BB1HW 4-1/2" x 4-1/2" 652	Ives
1	EA	Mortise Lock	L9040 .17.A .626 .OS-OCC	Schlage
1	EA	Surface Closer	4011 .REGARM .689	LCN Closers
1	EA	Kick Plate	8400 12" x 34" US32D	Ives
1	EA	Wall Stop	WS402CVX 626	Ives

**Hardware Set 08**

Doors: 120B, 121B

Each to receive:

3	EA	Hinge, Full Mortise, Hvy Wt	5BB1HW 4-1/2" x 4-1/2" 652	Ives
1	EA	Mortise Lock	L9050 .R .17.A .626	Schlage
1	EA	Overhead Holder/Stop Overhead Stop	104S 630	Glynn-Johnson
1	EA	Kick Plate	8400 12" x 34" US32D	Ives

**Hardware Set 09**

Doors: 120F, 121F

Each to receive:

3	EA	Hinge, Full Mortise, Hvy Wt	5BB1HW 4-1/2" x 4-1/2" 652	Ives
1	EA	Mortise Lock	L9070 .R .17.A .626	Schlage
1	EA	Overhead Holder/Stop Overhead Stop	104S 630	Glynn-Johnson
1	EA	Kick Plate	8400 12" x 34" US32D	Ives

**Hardware Set 10**

Doors: 011, 013, 109, 110, 112, 113, 122

Each to receive:

3	EA	Hinge, Full Mortise, Hvy Wt	5BB1HW 4-1/2" x 4-1/2" 652	Ives
1	EA	Mortise Lock	L9080 .R .17.A .626	Schlage
1	EA	Electric Strike	1006CS 630	HES
1	EA	Surface Closer	4011 .REGARM .689	LCN Closers
1	EA	Kick Plate	8400 12" x 34" US32D	Ives
1	EA	Wall Stop	WS402CVX 626	Ives
1	EA	Position Switch	679-05HM	Schlage Electronic
1	EA	Reader	MT15-485 .BL	Schlage Electronic

**Hardware Set 11**

Doors: 107A, 116, 117

Each to receive:

3	EA	Hinge, Full Mortise, Hvy Wt	5BB1HW 4-1/2" x 4-1/2" 652	Ives
1	EA	Mortise Lock	L9070 .R .17.A .626	Schlage
1	EA	Electric Strike	1006CS 630	HES
1	EA	Surface Closer	4011 .REGARM .689	LCN Closers
1	EA	Kick Plate	8400 12" x 34" US32D	Ives
1	EA	Wall Stop	WS402CVX 626	Ives
1	EA	Position Switch	679-05HM	Schlage Electronic
1	EA	Reader	MT15-485 .BL	Schlage Electronic

**Hardware Set 12**

Doors: 115, 118, 303A

Each to receive:

3	EA	Hinge, Full Mortise, Hvy Wt	5BB1HW 4-1/2" x 4-1/2" 652	Ives
1	EA	Mortise Lock	L9050 .R .17.A .626	Schlage
1	EA	Electric Strike	1006CS 630	HES
1	EA	Surface Closer	4011 .REGARM .689	LCN Closers
1	EA	Kick Plate	8400 12" x 34" US32D	Ives
1	EA	Wall Stop	WS402CVX 626	Ives
1	EA	Position Switch	679-05HM	Schlage Electronic
1	EA	Reader	MT15-485 .BL	Schlage Electronic

**Hardware Set 13**

Doors: 120A, 121A

Each to receive:

3	EA	Hinge, Full Mortise, Hvy Wt	5BB1HW 4-1/2" x 4-1/2" 652	Ives
1	EA	Mortise Lock	L9070 .R .17.A .626	Schlage
1	EA	Electric Strike	1006CS 630	HES
1	EA	Surface Closer	4111 .EDA .689	LCN Closers
1	EA	Kick Plate	8400 12" x 34" US32D	Ives
1	EA	Wall Stop	WS402CVX 626	Ives
1	EA	Position Switch	679-05HM	Schlage Electronic
1	EA	Reader	MT15-485 .BL	Schlage Electronic

**Hardware Set 14**

Doors: 302A, 302B, 308B

Each to receive:

3	EA	Hinge, Full Mortise, Hvy Wt	5BB1HW 4-1/2" x 4-1/2" 652	Ives
1	EA	Rim Exit Device	99.LBE .626 .996L-BE	Von Duprin
1	EA	Surface Closer	4011 .REGARM .689	LCN Closers
1	EA	Kick Plate	8400 12" x 34" US32D	Ives
1	EA	Wall Stop	WS402CVX 626	Ives

**Hardware Set 15**

Doors: 184C, 304B

Each to receive:

3	EA	Hinge, Full Mortise, Hvy Wt	5BB1HW 4-1/2" x 4-1/2" 652	Ives
1	EA	Mortise Lock	L9070 .R .17.A .626	Schlage
1	EA	Surface Closer	4111 .EDA .689	LCN Closers
1	EA	Kick Plate	8400 12" x 34" US32D	Ives
1	EA	Wall Stop	WS402CVX 626	Ives

**Hardware Set 16**

Doors: 303B

Each to receive:

3	EA	Hinge, Full Mortise, Hvy Wt	5BB1HW 4-1/2" x 4-1/2" 652	Ives
1	EA	Mortise Lock	L9070 .R .17.A .626	Schlage
1	EA	Surface Closer	4111 .EDA .689	LCN Closers
1	EA	Kick Plate	8400 12" x 34" US32D	Ives
1	EA	Wall Stop	WS402CVX 626	Ives

**Hardware Set 17**

Doors: 005, 006, 007, 008, 009, 127, 307

Each to receive:

1	EA	Electric Strike	1006CS 630	HES
1	EA	Position Switch	679-05HM	Schlage Electronic
1	EA	Reader	MT15-485 .BL	Schlage Electronic

**Hardware Set 18**

Doors: 184A, 184B

Each to receive:

6	EA	Hinge, Full Mortise, Hvy Wt	5BB1HW 4-1/2" x 4-1/2" 652	Ives
1	EA	Electric Power Transfer	EPT10 .689	Von Duprin
1	EA	Fire Rated Conc Vert Cable	9850WDC.L.F .626 .996L(Std)	Von Duprin
1	EA	Fire Rated Conc Vert Cable	.QEL 9850WDC.L.F .626 .996L(Std)	Von Duprin
1	EA	Cylinder	20-757 .626	Schlage
2	EA	Surface Closer	4111 .SCUSH .689	LCN Closers
2	EA	Kick Plate	8400 12" x 34" US32D	Ives
2	EA	Wall Stop	WS402CVX 626	Ives
2	EA	Position Switch	679-05HM	Schlage Electronic
1	EA	Reader	MT15-485 .BL	Schlage Electronic

**Hardware Set 19**

Doors: 303C, 303D

Each to receive:

6	EA	Hinge, Full Mortise, Hvy Wt	5BB1HW 4-1/2" x 4-1/2" 652	Ives
1	EA	Electric Power Transfer	EPT10 .689	Von Duprin
1	EA	Concealed Vert Cable Exit	9849.L .626 .996L(Std)	Von Duprin
1	EA	Concealed Vert Cable Exit	.QEL 9849.L .626 .996L(Std)	Von Duprin
1	EA	Cylinder	20-757 .626	Schlage
2	EA	Surface Closer	4111 .SCUSH .689	LCN Closers
2	EA	Kick Plate	8400 12" x 34" US32D	Ives
2	EA	Wall Stop	WS402CVX 626	Ives
2	EA	Position Switch	679-05HM	Schlage Electronic
1	EA	Reader	MT15-485 .BL	Schlage Electronic

**Hardware Set 20**

Doors: 304A

Each to receive:

6	EA	Hinge, Full Mortise, Hvy Wt	5BB1HW 4-1/2" x 4-1/2" 652	Ives
1	EA	Dust Proof Strike	DP2 626	Ives
2	EA	Flush Bolt	FB458 626	Ives
1	EA	Mortise Lock	L9070 .R .17.A .626	Schlage
1	EA	Overhead Holder/Stop Overhead Stop	104S 630	Glynn-Johnson
1	EA	Surface Closer	4011 .REGARM .689	LCN Closers
1	EA	Wall Stop	WS402CVX 626	Ives

**Hardware Set 21**

Doors: 128

Each to receive:

1	EA	Electric Strike	1006CS 630	HES
2	EA	Position Switch	679-05HM	Schlage Electronic
1	EA	Reader	MT15-485 .BL	Schlage Electronic

**END OF SECTION**

## **SECTION 08 80 00 - GLAZING**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Glass.
- B. Glazing compounds and accessories.

#### **1.02 RELATED SECTIONS**

- A. Section 07 90 00 - Joint Sealers: Sealant and back-up material.
- B. Section 08 11 00 - Steel Doors and Frames: Glazed doors and borrowed lites.
- C. Section 08 21 01 - Flush Wood Doors: Glazed doors.
- D. Section 08 41 00 - Metal-Framed Storefronts.

#### **1.03 REFERENCES**

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; current edition.
- B. ASTM C 864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 1999 (Reapproved 2005).
- C. ASTM C 920 - Standard Specification for Elastomeric Joint Sealants; 2002.
- D. ASTM C 1036 - Standard Specification for Flat Glass; 2001.
- E. ASTM C 1048 - Standard Specification for Heat-Treated Flat Glass--Kind HS, Kind FT Coated and Uncoated Glass; 2004.
- F. ASTM C 1193 - Standard Guide for Use of Joint Sealants; 2005.
- G. ASTM E 773 - Standard Test Method for Accelerated Weathering of Sealed Insulating Glass Units; 2001.
- H. ASTM E 774 - Standard Specification for the Classification of the Durability of Sealed Insulating Glass Units; 1997.
- I. GANA (GM) - GANA Glazing Manual; Glass Association of North America; 2004.
- J. GANA (SM) - FGMA Sealant Manual; Glass Association of North America; 1990.

#### **1.04 PERFORMANCE REQUIREMENTS**

- A. Provide glass and glazing materials for continuity of building enclosure vapor retarder and air barrier:
  - 1. In conjunction with vapor retarder and joint sealer materials described in other sections.
  - 2. To utilize the inner pane of multiple pane sealed units for the continuity of the air barrier and vapor retarder seal.
  - 3. To maintain a continuous air barrier and vapor retarder throughout the glazed assembly from glass pane to heel bead of glazing sealant.

#### **1.05 SUBMITTALS**

- A. See Section 01300 - Administrative Requirements, for submittal procedures.
- B. Product Data on Glass Types: Provide structural, physical and environmental characteristics, size limitations, special handling or installation requirements.

- C. Product Data on Glazing Compounds: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colors.
- D. Certificates: Certify that products meet or exceed specified requirements.
- E. Manufacturer's Certificate: Certify that insulated types of glass meets or exceeds specified requirements.

#### 1.06 QUALITY ASSURANCE

- A. Perform Work in accordance with GANA Glazing Manual and FGMA Sealant Manual for glazing installation methods.

#### 1.07 PRE-INSTALLATION MEETING

- A. Convene one week before starting work of this section.

#### 1.08 ENVIRONMENTAL REQUIREMENTS

- A. Do not install glazing when ambient temperature is less than 50 degrees F.
- B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

#### 1.09 WARRANTY

- A. See Section 01780 - Closeout Submittals, for additional warranty requirements.
- B. Provide a five (5) year warranty to include coverage for sealed glass units from seal failure, interpane dusting or misting, and replacement of same.

### **PART 2 PRODUCTS**

#### 2.01 FLAT GLASS MATERIALS

- A. Manufacturers:
  - 1. AFG Industries, Inc: [www.afglass.com](http://www.afglass.com).
  - 2. Guardian Glass (Basis of Design - IG):
  - 3. PPG Industries, Inc: [www.ppg.com](http://www.ppg.com).
  - 4. Visteon Glass Systems: [www.visteon.com/floatglass](http://www.visteon.com/floatglass).
  - 5. Substitutions: Refer to Section 01600 - Product Requirements.
- B. Clear Float Glass: Clear, annealed.
  - 1. Comply with ASTM C 1036, Type I, transparent flat, Class 1 clear, Quality Q3 (glazing select).
  - 2. Comply with ASTM C 1048.
  - 3. 6 mm minimum thick.
- C. Safety Glass: Clear; fully tempered with horizontal tempering.
  - 1. Comply with ASTM C 1036, Type I, transparent flat, Class 1 clear, Quality Q3 (glazing select) and ASTM C 1048.
  - 2. Comply with 16 CFR 1201 test requirements for Category II.
  - 3. 6 mm minimum thick.
- D. Low E Glass: Float type, heat strengthened, clear.
  - 1. Comply with ASTM C 1036, Type I, transparent flat, Quality Q3 (glazing select).
  - 2. Comply with ASTM C 1048.
  - 3. 6 mm minimum thick.
- E. Spandrel Glass: Heat strengthened, clear.



1. Ceramic fused frit of solid color as selected by Architect on interior back surface, No. 4.
2. Comply with ASTM C 1036 Type I, transparent flat, Quality Q3.
3. Comply with ASTM C 1048.
4. 6 mm thick.

## 2.02 SEALED INSULATING GLASS MATERIALS

- A. Manufacturers:
1. Any of the manufacturers listed under Flat Glass Materials.
- B. Insulated Glass Units: Double pane with glass to elastomer edge seal.
1. Outer pane of clear glass, inner pane of Low E glass.
  2. Place Low E coating on No. 2 surface within the unit.
  3. Comply with ASTM E 774 and E 773, Class CBA.
  4. Purge interpane space with dry hermetic air.
  5. Total unit thickness of 1 inch minimum.
  6. Visible light transmittance of 68percent, Reflectance out 11%, Reflectance in 12%, U –Value .29 Solar Heat Gain Coefficient .38, Light to Solar Gain 1.80
- C. Insulated Spandrel Glass Units: Double pane with glass to elastomer edge seal.
1. Outer pane of clear glass, inner pane of Spandrel glass.
  2. Place Low E coating on No. 2 surface within the unit.
  3. Comply with ASTM E 774 and E 773, Class CBA.
  4. Purge interpane space with dry hermetic air.
  5. Total unit thickness of 1 inch minimum.

## 2.03 FIRE-RESISTANCE RATED GLASS

- A. Manufacturers:
- a. Pilkington Pyrostop (Basis of Design)
  - b. Firelite
  - c. Safti First
  - d. Substitutions: Refer to Section 01600 - Product Requirements.
- B. Composition: Composed of multiple sheets of "Optiwhite" high visible light transmission glass laminated with an intumescent interlayer. [Most configurations are available with a translucent interlayer for added obscurity and privacy.]
- C. Properties:
- a. Thickness: For Interior Use: 7/8", #60-101
  - b. Weight: Varies with thickness (approximate range 9 to 22 lbs./sq. ft.).
  - c. Approximate Visible Transmission: Varies with thickness (approximate range 88 to 75 percent).
  - d. Fire-rating: 60 minutes.
  - e. Impact Safety Resistance: ANSI Z97.1 and CPSC 16CFR1201 (Cat. I and II).
  - f. STC Rating: Up to 46 dB.
- D. Permanently label each piece of Pilkington Pyrostop® with the appropriate marking.
- E. Fire Rating – 60 Minutes and Greater: Fire rating classified and labeled by UL for fire rating scheduled at opening locations on drawings, when tested in accordance with ASTM E 119 and UL 263.
- F. Substitutions: Refer to Section 01600 - Product Requirements.

## 2.04 FIRE RATED GLASS MATERIALS INSTALLED AS VISION LITES

- A. Manufacturers :
1. (Basis of Design) Fireglass 20 as distributed by Technical Glass Products
  2. Schott
  3. Firelite
  4. Safety First

1. Pilkington
2. Substitutions: Refer to Section 01600 - Product Requirements.

B. Properties:

1. Thickness: 1/4 inch.
2. Weight: 3.0 lbs./sq. ft.
3. Approximate Visible Transmission: 89 percent.
4. Approximate Visible Reflection: 8 percent.
5. Fire-rating: 20 minutes (WITHOUT HOSE STREAM TEST).
6. Impact Safety Resistance: ANSI Z97.1 and CPSC 16CFR1201 (Cat. I and II).

Labeling: Permanently label each piece of Fireglass®20 with the Fireglass®20 logo, UL logo and fire rating in sizes up to 6,396 sq. in.

Fire Rating: Fire rating listed and labeled by UL for fire rating scheduled at opening locations on drawings, when tested in accordance with NPFA 252 and UL10C

## 2.05 SECURITY GLASS MATERIALS

A. Manufacturers:

1. School Guard Glass
2. Thompson I.G. - SchoolDefender

B. Laminated Glass Units: Laminated glass with custom security, heat strengthened, chemically bonded core

1. Product: (Basis of Design) SG5
2. 1/4" thickness. At existing glass to be replaced, field verify thicknesses
3. Comply with ASTM C1036, C1172, ANSI Z97.1, CPSC 16 CFR 1201
4. Ratings: UL 972, 5-aal Rate for 12 min., ASTM F1233 Class 1.4 (Tested to 5 min. of class 1.5 until failure)

C. Insulated Glass Units: Double pane with glass to elastomer edge seal.

1. Product: (Basis of Design) SG5
2. Interior pane: SG5, Exterior pane: clear tempered or laminated
3. 1 1/8" thickness. At existing glass to be replaced, field verify thicknesses.
4. Comply with ASTM C1036, ASTM C1172, ANSI Z97.1, CPSC 16 CFR 1201
5. Ratings: UL 972, 5-aal Rate for 12 min., ASTM F1233 Class 1.4 (Tested to 5 min. of class 1.5 until failure)
6. Purge interpane space with dry hermetic air.

## 2.06 GLAZING COMPOUNDS

A. Manufacturers:

1. Bostik, Inc: [www.bostik-us.com](http://www.bostik-us.com).
2. GE Plastics: [www.geplastics.com](http://www.geplastics.com).
3. Pecora Corporation: [www.pecora.com](http://www.pecora.com).
4. Degussa Building Systems: [www.chemrex.com](http://www.chemrex.com).
5. Substitutions: Refer to Section 01600 - Product Requirements.

B. Butyl Sealant: Single component; ASTM C 920, Grade NS, Class 12-1/2, Uses M and A; Shore A hardness of 10 to 20; black color; non-skinning.

C. Polyurethane Sealant: Single component, chemical curing, non-staining, non-bleeding; ASTM C 920, Type S, Grade NS, Class 25, Uses M, A, and G; Shore A Hardness Range 20 to 35; color as selected.

- D. Silicone Sealant: Single component; neutral curing; capable of water immersion without loss of properties; non-bleeding, non-staining; ASTM C 920, Type S, Grade NS, Class 25, Uses M, A, and G; cured Shore A hardness of 15 to 25; color as selected.

## 2.07 GLAZING ACCESSORIES

- A. Setting Blocks: Neoprene, 80 to 90 Shore A durometer hardness, ASTM C 864 Option I. Length of 0.1 inch for each square foot of glazing or minimum 4 inch x width of glazing rabbet space minus 1/16 inch x height to suit glazing method and pane weight and area.
- B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness, ASTM C 864 Option I. Minimum 3 inch long x one half the height of the glazing stop x thickness to suit application, self adhesive on one face.
- C. Glazing Tape: Preformed butyl compound; 10 to 15 Shore A durometer hardness; coiled on release paper; black color.
  - 1. Manufacturers:
    - a. Pecora Corporation: [www.pecora.com](http://www.pecora.com).
    - b. Saint-Gobain Performance Plastics: [www.plastics.saint-gobain.com](http://www.plastics.saint-gobain.com).
    - c. Substitutions: Refer to Section 01600 - Product Requirements.
- D. Glazing Clips: Manufacturer's standard type.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that openings for glazing are correctly sized and within tolerance.
- B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and ready to receive glazing.

### 3.02 PREPARATION

- A. Clean contact surfaces with solvent and wipe dry.
- B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- C. Prime surfaces scheduled to receive sealant.
- D. Install sealants in accordance with ASTM C 1193 and FGMA Sealant Manual.
- E. Install sealant in accordance with manufacturer's instructions.

### 3.03 INSTALLATION - EXTERIOR WET METHOD (SEALANT AND SEALANT)

- A. Place setting blocks at 1/4 points and install glazing pane or unit.
- B. Install removable stops with glazing centered in space by inserting spacer shims both sides at 24 inch intervals, 1/4 inch below sight line.
- C. Fill gaps between glazing and stops with sealant to depth of bite on glazing, but not more than 3/8 inch below sight line to ensure full contact with glazing and continue the air and vapor seal.
- D. Apply sealant to uniform line, flush with sight line. Tool or wipe sealant surface smooth.

### 3.04 INSTALLATION - INTERIOR WET METHOD (COMPOUND AND COMPOUND)

- A. Install glazing resting on setting blocks. Install applied stop and center pane by use of spacer shims at 24 inch centers, kept 1/4 inch below sight line.

- B. Locate and secure glazing pane using glazers' clips.
- C. Fill gaps between glazing and stops with glazing compound until flush with sight line. Tool surface to straight line.

### 3.05 CLEANING

- A. Remove glazing materials from finish surfaces.
- B. Remove labels after Work is complete.
- C. Clean glass and adjacent surfaces.

**END OF SECTION 08 80 00**

**SECTION 09 21 16**  
**GYPSUM BOARD ASSEMBLIES**

**PART 1 - GENERAL**

**1.01 SECTION INCLUDES**

- A. Metal stud wall framing.
- B. Metal channel ceiling framing.
- C. Metal drywall suspension system.
- D. Metal drywall acoustic suspension system.
- E. Fire rated walls.
- F. Gypsum wallboard.
- G. Joint treatment and accessories.

**1.02 RELATED SECTIONS**

- B. Section 04 22 00 – Concrete Unit Masonry
- C. Section 05 40 00 - Cold Formed Metal Framing: Exterior wind-load-bearing metal stud framing.
- D. Section 07 21 00 - Board and Batt Insulation: Thermal and acoustic insulation.
- E. Section 07 90 00 - Joint Sealers: Acoustic sealant.

**1.03 REFERENCES**

- A. AISI SG02-1 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2001 with 2004 supplement. (replaced SG-971)
- B. AISI SG-971 - Specification for the Design of Cold-Formed Steel Structural Members; 1996, with 2000 Supplement.
- C. ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2004a.
- D. ASTM C 475/C 475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2002.
- E. ASTM C 645 - Standard Specification for Nonstructural Steel Framing Members; 2004a.
- F. ASTM C 754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2004.
- G. ASTM C 840 - Standard Specification for Application and Finishing of Gypsum Board; 2004a.
- H. ASTM C 954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2004.
- I. ASTM C 1002 - Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2004.

- J. ASTM C 1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base; 2004.
- K. ASTM C 1177/C 1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2004.
- L. ASTM C 1396/C 1396M - Standard Specification for Gypsum Board; 2004.
- M. ASTM D 226 - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing; 1997a.
- N. ASTM D 3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2000.
- O. GA-226 - Application of Gypsum Board to Form Curved Surfaces; Gypsum Association; 1996.
- P. GA-600 - Fire Resistance Design Manual; Gypsum Association; 2003.

#### 1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on metal framing, gypsum board, glass mat faced gypsum board, accessories, and joint finishing system.
- C. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

#### 1.05 QUALITY ASSURANCE

- A. Perform in accordance with ASTM C 840. Comply with requirements of GA-600 for fire-rated assemblies.
- B. Applicator Qualifications: Company specializing in performing gypsum board application and finishing, with minimum 3 years of documented experience.

#### 1.06 REGULATORY REQUIREMENTS

- A. Conform to applicable code for fire rated assemblies as indicated on drawings.

### **PART 2 - PRODUCTS**

#### 2.01 METAL FRAMING MATERIALS

- A. Manufacturers - Metal Framing, Connectors, and Accessories:
  - 1. Clark Steel Framing Systems: [www.clarksteel.com](http://www.clarksteel.com).
  - 2. Dale/Incor: [www.daleincor.com](http://www.daleincor.com).
  - 3. Dietrich Metal Framing: [www.dietrichindustries.com](http://www.dietrichindustries.com).
  - 4. Marino-Ware: [www.marinoware.com](http://www.marinoware.com).
  - 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Metal Framing Connectors and Accessories:
  - 1. Same manufacturer as framing.
  - 2. The Steel Network Inc: [www.SteelNetwork.com](http://www.SteelNetwork.com).
  - 3. Substitutions: See Section 01 60 00 - Product Requirements.

- C. Non-Loadbearing Framing System Components: ASTM C 645; galvanized sheet steel, of size and properties necessary to comply with ASTM C 754 for the spacing indicated, with maximum deflection of wall framing of L/240 at 5 psf.
  - 1. Studs: "C" shaped with flat or formed webs.
  - 2. Runners: U shaped, sized to match studs.
  - 3. Ceiling Channels: C shaped.
  - 4. Furring: Hat-shaped sections, minimum depth of 7/8 inch.
- D. Loadbearing Studs for Application of Gypsum Board: As specified in Section 05 40 00.
- E. Ceiling Hangers: Type and size as specified in ASTM C 754 for spacing required.
- F. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection using slotted holes, screws and anti-friction bushings, preventing rotation of studs while maintaining structural performance of partition.
  - 1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI North American Specification for the Design of Cold-Formed Steel Structural Members.
  - 2. Material: ASTM A 653/A 653M steel sheet, SS Grade 50, with G60/Z180 hot dipped galvanized coating.
  - 3. Provide components UL-listed for use in UL-listed fire-rated head of partition joint systems indicated on drawings.
  - 4. Provide top track preassembled with connection devices spaced to fit stud spacing indicated on drawings; minimum track length of 12 feet.

## 2.02 METAL DRYWALL SUSPENSION SYSTEM

- A. Manufacturers:
  - 1. Armstrong World Industries, Inc (Basis of Design)
  - 2. USG
  - 3. Rockfon.
  - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Components:
  - 1. Main Beam: Shall be double-web construction (minimum 0.0179 inch prior to protective coating, ASTM C645), hot dipped galvanized (per ASTM A653).
    - a. HD8906/HD890610: 1-11/16 inch web height, 1-1/2 inch flange, available with G40 or G90 hot dipped galvanization.
    - b. HD8906IIC (at acoustic assembly): 1-11/16 inch web height, 1-1/2 inch flange, IIC knockouts every 8" along main shall be provided to accept Impact Isolation Clips (IIC)
  - 2. Primary Cross Tees: Shall be double-web steel construction (minimum 0.0179 inch prior to protective coating, ASTM C645), hot dipped galvanized (minimum G40 or G90 per ASTM A653)
    - a. XL8945P: 48 inch, web height 1-1/2 inch with rectangular bulb and pre-finished 1-1/2 inch knurled flange
  - 3. Framing Angles
  - 4. Transition Molding: Drywall to Acoustical ceiling. Pre-Painted Armstrong Global White integral acoustical flange and drywall taping flange, hot dipped cold rolled steel.
  - 5. Drywall Grid Hanger Clip (DGHC) for attachment of suspended ceiling system below.
  - 6. Impact Isolation Clips (IIC) shall be provided at suspended acoustic ceiling assemblies.

## 2.03 GYPSUM BOARD MATERIALS

- A. Manufacturers:
  - 1. G-P Gypsum Corporation: [www.gp.com/build](http://www.gp.com/build).

2. National Gypsum Company: [www.nationalgypsum.com](http://www.nationalgypsum.com).
  3. USG: [www.usg.com](http://www.usg.com).
  4. BPB America Inc.: [www.bpb-na.com](http://www.bpb-na.com)
  5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Gypsum Wallboard: ASTM C 1396/C 1396M. Sizes to minimize joints in place; ends square cut.
1. Special Type X: Fire resistant in excess of ASTM C 1396/C 1396M requirements, UL or WH rated.
    - a. Application: Where required for fire-rated assemblies, unless otherwise indicated.
    - b. Thickness: 1/2 inch, 5/8 inch, as indicated.
    - c. Edges: Tapered.
  2. Ceiling Board: Special sag-resistant type.
    - a. Application: Ceilings, unless otherwise indicated.
    - b. Thickness: 1/2 inch, 5/8 inch, as indicated.
    - c. Edges: Tapered.
  3. Abuse-Resistant Type: Gypsum wallboard especially formulated for increased impact resistance, with enhanced gypsum core and heavy duty face and back paper.
    - a. Application: See Drawings and min. 48" A.F.F. at hallways, corridors, and common areas.
    - b. Core Type: Regular and Type X, as indicated.
    - c. Thickness: 1/2 inch, 5/8 inch, as indicated.
    - d. Edges: Tapered.
  3. Acoustically Enhanced Gypsum Wallboard – Basis of Design: Gold Bond 5/8" Soundbreak
    - a. Application: STC Rated Walls, See wall type legend.
    - b. Core Type: Layer of Viscoelastic Dampening Polymer sandwiched between two layers of mold-resistant gypsum board.
    - c. Thickness: 5/8 inch, as indicated.
    - d. Edges: Tapered.
- C. Water-Resistant Gypsum Backing Board: ASTM C 1396/C 1396M; ends square cut.
1. Application: Vertical surfaces behind thinset tile, except in wet areas.
  2. Edges: Tapered.
- D. Exterior Gypsum Soffit Board: ASTM C 1396/C 1396M; sizes to minimize joints in place; ends square cut.
1. Application: Ceilings and soffits in protected exterior areas, unless otherwise indicated.
  2. Core Type: Regular.
  3. Thickness: 1/2 inch, 5/8 inch, as indicated.
  4. Edges: Tapered.

## 2.04 FIBERGLASS FACED BOARD MATERIALS

- A. Glass Mat Faced Gypsum Board: Gypsum panels with moisture-resistant core and coated inorganic fiberglass mat back surface designed to resist growth of mold and mildew, per ASTM D 3273.
1. Fiberglass Mat Faced Board: Comply with performance requirements of ASTM C 1396/C 1396M for water-resistant gypsum backing board and ASTM C 1177/C 1177M for sheathing; tapered long edges.
    - a. Standard Type: Thickness 5/8 inch.
    - b. For use as exterior wall sheathing behind masonry veneer.
    - c. For use as exterior wall sheathing behind exterior insulation finish system.

## 2.05 ACCESSORIES



- A. Acoustic Insulation: As specified in Section 07 21 00.
- B. Air and Moisture Barrier: As specified in Section 07 25 00.
- C. Acoustic Sealant: As specified in Section 07 90 00.
- D. Building Paper: Asphalt impregnated, No. 15 building felt, conforming to ASTM D 226, Type I.
- E. Finishing Accessories: ASTM C 1047, galvanized steel or rolled zinc, unless otherwise indicated.
  - 1. Types: As detailed or required for finished appearance.
  - 2. Special Shapes: In addition to conventional cornerbead and control joints, provide U-bead at exposed panel edges.
- F. Joint Materials: ASTM C 475 and as recommended by gypsum board manufacturer for project conditions.
  - 1. Tape: 2 inch wide, coated glass fiber tape for joints and corners, except as otherwise indicated.
  - 2. Ready-mixed vinyl-based joint compound.
  - 3. Chemical hardening type compound.
- G. High Build Drywall Surfer: Vinyl acrylic latex-based coating for spray application, designed to take the place of skim coating and separate paint primer in achieving increased abrasion and impact resistance.
  - 1. Product: Tuff-Hide manufactured by USG Abuse-Resistant Systems.
- H. Screws: ASTM C 1002; self-piercing tapping type.
- I. Screws: ASTM C 954; steel drill screws for application of gypsum board to loadbearing steel studs.
- J. If adhesives are used, see the applicable LEED-NC 2009 Reference Guide for the most current VOC limits for adhesives. This project is not pursuing LEED certification.

### **PART 3 - EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that project conditions are appropriate for work of this section to commence.

#### **3.02 FRAMING INSTALLATION**

- A. Metal Framing: Comply with ASTM C 754 and manufacturer's instructions.
- B. Suspended Ceilings and Soffits: Space framing and furring members as indicated.
  - 1. Level ceiling system to a tolerance of 1/600.
  - 2. Laterally brace entire suspension system.
  - 3. Install bracing as required at exterior locations to resist wind uplift.
- C. Studs: Space studs as indicated.
  - 1. Extend partition framing to structure in all locations and provide diagonal bracing as necessary to maintain wall deflection requirements.
  - 2. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
  - 3. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.

- D. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.
- E. Standard Wall Furring: Install at masonry walls scheduled to receive gypsum board, not more than 4 inches from floor and ceiling lines and abutting walls. Secure in place on alternate channel flanges at maximum 24 inches on center.
  - 1. Orientation: Horizontal.
  - 2. Spacing: As permitted by standard.
- F. Acoustic Furring: Install resilient channels at maximum 24 inches on center. Locate joints over framing members.
- G. Furring for Fire Ratings: Install as required for fire resistance ratings indicated and to GA-600 requirements.
- H. Blocking: Install blocking for support of plumbing fixtures, toilet partitions, wall cabinets, toilet accessories, hardware, and countertops. Bolt or screw steel channels to studs.

### 3.03 ACOUSTIC ACCESSORIES INSTALLATION

- A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
- B. Acoustic Sealant: Install in accordance with manufacturer's instructions.
  - 1. Place one bead continuously on substrate before installation of perimeter framing members.
  - 2. Place continuous bead at perimeter of each layer of gypsum board.
  - 3. In non-fire-rated construction, seal around all penetrations by conduit, pipe, ducts, and rough-in boxes.

### 3.04 GYPSUM BOARD AND GLASS MAT FACED BOARD INSTALLATION

- A. Comply with ASTM C 840 and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
- B. Single-Layer Non-Rated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.
  - 1. Exception: Tapered edges to receive joint treatment at right angles to framing.
- C. Double-Layer Non-Rated: Use gypsum board for first layer, placed parallel to framing or furring members, with ends and edges occurring over firm bearing. Use glass mat faced gypsum board at exterior walls and at other locations as indicated. Place second layer perpendicular to framing or furring members. Offset joints of second layer from joints of first layer.
- D. Fire-Rated Construction: Install gypsum board in strict compliance with requirements of listing authority.
- E. Gypsum Soffit Board: Install perpendicular to framing, with staggered end joints over framing members or other solid backing.
- F. Glass Mat Faced Gypsum Board: Install in strict accordance with manufacturer's instructions.
- G. Installation on Metal Framing: Use screws for attachment of all gypsum board except face layer of non-rated double-layer assemblies, which may be installed by means of adhesive lamination.
- H. Curved Surfaces: Apply gypsum board to curved substrates in accordance with GA-226.

- I. Moisture Protection: Treat cut edges and holes in moisture resistant gypsum board and exterior gypsum soffit board with sealant.

### 3.05 INSTALLATION OF TRIM AND ACCESSORIES

- A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
  - 1. Not more than 30 feet apart on walls and ceilings over 50 feet long – unless noted otherwise.
  - 2. At exterior soffits, not more than 30 feet apart in both directions, unless noted otherwise.
- B. Corner Beads: Install at external corners, using longest practical lengths.
- C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials and as indicated.

### 3.06 JOINT TREATMENT

- A. Glass Mat Faced Gypsum Board: Use fiberglass joint tape, bedded and finished with chemical hardening type joint compound.
- B. Paper Faced Gypsum Board: Use fiberglass joint tape, bedded with ready-mixed vinyl-based joint compound and finished with ready-mixed vinyl-based joint compound.
- C. Finish gypsum board in scheduled areas in accordance with levels defined in ASTM C 840 and as scheduled below.
- D. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
  - 1. Feather coats of joint compound so that camber is maximum 1/32 inch.
  - 2. Taping, filling, and sanding is not required at surfaces behind fixed cabinetry and full-height backsplashes.
  - 3. Taping, filling and sanding is not required at base layer of double layer applications.
- E. Spray apply high build drywall surfacer over entire surface after joints have been properly treated to achieve Level 5 finish in areas indicated.

### 3.07 TOLERANCES

- A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

### 3.08 FINISH LEVEL SCHEDULE

- A. Level 1: Above finished ceilings concealed from view.
- B. Level 2: Utility areas and areas behind cabinetry.
- C. Level 3: Walls scheduled to receive textured wall finish.
- D. Level 4: Walls and ceilings scheduled to receive flat or eggshell paint finish.
- E. Level 5: Walls and ceilings scheduled to receive semi-gloss or gloss paint finish.

**END OF SECTION 09 21 16**

## SECTION 09 30 00

### TILING

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Porcelain tile.
- B. Cementitious backer board as tile substrate.
- C. Tiling accessories.

##### 1.02 RELATED SECTIONS

- A. Section 07900 - Joint Sealers.

##### 1.03 REFERENCES

- A. ANSI A108 Series/A118 Series/A136.1 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium).
- B. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar.
- C. ANSI A108.1b - American National Standard Specifications for Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex Portland Cement Mortar.
- D. ANSI A108.1c - American National Standard Specifications; Contractors' Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar -or- Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex Portland Cement Mortar.
- E. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesives or Water Cleanable Tile Setting Epoxy Adhesive.
- F. ANSI A108.5 - American National Standard Specifications for Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar.
- G. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy.
- H. ANSI A108.7 - American National Standard Specification for Electrically Conductive Ceramic Tile Installed with Conductive Dry-Set Portland Cement Mortar.
- I. ANSI A108.8 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant Furan Mortar and Grout.
- J. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout.
- K. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework.
- L. ANSI A108.11 - American National Standard for Interior Installation of Cementitious Backer Units.
- M. ANSI A118.1 - American National Standard Specifications for Dry-Set Portland Cement Mortar.
- N. ANSI A118.2 - American National Standard Specifications for Conductive Dry-Set Portland Cement Mortar.
- O. ANSI A118.3 - American National Standard Specifications for Chemical Resistant, Water Cleanable Tile Setting and Grouting Epoxy and Water Cleanable Tile Setting Epoxy Adhesive.
- P. ANSI A118.4 - American National Standard Specifications for Latex-Portland Cement Mortar.
- Q. ANSI A118.5 - American National Standard Specifications for Chemical Resistant Furan Mortars and Grouts for Tile Installation.
- R. ANSI A118.6 - American National Standard Specifications for Ceramic Tile Grouts.
- S. ANSI A118.8 - American National Standard Specifications for Modified Epoxy Emulsion Mortar Grout.
- T. ANSI A118.9 - American National Standard Specifications for Cementitious Backer Units.
- U. ANSI A136.1 - American National Standard for Organic Adhesives for Installation of Ceramic Tile.
- V. ANSI A137.1 - American National Standard Specifications for Ceramic Tile.

##### 1.04 SUBMITTALS

- A. See Section 01300 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate tile layout.
- C. Product Data: Provide instructions for using grouts and adhesives.
- D. Samples: Mount tile and apply grout on two plywood panels, 8x8 inch in size illustrating pattern, color variations, and grout joint size variations.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Maintenance Data: Include recommended cleaning methods, cleaning materials, stain removal methods, and polishes and waxes.

#### 1.05 QUALITY ASSURANCE

- A. Material Source: Furnish each type, finish, and color of tile product and accessory materials from a single supplier.
- B. Maintain one copy of TCA Handbook and ANSI A108 Series/A118 Series on site.
- 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 three years experience.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store tile products and setting materials in manufacturer's sealed packages. Protect material from damage and store in dry location.
- B. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

#### 1.07 ENVIRONMENTAL REQUIREMENTS

- A. Do not install adhesives in an unventilated environment.
- B. Maintain ambient and substrate temperature of 50 degrees F during installation of mortar materials.

#### 1.08 EXTRA MATERIALS

- A. Deliver supply of maintenance materials to the owner. Furnish maintenance materials from same lot as materials installed, and enclosed in protective packaging with appropriate identifying labels.
  - 1. Furnish not less than 2 percent of total product installed maintenance stock for each type, color, pattern, and size of tile product installed.

### **PART 2 PRODUCTS**

#### 2.01 PORCELAIN TILE MATERIALS

- A. Manufacturers: All products by the same manufacturer.
  - 1. Americal Olean
  - 2. Dal-Tile
  - 3. Crossville
  - 4. Virginia Tile
  - 5. Substitutions: See Section 01 60 00 - Product Requirements
- B. Porcelain Tile (ANSI A137.1), conforming to the following:
  - 1. Moisture Absorption: 0 to 0.5 percent
  - 2. Size, Thickness and Shape: Refer to Drawings
  - 3. Edge: Refer to Drawings
  - 4. Color: to be selected by the architect. Refer to Finish Legend and Plans
  - 5. Trim Units: Refer to drawings.

## 2.02 WATERPROOF MEMBRANE

- A. Provide an anti-fracture waterproof membrane beneath the mortar bond coat of all ceramic tile to be installed on floor areas of Locker rooms, toilet rooms, kitchens, and other wet areas.
- B. Products similar or equal to: TEC "HydraFlex Waterproofing and Crack Isolation Membrane.

## 2.03 ADHESIVE MATERIALS

- A. Organic Adhesive: ANSI A136.1, thinset bond type; use Type I in areas subject to prolonged moisture exposure.
- B. Epoxy Adhesive: ANSI A118.3, thinset bond type.
- C. Tile Setting Adhesive: Elastomeric, waterproof, liquid applied.

## 2.04 MORTAR MATERIALS

- A. Manufacturers:
  - 1. Manufacturers: Products of the following manufacturers, provided they comply with requirements of the contract documents will also be considered acceptable:
    - a. Bostik.
    - b. H.B. Fuller, Inc.
    - c. Laticrete International, Inc.
    - d. Mapei
    - e. W. R. Bonsal Company.
- B. Mortar Bed Materials: Portland cement, sand, latex additive, polyvinyl acetate or ethylene vinyl acetate, and water.
- C. Mortar Bond Coat Materials:
  - 1. Dry-Set Portland Cement type: ANSI A118.1.
  - 2. Latex-Portland Cement type: ANSI A118.4.

## 2.05 GROUT MATERIALS

- A. Manufacturers: Products of the following manufacturers, provided they comply with requirements of the contract documents, will also be considered acceptable:
  - 1. "Hydroment" by Bostik.
  - 2. Laticrete International, Inc.
  - 3. "UltraColor" by Mapei
  - 4. "TEC" by H.B. Fuller Company
  - 5. W. R. Bonsal Company.
- B. Standard Grout: Latex-Portland cement type as specified in ANSI A118.6.
  - 1. Locations for use: Grouting of floor and wall tile.
  - 2. All components premeasured and prepackaged.
  - 3. Dry latex additive: Polyvinyl acetate or ethylene vinyl acetate.
  - 4. Liquid latex additive: Manufacturer's standard water emulsion.
  - 5. Mix in accordance with manufacturer's recommendations.
  - 6. Colors: Selected by Architect, after contract award, from manufacturer's standards.

## 2.06 ACCESSORY MATERIALS

- A. Reinforcing Mesh: 2 x 2 inch size weave of 16/16 wire size; welded fabric, galvanized.
- B. Cementitious Backer Board: ANSI A118.9; High density, cementitious, glass fiber reinforced, 1/2 inch thick; 2 inch wide coated glass fiber tape for joints and corners.
- C. Edge strips; fabricated from the following material with 1/8 inch wide exposed edge, and means for securing strip to substrate: Zinc alloy.
- D. Tile Cleaner: Product specifically acceptable to tile manufacturer and grout manufacturer for

- application indicated and as recommended by National Tile Promotion Federation or Ceramic Tile Institute.
- E. Slate reducer strips.
  - F. Aluminum Transition Moldings: Finish to be selected by Architect
    - 1. Floor-to-wall: Schluter DILEX-AHK
    - 2. Inside Corner: Schluter DILEX-AHK
    - 3. Outside Corner: Schluter QUADEC
    - 4. Mitered Corner: Schluter FINEC
    - 5. Tile Edging: Schluter QUADEC
    - 6. Contractor shall be responsible for compatible transitions accessories offer by manufacturer between molding.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify with the installer that substrate areas where tile is to be installed have been prepared correctly, and that all backing materials have been installed. Correct unacceptable conditions before start of tile work.
- B. Verify that wall surfaces are smooth and flat within tolerances specified in Section 09260, are dust-free, and are ready to receive tile.
- C. Verify that sub-floor surfaces are dust-free, and free of substances which would impair bonding of setting materials to sub-floor surfaces.
- D. Verify that concrete sub-floor surfaces are ready for tile installation by testing for moisture emission rate and alkalinity; obtain instructions if test results are not within the following limits:
  - 1. Moisture emission rate: Not greater than 3 lb per 1000 sq ft per 24 hours when tested using calcium chloride moisture test kit for 72 hours.
  - 2. Alkalinity: pH range of 5-9.
- E. Verify that required floor-mounted utilities are in correct location.

#### **3.02 PREPARATION**

- A. Factory-Blending: Before start of installation, verify that tile with an anticipated range of colors has been correctly blended to achieve a uniform color range from tile package to tile package.
- B. Protect surrounding work from damage.
- C. Vacuum clean surfaces and damp clean.
- D. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.
- E. Install cementitious backer board in accordance with ANSI A108.11 and board manufacturer's instructions. Tape joints and corners, cover with skim coat of dry-set mortar to a feather edge.
- F. Prepare substrate surfaces for adhesive installation in accordance with adhesive manufacturer's instructions.

#### **3.03 INSTALLATION - GENERAL**

- A. Install tile and thresholds and grout in accordance with applicable requirements of ANSI A108.1 through A108.10, manufacturer's instructions, and TCA Handbook recommendations.
- B. Installation Methods: Comply with TCA "Handbook for Ceramic Tile Installation" for type of applications indicated.
- C. Install tile under or behind equipment and fixtures.
- D. Joint Patterns: Lay out tile according to patterns indicated on drawings, or if not shown, in a grid pattern with floor joints aligning with wall and trim joints. Install joints straight and of uniform width.
  - 1. Joint width for porcelain tiles: 1/8" to a maximum of 3/16".
- E. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.
- F. Place edge strips at exposed tile edges.
- G. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases

- neatly. Align floor and base joints.
- H. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make joints watertight, without voids, cracks, excess mortar, or excess grout.
  - I. Form internal angles square and external angles bullnosed.
  - J. Install ceramic accessories rigidly in prepared openings.
  - K. Sound tile after setting. Replace hollow sounding units.
  - L. Keep control joints free of adhesive or grout. Apply sealant to joints.
  - M. Allow tile to set for a minimum of 48 hours prior to grouting.
  - N. Grout tile joints. Use standard grout unless otherwise indicated.
  - O. Apply sealant to junction of tile and dissimilar materials and junction of dissimilar planes.
  - P. Sealant-Filled Joints: Install expansion, control, and isolation joints where indicated on drawings.
    - 1. Expansion joint installation method: TCA EJ 171.
    - 2. Joint spacing: Install per TCA (The Tile Council of America) standard requirements.
    - 3. Required joint location: Locate and saw-cut joint directly over joints in concrete substrate and equally spaced between if required per TCA spacing requirements.
  - Q. Grout Installation Standards:
    - 1. Ceramic tile grouts (sanded cement, dry-set, commercial cement, and latex-cement): ANSI A108.10.
    - 2. Chemical-resistant, water-cleanable epoxy grout: ANSI A108.6. .
  - R. Edge Strips: Install where indicated and where exposed edge of tile meets other finishes flush with top of tile.
  - S. Floor Drains @ Thin-Set Floor Tile Applications: This contractor to coordinate with concrete slab contractor that floors shall slope a minimum of 1/2" to floor drain location in a 24" radius around floor drain.

### 3.04 INSTALLATION - FLOORS - THIN-SET METHODS

- A. Over exterior concrete substrates, install in accordance with TCA Handbook Method F102, with standard grout.
- B. Over interior concrete substrates, install in accordance with TCA Handbook Method F113, dry-set or latex-portland cement bond coat, with standard grout, unless otherwise indicated.
  - 1. Where waterproofing membrane is indicated, install in accordance with TCA Handbook Method F122, with latex-portland cement grout.
  - 2. Where epoxy bond coat and grout are indicated, install in accordance with TCA Handbook Method F131.
    - a. Bond coat: Latex-portland cement mortar, ANSI A108.5.
  - 3. Grout: Chemical-resistant epoxy resin.
  - 4. Where furan bond coat and grout are indicated, install in accordance with TCA Handbook Method F133.
  - 5. Where epoxy or furan grout is indicated, but not epoxy or furan bond coat, install in accordance with TCA Handbook Method F115.
- C. Over interior structural glazed tile, install in accordance with TCA recommendations..

### 3.05 INSTALLATION - FLOORS - MORTAR BED METHODS

- A. Over exterior concrete substrates, install in accordance with TCA F101, bonded, with standard grout.
- B. Over interior concrete substrates, install in accordance with TCA Handbook Method F112, bonded, unless otherwise indicated.
  - 1. Mortar bed: Portland cement mortar, ANSI A108.1.
  - 2. Bond coat: Latex-portland cement mortar, ANSI A108.5.
- C. Grout: Chemical-resistant epoxy resin.
  - 1. Where waterproofing membrane is indicated, with standard grout or no mention of grout type, install in accordance with TCA Handbook Method F121.
  - 2. Where epoxy bond coat and grout are indicated, install in accordance with TCA Handbook Method F132, bonded.



3. Where conductive tile are indicated, install in accordance with TCA Handbook Method F125, bonded.
4. Where epoxy or furan grout is indicated, but not epoxy or furan bond coat, install in accordance with TCA Handbook Method F114, with cleavage membrane.
- D. Cleavage Membrane: Lap edges and ends.
- E. Mortar Bed Thickness: 5/8 inch, unless otherwise indicated.

### 3.06 INSTALLATION - WALL TILE

- A. On exterior walls install in accordance with TCA Handbook Method W244, thin-set over cementitious backer units, with waterproofing membrane.
  1. Bond coat: Latex-portland cement mortar, ANSI A108.5.
- B. Over cementitious backer units install in accordance with TCA Handbook Method W244, using membrane at toilet rooms.
- C. Over gypsum wallboard on wood or metal studs install in accordance with TCA Handbook Method W243, thin-set with dry-set or latex-portland cement bond coat, unless otherwise indicated.
  1. Where mortar bed is indicated, install in accordance with TCA Handbook Method W222, one coat method.
  2. Where waterproofing membrane is indicated other than at showers and bathtub walls, install in accordance with TCA Handbook Method W222, one coat method.
- D. Over interior concrete and masonry install in accordance with TCA Handbook Method W202, thin-set with dry-set or latex-portland cement bond coat.
- E. Over metal studs without backer install in accordance with TCA Handbook Method W241, mortar bed, with membrane where indicated.

### 3.07 CLEANING

- A. Clean tile and grout surfaces.
  1. Wipe latex residue from tile with a damp cloth or sponge as soon as possible after tile installation as per tile / grout manufacturer directions.
- B. Replace any broken, chipped, marred, or otherwise damaged tile before final acceptance.

### 3.08 PROTECTION OF FINISHED WORK

- A. Overlay completed tile installation with kraft paper for protection from subsequent construction activities.
- B. Do not permit traffic over finished floor surface for 7 days after installation.
- C. Remove protection, rinse, and dry tile installations per manufacturer directions before final review and acceptance.

**END OF SECTION 09 30 00**

**SECTION 09 51 00**

**SUSPENDED ACOUSTICAL CEILINGS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Suspended metal grid ceiling system.
- B. Acoustical units.

**1.02 RELATED SECTIONS**

- A. Section 28 31 01 - Fire Alarm System: Fire alarm components in ceiling system.
- B. Section 21 13 00 - Fire Suppression Sprinkler Systems: Sprinkler heads in ceiling system.
- C. Section 23 37 00 - Air Outlets and Inlets: Air diffusion devices in ceiling.
- D. Section 26 51 00 - Interior Lighting: Light fixtures in ceiling system.
- E. Section 27 31 01 - Communication System: Speakers in ceiling system.

**1.03 REFERENCES**

- A. ASTM C 635 - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2004.
- B. ASTM C 636 - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels; 2004.
- C. ASTM E 580 - Standard Practice for Application of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Requiring Seismic Restraint; 2002.
- D. ASTM E 1264 - Standard Classification for Acoustical Ceiling Products; 1998.

**1.04 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on suspension system components and acoustical units.
- C. Samples: Submit two samples 12 x 12 inch in size illustrating material and finish of acoustical units.
- D. Manufacturer's Installation Instructions: Indicate special procedures.

**1.05 SURPLUS MATERIALS**

- A. 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: Provide 5 percent of total acoustical unit area of each type of acoustical unit for the owners 's use in maintenance of project. At minimum, furnish to Owner any opened cartons and two (2) unopened cartons for each ceiling tile type.
  - 2. Exposed Suspension System Components: Furnish quantity of each exposed suspension component equal to 2.0 percent of amount installed.

#### 1.06 QUALITY ASSURANCE

- A. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- B. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

#### 1.07 ENVIRONMENTAL REQUIREMENTS

- A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

#### 1.08 PROJECT CONDITIONS

- A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
- B. Install acoustical units after interior wet work is dry.

#### 1.09 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
  - 2. Grid System: Rusting and manufacturer's defects
- B. Warranty Period:
  - 1. Acoustical panels: Ten (10) years from date of substantial completion.
  - 2. Grid: Ten (10) 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.

### **PART 2 PRODUCTS**

#### 2.01 ACOUSTICAL UNITS

- A. Manufacturers:
  - 1. Armstrong World Industries, Inc: [www.armstrong.com](http://www.armstrong.com).
  - 2. USG: [www.usg.com](http://www.usg.com).
  - 3. Substitutions: See Section 01600 - Product Requirements.
- B. Acoustical Units - General: ASTM E 1264, Class A.
  - 1. Units for Installation in Fire-Rated Suspension System: Listed and classified for the fire-resistive assembly the suspension system is a part of.
- C. Acoustical Tile:
  - 1. Size: 24 inch x 24 inch x 3/4 inch.
  - 2. Edge: Bevel Tegular on 15/16" grid.
  - 3. Color: White.
  - 4. Product: Ultima Tegular

5. Suspension System: Type SS-1.

## 2.02 SUSPENSION SYSTEM

- A. Manufacturers:
  - 1. Armstrong World Industries, Inc: [www.armstrong.com](http://www.armstrong.com) (Basis of Design).
  - 2. Chicago Metallic Corporation: [www.chicagometallic.com](http://www.chicagometallic.com).
  - 3. USG: [www.usg.com](http://www.usg.com).
  - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Suspension Systems - General: ASTM C 635; die cut and interlocking components, with stabilizer bars, clips, splices, perimeter moldings, and hold down clips as required.
- C. Exposed Steel Suspension System Type SS-1: Formed steel, commercial quality cold rolled; heavy-duty.
  - 1. Profile: Tee 15/16" Exposed Tee.
  - 2. Construction: Double web.
  - 3. Finish: White painted.

## 2.03 ACCESSORIES

- A. Support Channels and Hangers: Galvanized steel; size and type to suit application and ceiling system flatness requirement specified.
- B. Perimeter Moldings: Same material and finish as grid.
  - 1. At Exposed Grid: Provide L-shaped molding for mounting at same elevation as face of grid.
- C. Touch-up Paint: Type and color to match acoustical and grid units.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that layout of hangers will not interfere with other work.

### 3.02 INSTALLATION - SUSPENSION SYSTEM

- A. Install suspension system in accordance with ASTM C 636, ASTM E 580, and manufacturer's instructions and as supplemented in this section.
- B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:240.
- C. Locate system on room axis according to reflected plan.
- D. Install after major above-ceiling work is complete. Coordinate the location of hangers with other work.
- E. Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
- F. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
- G. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.

- H. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.
- I. Do not eccentrically load system or induce rotation of runners.
- J. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
  - 1. Use longest practical lengths.
  - 2. Overlap and rivet corners.

### 3.03 INSTALLATION - ACOUSTICAL UNITS

- A. Install acoustical units in accordance with manufacturer's instructions.
- B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
- C. Lay directional patterned units with pattern parallel to longest room axis.
- D. Fit border trim neatly against abutting surfaces.
- E. Install units after above-ceiling work is complete.
- F. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- G. Cutting Acoustical Units:
  - 1. Cut to fit irregular grid and perimeter edge trim.
  - 2. Make field cut edges of same profile as factory edges.
  - 3. Double cut and field paint exposed reveal edges.
- H. Where round obstructions and bullnose concrete block corners occur, provide preformed closures to match perimeter molding.
- I. Install hold-down clips on each panel to retain panels tight to grid system; comply with fire rating requirements.
- J. Install hold-down clips on panels within 20 ft of an exterior door and as indicated on the drawings.

### 3.04 ERECTION TOLERANCES

- A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.
- B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

**END OF SECTION 09 51 00**

**SECTION 09 65 00**  
**RESILIENT FLOORING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Resilient sheet flooring.
- B. Resilient tile flooring.
- C. Resilient base.
- D. Installation accessories.

**1.02 REFERENCES**

- A. ASTM E 648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2004.
- B. ASTM F 710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2005.
- C. ASTM F 1066 - Standard Specification for Vinyl Composition Floor Tile; 2004.
- D. ASTM F 1303 - Standard Specification for Sheet Vinyl Floor Covering with Backing; 2004.
- E. ASTM F 1861 - Standard Specification for Resilient Wall Base; 2002.
- F. ASTM F 1913 - Standard Specification for Vinyl Sheet Floor Covering Without Backing; 2004.
- G. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; National Fire Protection Association; 2006.

**1.03 SUBMITTALS**

- A. See Division 1 for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- C. Selection Samples: Submit manufacturer's complete set of color samples for Architect's initial selection.
- D. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

**1.04 SURPLUS MATERIALS**

- A. Contractor to provide a minimum quantity of 2% overage, in addition to the amount necessary for installation, of each material specified for the owner's future use.

**1.05 DELIVERY, STORAGE, AND PROTECTION**

- A. Protect roll materials from damage by storing on end.

## 1.06 ENVIRONMENTAL REQUIREMENTS

- A. Maintain temperature in storage area between 55 degrees F and 90 degrees F.
- B. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

## PART 2 PRODUCTS

### 2.01 MATERIALS - SHEET FLOORING

- A. Sheet Vinyl Flooring Type SV: Homogeneous with backing, color and pattern throughout full thickness:
  - 1. Minimum Requirements: Comply with ASTM F 1303, Type II, without backing, or ASTM F 1913.
  - 2. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E 648 or NFPA 253.
  - 3. Wear Layer Thickness: 0.080 inch nominal.
  - 4. Sheet Width: 6'-6" wide rolls
  - 5. Heat welded seams.
  - 6. Color and Pattern: As selected by the Architect from manufacturer's product line indicated. Pigments comprising a through-grain vinyl chip visual with pattern and color uniformly dispersed throughout the entire thickness.
  - 7. Manufacturers and Style: See Finish Schedule
    - a. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Vinyl Welding Rod: Solid vinyl bead produced by manufacturer of vinyl flooring for heat welding seams, in color matching field color.

### 2.02 MATERIALS – LVT FLOORING

- A. Luxury Vinyl Tile
    - 1. Type: As indicated on Finish Schedule.
    - 2. Color: As indicated on Finish Schedule.
    - 3. Manufacturers:
      - a. Mannington
      - b. Tarkett Commercial
- Substitutions: See Section 01 60 00 - Product Requirements.

### 2.03 MATERIALS - BASE

- A. Resilient Base: ASTM F 1861, Type TS rubber, vulcanized thermoset; top set Style B, Cove, and as follows:
  - 1. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E 648 or NFPA 253.
  - 2. Height: 4 inch
  - 3. Thickness: 0.125 inch thick.
  - 4. Finish: Satin.
  - 5. Length: Roll.
  - 6. Color: As selected by architect from manufacturer's standards.
  - 7. Accessories: Premolded external corners and end stops.
  - 8. Manufacturers:
    - a. Johnsonite, Inc: [www.johnsonite.com](http://www.johnsonite.com)
    - b. Roppe Corp: [www.roppe.com](http://www.roppe.com).
    - c. Mannington: [www.mannington.com](http://www.mannington.com)

- d. Substitutions: See Division 1.

## 2.04 ACCESSORIES

- A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.
- B. Primers, Adhesives, and Seaming Materials: Waterproof; types recommended by flooring manufacturer.
- C. Sealer: Types recommended by flooring manufacturer.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that sub-floor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive resilient flooring.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.
- C. Verify that sub-floor surfaces are dust-free and free of substances which would impair bonding of adhesive materials to sub-floor surfaces.
- D. Verify that concrete sub-floor surfaces are ready for resilient flooring installation by testing for moisture emission rate and alkalinity in accordance with ASTM F 710; obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.
- E. Verify that required floor-mounted utilities are in correct location.

### 3.02 PREPARATION

- A. All required floor preparation required for proper, level and smooth installation, is the responsibility of the flooring contractor. No exceptions. A field visit is required to assess current conditions and must be done prior to providing a bid price.
- B. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates. Remove sub-floor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with sub-floor filler to achieve smooth, flat, hard surface.
- C. Prohibit traffic until filler is cured.
- D. Clean substrate.
- E. Apply primer as required to prevent "bleed-through" or interference with adhesion by substances that cannot be removed.

### 3.03 INSTALLATION - SHEET FLOORING

- A. Install in accordance with manufacturer's instructions.
- B. Spread only enough adhesive to permit installation of materials before initial set.
- C. Set flooring in place, press with heavy roller to attain full adhesion.
- D. Lay flooring with joints and seams parallel to longer room dimensions, to produce minimum number of seams. Lay out seams to avoid widths less than 1/3 of roll width; match patterns carefully at seams.
- E. Double cut sheet at seams.



- F. Lay flooring with tightly butted seams, without any seam sealer unless otherwise indicated.
- G. Finish seams in sheet vinyl by heat welding.
- H. Double cut sheet; provide heat welded seams.
- I. Where floor finishes are different on opposite sides of door, terminate flooring under centerline of door.
- J. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated. After installation of flooring, secure metal strips with stainless steel screws. Secure resilient strips by adhesive.
- K. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

#### 3.04 INSTALLATION - TILE FLOORING

- A. Install in accordance with manufacturer's instructions.
- B. Mix tile from container to ensure shade variations are consistent when tile is placed.
- C. Spread only enough adhesive to permit installation of materials before initial set.
- D. Set flooring in place, press with heavy roller to attain full adhesion.
- E. Lay flooring with joints and seams parallel to building lines to produce symmetrical tile pattern.
- F. Lay flooring with grain running in one direction.
- G. Where floor finishes are different on opposite sides of door, terminate flooring under centerline of door.
- H. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated. After installation of flooring, secure metal strips with stainless steel screws.
- I. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

#### 3.05 INSTALLATION - BASE

- A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.
- B. Miter internal corners. At external corners, use premolded units. At exposed ends, use premolded units.
- C. Install base on solid backing. Bond tightly to wall and floor surfaces.
- D. Scribe and fit to door frames and other interruptions.

#### 3.06 CLEANING

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean, seal, and wax resilient flooring products in accordance with manufacturer's instructions.

**END OF SECTION 09 65 00**

**SECTION 09 65 66  
RESILIENT ATHLETIC FLOORING**

**PART 1 – GENERAL**

**1.1 SUMMARY**

**1.1.1 Section Includes**

- A. Multi-layered Rubber flooring
- B. Rubber Sheet Flooring
- C. Accessories required for installation, maintenance and repair.

**1.2 REFERENCES**

**1.2.1 ASTM International (ASTM)**

- A. ASTM D412: Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension.
- B. ASTM D2047: Standard Test Method for Static Coefficient of Friction of Polish-Coated Floor Surfaces as measured by the James Machine.
- C. ASTM D2240: Standard Test Method for Rubber Property (Durometer Hardness).
- D. ASTM D3389: Standard Test Method for Coated Fabrics Abrasion Resistance (Rotary Platform Abrader).
- E. ASTM E648: Standard Test Method for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.
- F. ASTM E662: Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials.
- G. ASTM E1643: Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
- H. ASTM E1745: Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.
- I. ASTM E2179: Standard Test Method for Laboratory Measurement of the Effectiveness of Floor Coverings in Reducing Impact Sound Transmission Through Concrete Floors.
- J. ASTM F386: Standard Test Method for Thickness of Resilient Flooring Materials Having Flat Surfaces.
- K. ASTM F710: Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
- L. ASTM F925: Standard Test Method for Resistance to Chemicals of Resilient Flooring.
- M. ASTM F970: Standard Test Method for Static Load Limit.
- N. ASTM F1514: Standard Test method for Measuring Heat Stability of Resilient Flooring by Color Change.
- O. ASTM F1515: Standard Test Method for Measuring Light Stability of Resilient Flooring by Color Change.
- P. ASTM F1869: Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
- Q. ASTM F2170: Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.
- R. ASTM F2772: Standard Specification for Athletic Performance Properties of Indoor Sports Floor Systems.

1.2.2 State of California (CA)

- A. CA Section 01350: Standard Method for the Testing and Evaluation of Volatile Organic Compound Emissions from Indoor Sources Using Environmental Chambers.

1.2.3 GREENGUARD Environmental Institute (GEI)

- A. GREENGUARD Certification: Compliant with stringent emission levels for over 360 VOCs, plus a limit on the total of all chemical emissions combined (TVOC).
- B. GREENGUARD Gold: Compliant with safety factors to account for sensitive individuals (such as children and the elderly) and ensures that a product is acceptable for use in environments such as schools and healthcare facilities.

1.2.4 International Organization for Standardization (ISO)

- A. ISO 9001: Quality Management Systems - Requirements.

1.3 SUBMITTALS

1.3.1 Action Submittals

- A. Provide current printed data sheets for all Products Supplied.
- B. Provide samples, 6 inches x 6 inches, for verification of such characteristics as color and surface texture of each specified resilient athletic flooring product.
- C. If line painting is specified, provide samples of available paint colors for selection and approval.
- D. As necessary, provide shop drawings prepared for project illustrating layouts, details, dimensions and other data.

1.3.2 Informational Submittals

- A. Provide Manufacturer's current printed subfloor preparation guidelines.
- B. Provide Manufacturer's current printed installation guidelines for Products Supplied.

1.3.3 Closeout Submittals

- A. Provide Manufacturer's current printed maintenance guidelines for resilient athletic flooring.
- B. Provide Manufacturer's current printed standard warranty for resilient athletic flooring.

1.3.4 Maintenance Material Submittals

- A. Provide extra stock materials from original dye lots, for use in facility operations and maintenance (approximately 2% of the total floor surface for each color, surface texture and format of Manufactured Product).

1.4 QUALITY ASSURANCE

- A. Manufacturer must be certified ISO 9001.
- B. Manufactured Product must have undergone a vulcanization process; factory lamination should not be accepted as equivalent.
- C. In accordance with ASTM E648, the Manufactured Product must have a critical radiant flux  $\geq 0.45\text{W/cm}^2$  (Class 1).

- D. In accordance with ASTM E662, the Manufactured Product must have an optical density of smoke <450.
- E. Manufacturer must have a minimum of fifteen (15) years of experience in the manufacturing of prefabricated resilient athletic flooring.
- F. Installer must have performed installations of the same scale in the last three (3) years.
- G. Installer to be recognized and approved by the Manufacturer.
- H. If line painting is specified, painting must be done by professionals with proper experience and qualifications to effectively perform the work.

#### 1.5 DELIVERY, STORAGE AND HANDLING

- A. Products Supplied must be delivered in Manufacturer's original, unopened and undamaged packaging with identification labels intact.
- B. Products Supplied must be protected from exposure to harmful weather conditions and must be safely stored on a clean, dry, flat surface. Store rolls of resilient athletic flooring upright.
- C. Climate controlled storage is recommended. Storage temperature must not be below 55°F (13°C) and must not exceed 100°F (38°C).
- D. Avoid storing Manufactured Product for extended periods of time or additional material trimming may be required.
- E. Products Supplied need not suffer damage during handling (i.e. dents/scratches, edge chipping, excessive warping, etc.).

#### 1.6 SITE CONDITIONS

- A. The General Contractor or Construction Manager shall be responsible for ensuring all site conditions meet the requirements of the Manufacturer, as referenced herein at sections 3.2 and 3.3.
- B. Concrete subfloors, on or below grade, must be installed over a permanent effective vapor retarder, respecting current versions of the standard practice ASTM E1643 and the standard specification ASTM E1745. The vapor retarder must be placed directly underneath the concrete slab, above the granular fill, as per Manufacturer's instructions. The vapor retarder must have a perm rating of 0.1 or less and must have a minimum thickness of 10 mil (0.010in).
- C. No concrete sealers or curing compounds are applied or mixed with the subfloors (refer to Section 03 05 00 – Common Work Results for Concrete of Division 3).
- D. Installation of the resilient athletic flooring to be carried out no sooner than the specified curing time of concrete subfloor (normal density concrete curing time is approximately 28 days for development of design strength). Refer to current version of ASTM F710.
- E. The subfloor surface must be free of any paint, wax, oil, grease, sealer, curing compound, solvent or any other contaminants that may inhibit bond. All contaminants must be removed from the surface via mechanical abatement. Use of abatement chemicals is not recommended.
- F. Concrete to have smooth, dense finish, and be highly compacted with a tolerance of 1/8" in a 10ft radius (3.2mm in 3.05m radius). Floor Flatness (FF) and Floor Levelness (FL) numbers are not recognized.
- G. Moisture and alkalinity tests must be performed on all concrete substrates, under in-service conditions. It is recommended to turn on the HVAC unit prior to performing moisture testing, in order to ensure stable testing conditions and accurate results. The concrete's surface pH should be between 7 and 10. Relative humidity of the concrete slab must not exceed 85%, in accordance with ASTM F2170 (in situ probes). Moisture vapor emissions from the concrete slab must not exceed the tolerance of the adhesive specified, in accordance with ASTM F1869 (anhydrous calcium chloride).
- H. If installing over wood subfloors, ensure exterior grade plywood with at least one good side, such as: APA (Engineered Wood Association) Exterior grade plywood (A-A Exterior, A-B Exterior or AC Exterior) and CANPLY (Canadian Plywood Association) Exterior certified plywood (Canada: Grade G2S A-A or G1S A-C. USA: G2S A-A, A-B, B-B, or G1S A-C, B-C). There must be proper underfloor

ventilation, plywood must be dry and should have a moisture content ranging between 6 and 12%, when measured with a quality wood moisture meter (electronic hygrometer).

- I. Maintain a stable room and subfloor temperature within the recommended range of 65°F to 86°F (18°C to 30°C), 48 hours prior to installation, during the installation, and 48 hours after the installation. Recommended ambient humidity control level is between 35 to 55%.
- J. Installation of resilient athletic flooring will not commence until the building is enclosed and all other trades have completed their work. It is the General Contractor or Construction Manager's responsibility to maintain a secure and clean working area before, during and after the installation of the resilient athletic flooring.

## 1.7 WARRANTY

- A. The resilient athletic flooring is warranted to be free from manufacturing defects for a period of one (1) year from the date of shipment from the Manufacturer.
- B. The resilient athletic flooring is warranted against excessive wear under normal usage for a period of ten (10) years from the date of shipment from the Manufacturer.
- C. Refer to current copy of Manufactured Product's Limited Warranty for all terms and conditions.

## PART 2 – PRODUCTS

### 2.1 Multi-Layered Rubber Flooring

#### 2.1.1 Manufacturer

- A. Mondo Luxembourg S.A.: Z.I. Foetz - Rue de l'Industrie, L-3895 Foetz, Luxembourg.

#### 2.2.1 At Multipurpose Room:

- A. Advance NG is prefabricated resilient rubber athletic flooring, calendered and vulcanized with a base of natural and synthetic rubbers, stabilizing agents and pigmentation, as manufactured by Mondo Luxembourg S.A. or approved equal.
- B. Advance NG is phthalate-free, halogen-free, heavy metal-free, formaldehyde-free, isocyanatefree and BPA-free.
- C. Thickness: 0.394" (10mm).
- D. Colors: To be selected by Architect from Manufacturer's full range
- E. Surface Texture: Smooth.
- F. Manufactured in two layers which are vulcanized together. The shore hardness of the top layer will be greater than that of the bottom layer; shore hardness of layers to be recommended by the Manufacturer and the limits specified.
- G. Format: Available in sheets that are 6'1" (1.86m) wide and 42'7" (13m) long [min. 19'8" (6m)/max. 55'9" (17m)].

#### 2.2.2 Performance

- A. Manufactured Product tested following standard specification ASTM F2772 (Athletic Performance Properties).
- B. Performance of Manufactured Product to conform to the following criteria:

Performance Criterion	Test Method	Requirement	Result
Elongation at Break	ASTM D412	-	≥230%
Tensile Strength	ASTM D412	-	≥500psi

Static Coefficient of Friction	ASTM D2047	≥0.50	>0.60
Hardness (Shore A)	ASTM D2240	-	78 ±5 (wear layer) 60 ±5 (backing)
Abrasion Resistance (H18 wheel, 1000g, 1000 cycles)	ASTM D3389	≤1.0	<0.75g
Critical Radiant Flux	ASTM E648	≥0.45	≥0.45W/cm <sup>2</sup> (Class 1)
Optical Density of Smoke	ASTM E662	<450	<450
Reduction of Impact Sound Transmission	ASTM E2179	-	20dB (ΔIIC)
Thickness	ASTM F386	-	8mm (±0.1mm)
Resistance to Chemicals	ASTM F925	-	Compliant
Static Load Limit (tested at 250psi)	ASTM F970	-	<0.005in
Heat Stability	ASTM F1514	ΔE ≤8.0	Compliant
Light Stability	ASTM F1515	ΔE ≤8.0	Compliant
Force Reduction	ASTM F2772	-	Class 1
Vertical Deformation	ASTM F2772	-	Pass
Ball Rebound	ASTM F2772	-	Pass
Performance Criterion	Test Method	Requirement	Result
Surface Finish Effect	ASTM F2772	-	Pass
Indoor Air Quality	CA 01350	-	Compliant
Greenguard Certification	Greenguard	-	Yes
Greenguard Gold	Greenguard	-	Yes

### 2.3.1 At Weight Room:

- A. Sport Impact is prefabricated resilient athletic flooring, calendered and vulcanized, with a base of natural and synthetic rubbers, stabilizing agents and pigmentation, as manufactured by Mondo Luxembourg S.A. or approved equal.
- B. Dual durometer construction, vulcanized into a single prefabricated sheet/tile for optimal performance and durability. The Shore hardness of the top layer (wear layer) will be greater than that of the bottom layer (backing); Shore hardness of layers to be recommended by the Manufacturer and to respect limits specified.
- C. At Mondo, we pride ourselves on producing premium high-quality rubber flooring products that can be utilized in areas with stringent health and safety controls; we do not use red listed ingredients
- D. (2024 LBC Red List CASRN Guide) to manufacture our rubber flooring products, which includes but is not limited to harmful chemicals of concern like bisphenol A (BPA), formaldehyde, halogens, heavy metals, isocyanates, phthalates, polyvinyl chloride (PVC), perfluorinated compounds (PFC) and perfluoroalkyl and polyfluoroalkyl substances (PFA). Also, a product-specific Type III Environmental Product Declaration (EPD) is available for this product. SPORT IMPACT complies with CDPH v1.2-2017 (California Section 01350) and is GREENGUARD Gold certified. D. Thickness: 0.394" (10 mm).
- E. Colors: Provided in standard, solid background colors with randomly dispersed colored chips throughout the wear layer's entire depth.
- F. Surface Texture: Sealskin.

G. Formats: Available in sheets that are 6'1" (1.86 m) wide and 29'6" (9 m) long [min. 19'8" (6 m)/max. 36'1" (11 m)]; available in tiles that are 36" x 36" (91.35 cm x 91.35 cm).

## 2.3.2 Performance

A. Performance of the Manufactured Product to conform to the following criteria:

Performance Criterion	Test Method	Requirement	Result*
Elongation at Break	ASTM D412	≥100%	≥110%
Tensile Strength	ASTM D412	≥300 psi	≥500 psi
Static Coefficient of Friction (neolite heel)	ASTM D2047	≥0.50 (dry)	≥0.85 (dry)
Hardness of Top Layer (Shore A)	ASTM D2240	80 ± 5	80
Hardness of Bottom Layer (Shore A)	ASTM D2240	70 ± 8	65
Abrasion Resistance (H18 wheel, 1000g, 1000 cycles)	ASTM D3389	≤1.0 g	≤0.6 g
Impact Insulation Class	ASTM E492	-	≈ 59 dB (IIC)
Critical Radiant Flux	ASTM E648	≥0.22 W/cm <sup>2</sup> (Class 2)	≥0.45 W/cm <sup>2</sup> (Class 1)
Reduction of Bacterial Activity - <i>MRSA</i> (ATC 43300)	ASTM E2180	-	≥99,99% reduction
Thickness	ASTM F386	10 mm (±0.2 mm) 0.394" (±0.008")	Compliant
Resistance to Chemicals	ASTM F925	≤Slight Change	Compliant **
Static Loading (Tested at 250psi)	ASTM F970	≤0.008 in	0.004 in
Heat Resistance	ASTM F1514	ΔE ≤8.0	Compliant
Light Resistance	ASTM F1515	ΔE ≤8.0	Compliant
Reduction of Bacterial Activity - <i>MRSA</i> (ATC 43300)	ISO 22196	-	≥99,999% reduction
<b>Indoor Air Quality (IAQ) Certifications</b>			
CA Section 01350	CA: V1.1-2010	-	Compliant
Greenguard Gold	Greenguard	-	Compliant
Greenguard Certification	Greenguard	-	Compliant
French Decree № 2011-321	ISO 16000-9	-	Compliant (Class A+)

## 2.4 Materials

A. Provide resilient athletic flooring as specified in section 2.2 & 2.3 Description.

## 2.5 Accessories

- A. Provide adhesive certified by Manufacturer: Mondo PU 105 (polyurethane). For suitability, recommendations and use please refer to Manufacturer's current printed adhesive guidelines. In some cases, Mondo EP 55 (epoxy) may be used in areas that have not been specified to receive Everlay, and that will not be subject to surface impacts (such as falling free weights) or heavier dynamic loads (such as bleachers).
- B. Patching or leveling compound to be supplied or recommended/approved by Manufacturer.
- C. If line painting is specified, all painting products are to be supplied or recommended/approved by Manufacturer.

## PART 3 – EXECUTION

### 3.1 INSTALLERS

- A. Refer to section 1.4 of this document for information on installers.

### 3.2 EXAMINATION

- A. Ensure that concrete subfloors, on or below grade, are installed over a permanent effective vapor retarder, respecting current versions of the standard practice ASTM E1643 and standard specification ASTM E1745. The vapor retarder must be placed directly underneath the concrete slab, above the granular fill, as per Manufacturer's instructions. The vapor retarder must have a perm rating of 0.1 or less and must have a minimum thickness of 10 mil (0.010in).
- B. Installation of the resilient athletic flooring to be carried out no sooner than the specified curing time of concrete subfloor (normal density concrete curing time is approximately 28 days for development of design strength). Refer to current version of ASTM F710.
- C. Ensure that no concrete sealers or curing compounds have been applied to or mixed into the concrete (refer to Section 03 05 00 – Common Work Results for Concrete of Division 3).
- D. Subfloor surface must be free of any paint, wax, oil, grease, sealer, curing compound, solvent or any other contaminants that may inhibit bond. All contaminants must be removed from the surface via mechanical abatement. Use of abatement chemicals is not recommended.
- E. Confirm concrete has smooth, dense finish, and is highly compacted with a tolerance of 1/8" in a 10ft radius (3.2mm in 3.05m radius). Floor Flatness (FF) and Floor Levelness (FL) numbers are not recognized.
- F. Moisture and alkalinity tests must be performed on all concrete substrates, under in-service conditions. It is recommended to turn on the HVAC unit prior to performing moisture testing, in order to ensure stable testing conditions and accurate results. The concrete's surface pH should be between 7 and 10. Relative humidity of the concrete slab must not exceed 85%, in accordance with ASTM F2170 (in situ probes). Moisture vapor emissions from the concrete slab must not exceed the tolerance of the adhesive specified, in accordance with ASTM F1869 (anhydrous calcium chloride).
- G. If installing over wood subfloors, ensure exterior grade plywood with at least one good side, such as: APA (Engineered Wood Association) Exterior grade plywood (A-A Exterior, A-B Exterior or AC Exterior) and CANPLY (Canadian Plywood Association) Exterior certified plywood (Canada: Grade G2S A-A or G1S A-C. USA: G2S A-A, A-B, B-B, or G1S A-C, B-C). There must be proper underfloor ventilation, plywood must be dry and should have a moisture content ranging between 6 and 12%, when measured with a quality wood moisture meter (electronic hygrometer).
- H. Maintain a stable room and subfloor temperature within the recommended range of 65°F to 86°F (18°C to 30°C), 48 hours prior to installation, during the installation, and 48 hours after the installation. Recommended ambient humidity control level is between 35 to 55%.



- I. Installation of resilient athletic flooring will not commence until the building is enclosed and all other trades have completed their work. Ensure a secure and clean working area before, during and after the installation of the resilient athletic flooring.

### 3.3 PREPARATION

- A. Prepare subfloor in accordance with Manufacturer's current printed guidelines.

### 3.4 INSTALLATION

- A. Install rolls of resilient athletic flooring following Manufacturer's current printed guidelines.
- B. Install all accessories following Manufacturer's current printed guidelines.

### 3.5 REPAIR

- A. Refer to section 1.3.4 for extra stock materials.
- B. Repair material must be from the same original dye lot as the Manufactured Product initially installed.
- C. Repairs are to be performed by qualified installers/technicians only.

### 3.6 CLEANING

- A. Always wait at least a minimum of 72 hours after the resilient athletic flooring has been completely installed before performing initial maintenance.
- B. For surfaces having received newly painted lines, wait a minimum of 30 days after the application of the paint before scrubbing the surface to ensure proper curing of the paint.
- C. Always maintain the resilient athletic flooring following Manufacturer's current printed guidelines.

### 3.7 PROTECTION

- A. As needed, protect resilient athletic flooring with 1/8" Masonite during and after the installation, prior to acceptance by the Owner.

**End of Section 09 65 66**

**SECTION 09 66 23**  
**EPOXY-RESIN TERRAZZO FLOORING**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. 3/8" Nominal Epoxy Resin Matrix Terrazzo
- B. Work included in this section
  - 1. 3/8" Epoxy Resin Terrazzo poured in place with joint, edge, and termination divider strips as indicated on drawings.
  - 2. Crack suppression membrane with reinforcing mesh.
  - 3. Moisture Vapor Transmission Barrier on Concrete Slab.
- C. Related Work in other sections
  - 1. Cast in Place Concrete: Subfloor to be level with maximum variation of 1/4" in 10 feet, with a steel trowel finish surface. Concrete slab shall have effective moisture/vapor barrier placed beneath slab, free of damage causing tears or perforations.
  - 2. Adjacent Floor finishes – Division 9
  - 3. Placement of floor drains, plumbing fixtures and electrical fixtures.
  - 4. Joint sealants installed with Terrazzo at expansion joints
  - 5. Sufficient water, temporary heat and light and adequate electrical power connected with outlets within 100 feet of work area.

**1.02 QUALITY ASSURANCE**

- A. Acceptable Suppliers
  - 1. Suppliers shall be Associate Members of the National Terrazzo and Mosaic Association (NMTA) and shall supply materials in accordance with the standards and specifications of the NMTA.
  - 2. Marble chips and / or glass aggregates shall of standard colors and graduated sizes as supplied by NMTA members.
- B. Acceptable Installers
  - 1. Terrazzo installation contractor shall be current Contractor Member of the NMTA and shall perform all work in accordance with NMTA specifications and standards.

**1.03 SUBMITTALS**

- A. Product Data
  - 1. Submit Product Data for all related materials including resin matrix, crack suppression membrane, divider strips, expansion strips, sealers and cleaners.
- B. Samples
  - 1. Submit (3) six-inch square samples for each color and type of terrazzo specified or selected.
  - 2. Submit (3) six-inch lengths of each divider or expansion strip required.

C. Certifications

1. Submit certification letter that the terrazzo installation contractor is current member in good standing with the NMTA.

1.03 DELIVERY, STORAGE AND HANDLING

A. Delivery of Materials

1. Deliver materials in a manner to prevent damage or contamination of containers or bags of materials.

B. Storage of Materials

1. Store materials in a clean, dry location heated to a minimum of 50 degrees.

1.04 GUARANTEE / WARRANTY

- A. Terrazzo Materials and installation shall be guaranteed for a period of one (1) year from the date of substantial completion for repair and/or replacement of materials or workmanship found to be defective.

1.04 PROJECT CONDITIONS

B. Acceptable Substrates

1. Concrete sub-floor level tolerance shall be ¼" in 10 feet. Any irregularity of the surface, which requires repair, shall be performed with epoxy fillers and aggregates recommended by epoxy resin matrix manufacturer.
2. Maintain ambient room and floor temperature at 50 degrees F or above for a period extending 72 hours before, during, and after terrazzo floor installation.
3. Concrete substrate shall be tested to verify acceptable moisture levels prior to installation. Testing should be conducted in accordance with ASTM F2170 or by relative humidity test. Acceptable moisture levels shall not be as established by the NMTA for use with resin matrix terrazzo.

**PART 2 - PRODUCTS**

2.01 MATERIALS

- A. Primer: Resin manufacturer's 100% solids epoxy primer
- B. Flexible Membrane: Resin manufacturer's 100% solids epoxy crack suppression membrane
- C. Epoxy Resin: Epoxy Matrix, 100 % solids, -0- VOC Epoxy Resin.
  1. Acceptable Manufacturers are:
    - a. General Polymers
    - b. Crossfield Products
    - c. T&M Terroxy Resin Systems
    - d. Key Resin West

- D. Marble Chips: Standard color marble or glass chips as distributed by Heritage Glass, Inc. or equal. Maximum size # 2 per NMYA gradation standards. Color selected by Architect to match existing.
- E. Divider strips: Zinc, Brass or Aluminum, 1/8" in thickness unless noted otherwise on drawings.
- F. Terrazzo Cleaner: PH Factor between 7 and 10, biodegradable and phosphate free as recommended by epoxy resin system manufacturer.
- G. Sealer: Penetrating Sealer TESCO Crystalseal
- H. Moisture Transmission Barrier: as recommended by epoxy resin system manufacturer.

## 2.02 Mixes

- A. Terrazzo Selection
  - 1. 3/8" Nominal Epoxy Resin Matrix Thin-Set Terrazzo
  - 2. Terrazzo color mixes: NMTA color palette or custom matrix as produced by NMTA Member. Sample(s) matrix designation #: FL-4; FL-5; FL-6; FL-7A and FL-7B.
- B. Proportions: as recommended by epoxy resin system manufacturer.
- C. Mixing: Terrazzo Topping: Mix marble/aggregates and Epoxy Resin per formulations of approved samples.

## PART 3 - EXECUTION

### 3.01 INSPECTION

- A. Examine areas to receive terrazzo for:
  - 1. Defects in existing work that affect proper execution of terrazzo work. Notify contractor of any defects in concrete sub-floor or other related work for correction.
  - 2. Concrete shall be a minimum of 3,000 PSI compressive strength and minimum 300 PSI tensile strength, with 30-day cure, and shall be level to within 1/4" per 10 lineal feet. Concrete slab shall have effective moisture barrier and moisture tests should be conducted to confirm suitability for installation of epoxy resin terrazzo flooring system.
  - 3. Conduct Moisture Tests for concrete slab on grade in accordance with ASTM F2170 or relative humidity test. Report results for certification that moisture levels are acceptable for installation of terrazzo system.
  - 4. Inspect slab for visible crack. If total length of crack is less than the Square feet of the total terrazzo, membrane system may be deleted and all cracks bandaged per epoxy resin system manufacturer's recommendation
  - 5. Start only when all defects have been corrected and moisture test results have been certified as acceptable if installation is slab on grade.

### 3.02 INSTALLATION

- A. Subfloor

1. Prepare substrate to receive epoxy terrazzo by shot blasting to expose clean concrete substrate.
2. If required due to moisture vapor transmission rate test results exceeding NMTA recommended levels, install moisture vapor transmission barrier to concrete slab per manufacturer's recommendations.
3. Where required, install membrane at cold joints and crack isolation membrane over concrete substrate per manufacturer's recommendations.
4. Install divider strips as indicated on approved layout. Place expansion joint strips where required.

B. Placing Terrazzo

1. Prime subfloor in accordance with manufacturer's recommendations.
2. Place terrazzo mixture in panels formed by divider strips and trowel mixture to top of strips.

C. Curing

1. After completing placement of terrazzo, allow to cure until topping develops sufficient strength to prevent lifting or pulling of terrazzo strips during grinding.

D. Finishing

1. Rough Grinding
  - a. Grind with #24 or finer grit stones or with comparable diamond plates.
  - b. Follow initial grind with #80 or finer grit stones as required to meet finish of approved project control samples.
2. Grouting
  - a. Cleanse floor with clean water and rinse.
  - b. Remove excess rinse water and machine or hand-apply grout, taking care to fill voids.
  - c. Grout may be left on terrazzo until all heavy or messy work in project is complete.
3. Fine Grinding
  - a. Grind with #120 until all grout is removed from surface
  - b. Upon completion, terrazzo shall show a minimum of 70% marble chips.

E. Cleaning and Sealing

1. Wash all surfaces with a neutral cleaner.
2. Rinse with clean water and allow surface to dry.
3. Apply acrylic sealer in accordance with manufacturer's direction.

F. Protection

1. Upon completion, the work shall be ready for final inspection and acceptance by owner or agent.
2. The General Contractor shall protect the finished floor at the time that the Terrazzo Contractor completes the work.

**END OF SECTION 09 66 23**

**SECTION 09 84 33  
SOUND-ABSORBING WALL PANELS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Sound-absorbing wall panels, custom-fabricated and fabric-finished.

**1.02 REFERENCES**

- A. ASTM International
  - 1. ASTM C423 Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
  - 2. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
  - 3. ASTM E795 Standard Practices for Mounting Test Specimens During Sound Absorption Tests.

**1.03 SYSTEM DESCRIPTION**

- A. Performance Requirements:
  - 1. Surface Burning Characteristics (ASTM E84):
    - a. Flamespread: 25 maximum.
    - b. Smoke Developed: 450 maximum.
    - c. Fire ratings for all fabric covered panels is based on testing of the panel wrapped with the standard in stock fabric, Guilford of Maine, Model FR 701.

**1.04 SUBMITTALS**

- A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.
- B. Product Data: Submit product data sheet, for specified products.
- C. Shop Drawings: Submit shop drawings showing layout, edge profiles and panel components, including anchorage, accessories, finish colors and textures.
- D. Samples: Submit selection and verification samples of finishes, colors and textures.
- E. Test Reports: Certified test reports showing compliance with specified performance requirements.
  - 1. Standard Systems: Submit certified copies of previous test reports substantiating performance of system in lieu of retesting.

**1.05 DELIVERY, STORAGE, AND HANDLING**

- A. General: Comply with Division 1 Product Requirements Section.
- B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.

## 1.06 PROJECT CONDITIONS

- A. Environmental Requirements: Do not install panels until wet work, such as concrete and plastering, is complete; the building is enclosed; and the temperature and relative humidity are stabilized at 60 - 80 degrees F (16 - 27 degrees C) and 35% MINIMUM RH and 55% MAXIMUM RH, respectively. All products constructed with wood or wood fiber content must be stored for at least 72 hours in the controlled environment specified herein prior to installation to allow the materials to stabilize.

## PART 2 PRODUCTS

### 2.01 SOUND-ABSORBING WALL PANELS

- A. Manufacturer: Kinetics Noise Control, Inc.  
1. Contact: PO Box 655, 6300 Irelan Place, Dublin, OH 43017; Telephone: (614) 889-0480; Fax: (614) 889-0540; E-mail: [intsales@kineticsnoise.com](mailto:intsales@kineticsnoise.com); Web site: [www.kineticsnoise.com](http://www.kineticsnoise.com).
- B. Substitutions: See section 01 60 00.

### 2.02 MANUFACTURED UNITS

- A. SportsBoard Elite Fabric-Wrapped Copolymer Panels:
1. Thickness: 2-1/16 inches (52 mm).
  2. Size: As indicated on the drawings up to a maximum 48 inches (1219 mm) x 120 inches (3048 mm).
  3. Core: 2 inches (51 mm) thick, 6 - 7 pcf (96 - 112 kg/m<sup>3</sup>) density fiberglass.
  4. Edge Detail: Square hardened with a Class A hardening solution.
  5. Fabric Facing: 100% polyester fabric, FR 701 Style 2100 by Guilford of Maine
    - a. Color: As selected from fabric manufacturer's full range of colors.
  6. Copolymer Impact Resistant Layer: 1/16 inch (1.6 mm) thick copolymer perforated with 3/32 inch (2.4 mm) holes on 5/32 inch (4 mm) staggered centers.
  7. Sound Absorption (ASTM C423, A Mounting): Noise Reduction Coefficient of 1.00, 2 inch thick core minimum.
  8. Mounting Accessories: Z-clips

### 2.03 FABRICATION

- A. SportsBoard Elite Panels
1. Wrap panel edges and return facing fabric 1 to 2 inches (25.4 to 51 mm) on back of panel. Secure fabric with adhesive applied to edges and back of panel only.

### **PART 3 EXECUTION**

#### **3.01 MANUFACTURER'S INSTRUCTIONS**

- A. Compliance: Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions and product carton instructions for installation.

#### **3.02 EXAMINATION**

- A. Site Verification of Conditions: Verify that substrate conditions, which have been previously installed under other sections, are acceptable for product installation in accordance with manufacturer's instructions.

1. Verify that stud spacing is 16 inches (406 mm) o.c., maximum, for panels installed over open studs.
2. Do not install panels until unsatisfactory conditions are corrected.

#### **3.03 CLEANING**

- A. Follow manufacturer's instructions for cleaning panels soiled during installation. Replace panels that cannot be cleaned to as new condition.
- B. Keep site free from accumulation of waste and debris.

**END OF SECTION**



**SECTION 09 90 00**  
**PAINTING AND COATING**

**PART 1 - GENERAL**

**1.01 SECTION INCLUDES**

- A. Surface preparation.
- B. Field application of paints and other coatings.
- C. Painting of exposed mechanical ductwork and conduit identification.
- D. Pavement markings.
- E. Schedule - Surfaces to be finished at end of this Section.

**1.02 RELATED SECTIONS**

- A. Section 32 17 23 - Pavement markings.
- B. Section 05 50 00 - Metal Fabrications: Shop-primed items.
- C. Section 09 21 16 - Gypsum Board Assemblies: Gypsum Board.
- D. Section 23 05 53 - Mechanical Identification: Painted identification.
- E. Section 23 31 00 - Mechanical Ducts: Paint Exposed Ductwork.
- E. Section 26 05 53 - Electrical Identification: Painted identification.

**1.03 REFERENCES**

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. ASTM D 16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2003.
- C. ASTM D 523 - Standard Test Method for Specular Gloss; 1999.
- D. ASTM D 4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials; 1992 (Reapproved 2003).
- E. SSPC (PM1) - Good Painting Practice: SSPC Painting Manual, Vol. 1; Society for Protective Coatings; Fourth Edition.

**1.04 DEFINITIONS**

- A. Conform to ASTM D 16 for interpretation of terms used in this section.
- B. Terms flat, eggshell, semi-gloss and gloss used in this section and drawing Finish Schedule refer to the following gloss ranges when tested in accordance with ASTM D 523 test method:
  - 1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at a 85 degree meter.
  - 2. Eggshell refers to a low-sheen finish with a gloss range between 5 and 20 when measured at a 60 degree meter.
  - 3. Satin refers to low-sheen finish with a gloss range below 15 and 35 when measured at a 60 degree meter.
  - 4. Semigloss refers to medium-sheen finish with a gloss range between 30 and 65 when measured at a 60 degree meter.

- 5. Full gloss refers to a high-sheen finish with a gloss range more than 65 when measured at a 60 degree meter.
- C. Gloss Ranges: Ranges indicated in the Finish Schedule take precedence over ranges indicated in this section.

#### 1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on all finishing products, including VOC content.
- C. Manufacturer's Instructions: Indicate special surface preparation procedures and substrate conditions requiring special attention.
- D. Maintenance Data: Submit data on cleaning, touch-up, and repair of painted and coated surfaces.
- E. Certification: Provide certification that all coatings supplied are non-combustible and rated Class A for flame spread, fuel contribution, smoke development, and are compatible with materials, shop primers and coatings indicated.
- F. Submittals for Environmental Performance:
  - 1. VOC data: All paints and coatings installed in the building interior must be low-VOC and meet the testing and product requirements set forth in the LEED-NC 2009 Reference Guide. This project is not pursuing LEED certification.

#### 1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum ten years documented experience.
- B. Applicator Qualifications: Company specializing in performing the work of this section with minimum three years documented experience.

#### 1.07 REGULATORY REQUIREMENTS

- A. Conform to applicable code for flame and smoke rating requirements for products and finishes.

#### 1.08 DELIVERY, STORAGE, AND PROTECTION

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

#### 1.09 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.

- C. Minimum Application Temperatures for Latex Paints: 45 degrees F for interiors; 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.
- D. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

#### 1.10 EXTRA MATERIALS

- A. See Section 01 60 00 - Product Requirements, for additional provisions.
- B. Supply 5 gallons of each color and type; store where directed.
- C. Label each container with color, type, and room locations in addition to the manufacturer's label.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. Paints:
  - 1. Sherwin Williams Company: [www.sherwin-williams.com](http://www.sherwin-williams.com).
  - 2. ICI Paints North America: [www.icipaintsinna.com](http://www.icipaintsinna.com).
  - 3. Benjamin Moore & Co: [www.benjaminmoore.com](http://www.benjaminmoore.com).
  - 4. PPG Architectural Finishes, Inc: [www.ppgaf.com](http://www.ppgaf.com).
  - 5. Grahams Paint: [www.grahampaint.com](http://www.grahampaint.com)
  - 6. Substitutions: See Section 01 60 00 - Product Requirements.

#### 2.02 MATERIALS

- A. Paint Coatings: Provide the best quality line of low-VOC paint from manufacturers listed.
- B. Color Standard: Sherwin Williams designations used to establish color and quality level.
- C. Provide same brand of prime coats as succeeding coats throughout the work. Do not mix paints of different manufacturers.
- D. Compatibility: Provide block fillers, primers, finish coat and related materials compatible with one another and substrates indicated under conditions of service and application. As demonstrated by manufacturer based on testing and field experience.

#### 2.03 PAINTS AND COATINGS - GENERAL

- A. Paints and Coatings: Ready mixed, except field-catalyzed coatings. Prepare pigments:
  - 1. To a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating.
  - 2. For good flow and brushing properties.
  - 3. Capable of drying or curing free of streaks or sags.
- B. Volatile Organic Compound (VOC) Content:
  - 1. VOC data: All paints and coatings installed in the building interior must meet the testing and product requirements set forth in the LEED-NC 2009 Reference Guide.
- C. Chemical Content: The following compounds are prohibited:
  - 1. Aromatic Compounds: In excess of 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
  - 2. Acrolein, acrylonitrile, antimony, benzene, butyl benzyl phthalate, cadmium, di (2-ethylhexyl) phthalate, di-n-butyl phthalate, di-n-octyl phthalate, 1,2-dichlorobenzene, diethyl phthalate, dimethyl phthalate, ethylbenzene, formaldehyde, hexavalent chromium, isophorone, lead, mercury, methyl ethyl ketone, methyl isobutyl ketone, methylene chloride, naphthalene,

toluene (methylbenzene), 1,1,1-trichloroethane, vinyl chloride.

#### 2.04 PAINT SYSTEMS - EXTERIOR

- A. Ferrous Metals, Unprimed, Latex, 3 Coat:
  - 1. One coat of latex primer; 2.5 mils TDFT.
  - 2. Semi-gloss: Two coats of latex enamel; 1.3 mils TDFT.
- B. Ferrous Metals, Primed, Latex, 2 Coat:
  - 1. Touch-up with rust-inhibitive primer recommended by top coat manufacturer.
  - 2. Semi-gloss: Two coats of latex enamel; 1.3 mils TDFT.
- C. Galvanized Metals, Latex, 3 Coat:
  - 1. One coat galvanize primer as recommended by the manufacturer.
  - 2. Semi-gloss: Two coats of latex enamel; 1.3 mils TDFT.
- D. Pavement Marking Paint:
  - 1. Yellow: One coat; Traffic Marking Paint, 7 mils TDFT.

#### 2.04 PAINT SYSTEMS – LOW-VOC INTERIOR

- A. Wood, Opaque, Latex, 3 Coat:
  - 1. One coat of latex primer sealer; 1.6 mils TDFT.
  - 2. Semi-gloss: Two coats of latex enamel; 1.4 mils TDFT.
- B. Concrete Masonry Units (CMU), Opaque, Epoxy, 3 Coat:
  - 1. One coat of water based epoxy block filler; 10.0 mils TDFT.
  - 2. Semi-gloss: Two coats of high solids epoxy; 2.5 mils TDFT.
- C. Ferrous Metals, Unprimed, Latex, 3 Coat:
  - 1. One coat of latex primer; 2.5 mils TDFT.
  - 2. Semi-gloss: Two coats of latex enamel; 1.4 mils TDFT.
- D. Ferrous Metals, Primed, Alkyd, 2 Coat:
  - 1. Touch-up with alkyd base; 2.0 mils TDFT.
  - 2. Semi-gloss: One coat of alkyd interior enamel; 1.6 mils TDFT.
- E. Galvanized Metals, Latex, 3 Coat:
  - 1. One coat galvanize primer as recommended by the manufacturer.
  - 2. Semi-gloss: Two coats of latex enamel; 1.4 mils TDFT.
- F. Gypsum Board/Plaster, Latex, 3 Coat:
  - 1. One coat of latex primer sealer; 1.6 mils TDFT.
  - 2. Semi-gloss: Two coats of latex enamel; 1.4 mils TDFT.
  - 3. Eggshell: Two coats of latex enamel; 4.6 mils TDFT.
  - 4. Flat: Two coats of latex enamel; 1.6 mils TDFT.

#### 2.06 ACCESSORY MATERIALS

- A. Accessory Materials: Linseed oil, shellac, turpentine, paint thinners and other materials not specifically indicated but required to achieve the finishes specified; commercial quality.
- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that surfaces are ready to receive Work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- C. Test shop-applied primer for compatibility with subsequent cover materials.
- D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
  - 1. Plaster and Gypsum Wallboard: 12 percent.
  - 2. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.
  - 3. Interior Wood: 15 percent, measured in accordance with ASTM D 4442.

### **3.02 PREPARATION**

- A. Surface Appurtenances: Remove electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.
- B. Surfaces: Correct defects and clean surfaces which affect work of this section. Remove or repair existing coatings that exhibit surface defects.
- C. Marks: Seal with shellac those which may bleed through surface finishes.
- D. Impervious Surfaces: Remove mildew by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- E. Concrete and Unit Masonry Surfaces to be Painted: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter in compliance with SSPC-SP13. Allow to dry.
- F. Gypsum Board Surfaces to be Painted: Fill minor defects with filler compound. Spot prime defects after repair.
- G. Aluminum Surfaces to be Painted: Remove surface contamination by steam or high pressure water. Remove oxidation with acid etch and solvent washing. Apply etching primer immediately following cleaning.
- H. Galvanized Surfaces to be Painted: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.
- I. Uncoated Steel and Iron Surfaces to be Painted: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by hand wire brushing or sandblasting; clean by washing with solvent in compliance with SSPC-SP1.
- J. Shop-Primed Steel Surfaces to be Finish Painted: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
- K. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

### **3.03 APPLICATION**

- A. Apply products in accordance with manufacturer's instructions.
- B. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.

- C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- D. Apply each coat to uniform appearance. Apply each coat of paint slightly darker than preceding coat unless otherwise approved.
- E. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

### 3.04 FINISHING MECHANICAL AND ELECTRICAL EQUIPMENT

- A. Refer to Division 23 and Division 26 sections for schedule of color coding of equipment, duct work, piping, and conduit.
- B. Paint shop-primed equipment, where indicated.
- C. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- D. Finish equipment, piping, conduit, and exposed duct work in utility areas in colors according to the color coding scheme indicated.
- E. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

### 3.05 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for general requirements for field inspection.
- B. Owner will provide field inspection and testing.
- C. Inspect and test questionable coated areas in accordance with Owner's requirements.

### 3.06 CLEANING

- A. Collect waste material which may constitute a fire hazard, place in closed metal containers, and remove daily from site.

### 3.07 SCHEDULE - SURFACES TO BE FINISHED

- A. Do Not Paint or Finish the Following Items:
  - 1. Items fully factory-finished unless specifically noted.
  - 2. Fire rating labels, equipment serial number and capacity labels.
  - 3. Stainless steel items.
- B. Mechanical and Electrical: Use paint systems defined for the substrates to be finished.
  - 1. Paint all insulated and exposed pipes occurring in finished areas to match background surfaces, unless otherwise indicated.
  - 2. Paint all equipment, including that which is factory-finished, exposed to weather or to view on the roof and outdoors.
  - 3. Paint shop-primed items occurring in finished areas.
  - 4. Paint interior surfaces of air ducts that are visible through grilles and louvers with one coat of flat black paint to visible surfaces.
  - 5. Paint dampers exposed behind louvers, grilles, to match face panels.
- C. Paint both sides and edges of plywood backboards for electrical and telephone equipment before installing equipment.

### 3.08 SITE ENVIRONMENTAL PROCEDURES

- A. Indoor Air Quality:
  - 1. Temporary ventilation: Provide temporary ventilation for work of this Section.

B. Waste Management:

1. Coordinate with manufacturer for take-back program. Set aside scrap to be returned to manufacturer for recycling into new product. Close and seal all partially used containers of paint to maintain quality as necessary for reuse.

**END OF SECTION 09 90 00**

**SECTION 10 11 00**  
**VISUAL DISPLAY SURFACES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Markerboards

**1.02 RELATED SECTIONS**

- A. Section 09 21 16 - Gypsum Board Assemblies: Concealed supports in metal stud walls.

**1.03 REFERENCES**

- A. ANSI A135.4 - American National Standard for Basic Hardboard; 2004.
- B. ASTM A 424 - Standard Specification for Steel, Sheet, for Porcelain Enameling; 2000.
- C. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2005.
- D. ASTM F 793 - Standard Classification of Wallcovering by Durability Characteristics; 1993 (Reapproved 2004).
- E. FS L-P-1040 - Plastic Sheets and Strips (Polyvinyl Fluoride); Federal Specifications and Standards; Revision B, 1977.

**1.04 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's data on decorative display board cabinet, map rail, markerboard, tackboard, trim, accessories, and marker tray.
- C. Samples: Submit color charts for selection of color and texture of markerboard, tackboard, tackboard surface covering, and trim.
- D. Test Reports: Show conformance to specified surface burning characteristics requirements.
- E. Manufacturer's printed installation instructions.
- F. Maintenance Data: Include data on regular cleaning, stain removal.

**1.05 QUALITY ASSURANCE**

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

**1.06 WARRANTY**

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year warranty for and markerboard to include warranty against discoloration due to cleaning, crazing or cracking, and staining.



## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Visual Display Boards:
  - 1. Best-Rite: [www.best-rite.com](http://www.best-rite.com).
  - 2. Claridge Products and Equipment, Inc: [www.claridgeproducts.com](http://www.claridgeproducts.com).
  - 3. Polyvision Corporation (Nelson Adams): [www.polyvision.com](http://www.polyvision.com).
  - 4. Substitutions: See Section 01 60 00 - Product Requirements.

### **2.02 VISUAL DISPLAY BOARDS**

- A. Markerboards: Porcelain enamel on steel, laminated to core.
  - 1. Color: White.
  - 2. Metal Face Sheet Thickness: 0.024 inch (24 gage).
  - 3. Core: Hardboard, manufacturer's standard thickness, laminated to face sheet.
  - 4. Backing: Galvanized steel sheet, laminated to core.
  - 5. Sizes: as noted on drawings
  - 6. Frame: Extruded aluminum, with concealed fasteners.
  - 7. Frame Finish: Anodized, natural.
  - 8. Accessories: Provide tack strips, map rail and marker tray.

### **2.03 MATERIALS**

- A. Porcelain Enameled Steel Sheet: ASTM A 424, Type I, Commercial Steel, with fired-on vitreous finish.
- B. Vinyl Coated Fabric: ASTM F 793 Category VI; clear top overcoat of polyvinyl fluoride in accordance with FS L-P-1040 Type 1, Grade B, Class 2, 0.0005 inch thick.
- C. Hardboard for Cores: AHA A135.4, Class 1 - Tempered, S2S (smooth two sides).
- D. Steel Sheet Backing: Manufacturer's standard thickness.
- E. Adhesives: Type used by manufacturer.

### **2.04 ACCESSORIES**

- A. Tack Strip: Heavy gage extruded aluminum with 1 3/8 inch wide tan cork insert, approximately 2 inches wide overall.
  - 1. Product; No. 74 Deluxe Map and Display Rail, Basis of Design by Claridge Products and Equipment.
- B. Map Rail: Extruded aluminum, manufacturer's standard profile, with cork insert and runners for accessories; 1 inch wide overall, full width of frame.
- C. Map Supports: Formed aluminum sliding hooks and roller brackets to fit map rail.
- D. Temporary Protective Cover: Sheet polyethylene, 8 mil thick.
- E. Cleaning Instruction Plate: Provide instructions for markerboard cleaning on a metal plate fastened to perimeter frame near marker tray.
- F. Marker Tray: Aluminum, manufacturer's standard profile one piece full length of markerboard, closed ends; manufacturer's standard fastening method, same finish as frame.
- G. Mounting Brackets: Concealed.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that field measurements are as indicated.
- B. Verify that internal wall blocking is ready to receive work and positioning dimensions are as indicated on shop drawings.

### **3.02 INSTALLATION**

- A. Install boards in accordance with manufacturer's instructions.
- B. Install tackable surface material in accordance with manufacturer's instructions.
- C. Secure units level and plumb.
- D. Butt Joints: Install with tight hairline joints.
- E. Carefully cut holes in boards for thermostats, wall switches, and accessories.

### **3.03 CLEANING**

- A. Clean board surfaces in accordance with manufacturer's instructions.
- B. Cover with protective cover, taped to frame.
- C. Remove temporary protective cover at date of Substantial Completion.

**END OF SECTION 10 11 00**

**SECTION 10 21 13**  
**PLASTIC TOILET COMPARTMENTS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Solid plastic toilet compartments.
- B. Urinal screens.

**1.02 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall supports, door swings.
- C. Product Data: Provide data on panel construction, hardware, and accessories.
- D. Samples: Submit two samples of partition panels, 6 x 6 inch in size illustrating panel finish, color, and sheen.
- E. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

**1.03 COORDINATION**

- A. Coordinate the work with placement of support framing and anchors in wall.

**1.04 QUALITY ASSURANCE**

- A. Regulatory Requirements: Conform to ANSI A117.1 code for access for the handicapped operation of toilet compartment door and hardware.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Plastic Toilet Compartments:
  - 1. ASI: [www.asi-globalpartitions.com](http://www.asi-globalpartitions.com).
  - 2. Scranton Products: [www.scrantonproducts.com](http://www.scrantonproducts.com).
  - 3. Bobrick Washroom Equipment, Inc.: [www.bobrick.com](http://www.bobrick.com)
  - 4. Santana Products Co., Inc: [www.hinyhider.com](http://www.hinyhider.com).
  - 5. Substitutions: Section 01600 - Product Requirements.

**2.02 COMPONENTS**

- A. Toilet Compartments: Solid molded plastic panels, doors, and pilasters, floor-mounted headrail-braced.
  - 1. Color: As selected by the Architect from the manufacturer's standard colors.
  - 2. Content: Maximize the percent of post-consumer recycled content.
- B. Door and Panel Dimensions:
  - 1. Thickness: 1 inch.
  - 2. Door Width: 24 inch.

3. Door Width for Handicapped Use: 36 inch, out-swinging.
4. Height: 58 inch.
5. Thickness of Pilasters: 1 inch.

- B. Urinal Screens: Wall mounted with two panel brackets, and floor-to-ceiling vertical upright consisting of tubular headrail stock and sockets anchored to floor and ceiling.
1. Color: As selected by the Architect from the manufacturer's standard colors.
  2. Content: Maximize the percent of post-consumer recycled content.

## 2.03 ACCESSORIES

- A. Pilaster Shoes: Formed plastic to match, 3 in high, concealing floor fastenings.
1. Provide adjustment for floor variations with screw jack through steel saddles integral with pilaster.
- B. Head Rails: Hollow anodized aluminum tube, 1 x 1-5/8 inch size, with anti-grip strips and cast socket wall brackets.
- C. Pilaster Brackets: Plastic, to match.
- D. Wall Brackets: Continuous type, plastic, to match.
- E. Attachments, Screws, and Bolts: Stainless steel, tamper proof type.
1. For attaching panels and pilasters to brackets: Through-bolts and nuts; tamper proof.
- F. Hardware: Natural anodized aluminum:
1. Pivot hinges, gravity type, adjustable for door close positioning; two per door.
  2. Nylon bearings.
  3. Door Latch: Slide type with exterior emergency access feature.
  4. Door strike and keeper with rubber bumper; mounted on pilaster in alignment with door latch.
  5. Coat hook with rubber bumper; one per compartment, mounted on door.
  6. Provide door pull for outswinging doors.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify correct spacing of and between plumbing fixtures.
- C. Verify correct location of built-in framing, anchorage, and bracing.
- D. Report in writing to Architect prevailing conditions that will adversely affect satisfactory execution of the Work of this Section. Do not proceed with Work until unsatisfactory conditions have been corrected

### 3.02 INSTALLATION

- A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.
- B. Maintain 3/8 to 1/2 inch space between wall and panels and between wall and end pilasters.
- C. Attach panel brackets securely to walls using anchor devices.
- D. Attach panels and pilasters to brackets. Locate head rail joints at pilaster center lines.

### 3.03 ERECTION TOLERANCES

- A. Maximum Variation From True Position: 1/4 inch.
- B. Maximum Variation From Plumb: 1/8 inch.

#### 3.04 ADJUSTING

- A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch.
- B. Adjust hinges to position doors in partial opening position when unlatched. Return out-swinging doors to closed position.
- C. Adjust adjacent components for consistency of line or plane.

**END OF SECTION 10 21 13**

**SECTION 10 26 00  
SHEET WALL PROTECTION**

**PART 1 - GENERAL**

- 1.01 Summary
  - A. This section includes the following types of wall protection systems:
    - 1. Wall Covering
  - B. Related sections:
    - 1. Section 09 21 16 – Gypsum Board Assemblies
    - 2. Section 11 66 23 – Gymnasium Protection accessories
- 1.02 References
  - A. National codes (IBC, UBC, SBCCI, BOCA and Life Safety)
  - B. American Society for Testing and Materials (ASTM)
  - C. Underwriters Laboratories (UL)
  - D. California 01350 specification
- 1.03 Submittals

General: Submit the following in accordance with conditions of contract and Division 1 specification section 01 33 00 "Submittal Procedures":

  - A. Product data and detailed specifications for each system component and installation accessory required, including installation methods for each type of substrate.
  - B. Shop drawings showing locations, extent and installation details of wall covering products.
  - C. Samples for verification purposes: Submit the following samples, as proposed for this work, for verification of color, texture, pattern and thickness:
    - 1. Sample of each product specified available in 4" x 4" standard size. Available colors: solid, woodgrain & patterns, Acrovyn by Design® and textures.
  - D. Product test reports from a qualified independent testing laboratory showing compliance of each component with requirements indicated.
  - E. Maintenance data for wall protection system components for inclusion in the operating and maintenance manuals specified in Division 1.
- 1.04 Quality Assurance
  - A. Installer qualifications: Engage an installer who has no less than 3 years experience in installation of systems similar in complexity to those required for this project.
  - B. Manufacturer's qualifications: Not less than 5 years experience in the production of specified products and a record of successful in-service performance.
  - C. Code compliance: Assemblies should conform to all applicable codes including IBC, UBC, SBCCI, BOCA, Life Safety and CA 01350.
  - D. Fire performance characteristics: Provide engineered PVC FREE wall protection system components with UL label indicating that they are identical to those tested in accordance with ASTM E84 for composite (sheet and adhesive) Class A/1 fire performance characteristics listed below:
    - 1. Flame spread: 25 or less
    - 2. Smoke developed: 450 or less
  - E. Impact strength: Provide wall protection components that have been tested for impact using a ram-type impact test in accordance with the applicable provisions of ASTM F476 -84 .
  - F. Chemical and stain resistance: Provide wall protection system components with chemical and stain resistance in accordance with ASTM D543.
  - G. Color match: Provide wall protection components that are color matched in accordance with the following:
    - 1. Delta Ecmc of no greater than 1.0 using CIELab color space. (Specifier note:

- Construction Specialties' colors are matched under cool white fluorescent lighting and computer controlled within manufacturing tolerances. Color may vary if alternate lighting sources are present.)
- H. Single source responsibility: Provide all components of the wall protection system manufactured by the same company to ensure compatibility of color, texture and physical properties.
- 1.05 Delivery, Storage and Handling
- A. Deliver materials to the project site in unopened original factory packaging clearly labeled to show manufacturer.
  - B. Store materials in undamaged packaging in a clean, dry place out of direct sunlight and exposure to the elements. A minimum room temperature of 40°F (4°C) and a maximum of 100°F (38°C) should be maintained.
  - C. Materials must be stored flat.
- 1.06 Project Conditions
- A. Materials must be acclimated in an environment of 65-75°F (18-24°C) for at least 24 hours prior to beginning the installation.
  - B. Installation areas must be enclosed and weatherproofed before installation commences.
- 1.07 Warranty
- A. Acrovyn 5-year Limited Warranty
    - Applies to Interior Wall Protection orders that do not include recommended components or accessories
      - Accessories = Primer, Adhesive, Caulk, Trims & Moldings
  - B. Limited Lifetime Systems Warranty
    - Applies to CS Interior Wall Protection projects that include all recommended components and accessories related to CS Interior Wall Protection Products.
      - Accessories = Primer, Adhesive, Caulk, Trims & Moldings

## **PART 2 - PRODUCTS**

- 2.01 Manufacturers
- A. Interior surface protection products specified herein and included on the submittal drawings shall be manufactured by Construction Specialties, Inc., 3 Werner Way, Lebanon, NJ 08833 USA 800-233-8493; email: [cet@c-sgroup.com](mailto:cet@c-sgroup.com)
  - B. Drawings and specifications are based on manufacturer's literature from Construction Specialties, Inc. drawings and specifications unless otherwise indicated. Other manufacturers must be approved equal by Architect/Owner.
- 2.02 Materials
- A. Engineered PVC FREE: Rigid sheet should be high-impact Acrovyn 4000 with standard Suede texture. Chemical and stain resistance should be per ASTM D543 standards as established by the manufacturer.
    - 1. Nominal Thickness: .075" (1.91 mm)
  - B. Aluminum: Optional aluminum trims to be alloy 6063 T5 with clear or colored anodized finish; minimum strength and durability properties as specified in ASTM B221. The colored anodized finish is available in eight colors and is not covered under 1.04.G.
  - C. Cured ColorFlex® II Bacteria Resistant Caulk has a Shore A value of greater than 55 (product considered "pick-resistant" based on industry standards) testing conducted by independent lab in accordance with ASTM C661 and ASTM C920.
  - D. Acrovyn trim offering is available for .040" (1.02mm), .060" (1.52 mm) and .075" (1.91 mm) thickness. Vertical, Wainscot, inside and outside corner trims are available in 10' lengths. Visible trim width is 3/8" (9.53mm).

- 2.03 Wall Covering
  - A. Engineered PVC FREE rigid sheet to be CS Acrovyn:
    - 1. Sheet Size:
      - a) Suede Texture (standard) 4' x10'
    - 2. Finishes:
      - a) Select from one of Acrovyn solid colors: To be selected by Architect from Manufacturer's full range of colors
    - 3. Color-matched caulk and Acrovyn trims for joints/transitions.
- 2.04 Fabrication
  - A. General: Fabricate wall covering to comply with requirements indicated for design, dimensions, detail, finish and sizes.
- 2.05 Finishes
  - A. General: Comply with NAAMM "Metal Finishes Manual" for recommendations relative to applications and designations of finishes.
- 2.06 Accessories
  - A. Adhesive and Primer: Acrovyn wall covering shall be furnished as a complete packaged system, including appropriate standard adhesive.
  - B. Bacteria Resistant caulk and trims available for purchase.

### **PART 3 - EXECUTION**

- 3.01 Examination
  - A. Verification of conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.
    - 1. Do not proceed until unsatisfactory conditions have been corrected.
- 3.02 Preparation
  - A. Surface preparation: Prior to installation, clean substrate to remove dirt, debris and loose particles. Perform additional preparation procedures as required by manufacturer's instructions. Minimum Level 3 wall finish is required; for surfaces with Level 5 finish, ensure the surface and any surface coatings are fully dry and cured.
  - B. Protection: Take all necessary steps to prevent damage to material during installation as required in manufacturer's installation instructions.
  - C.
  - D. Protection: Take all necessary steps to prevent damage to material during installation as required in manufacturer's installation instructions.
- 3.03 Installation
  - A. Install the work of this section in strict accordance with the manufacturer's recommendations using approved adhesive. Note there are special installation instructions for non-standard conditions: radius walls, tile, CMU block, etc.
  - B. Temperature at the time of installation must be between 65-75°F (18-24°C) and be maintained for at least 48 hours after the installation to allow for proper adhesive set-up.
  - C. Relative humidity shall not exceed 80%.
  - D. Do not expose wall covering to direct sunlight during or after installation. This will cause the surface temperature to rise, which in turn will cause bubbles and delamination.
- 3.04 Cleaning
  - A. General: Immediately upon completion of installation, clean material in accordance with



manufacturer's recommended cleaning method.

- B. Remove surplus materials, rubbish and debris resulting from installation as work progresses and upon completion of work.

3.05 Protection

- A. Protect installed materials to prevent damage by other trades. Use materials that may be easily removed without leaving residue or permanent stains.

**END OF SECTION**

**SECTION 10 26 03**  
**WALL CORNER PROTECTION**

**PART 1 - GENERAL**

1.01 SECTION INCLUDES

- A. Corner Guard and End Wall Protection, Stainless Steel

1.02 SUBMITTALS

- A. Comply with requirements of Section 01 33 00 Submittals.
- B. Product data: Submit manufacturer's product data.
- C. Shop drawing: Submit shop drawings showing components, dimensions, anchorage details.
- D. Samples: Submit for approval 12 inch long sample for each model and color specified, including end caps and corner units.

1.03 QUALITY ASSURANCE

- A. Single Source Responsibility: Furnish all wall protection system components from a single source.
- B. Manufacturer: A firm regularly engaged in the manufacture of wall protection system components similar to those specified.
- C. Installer: A firm with at least 3 years of successful experience in the installation of wall protection systems similar to those specified.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging with labels clearly indicating manufacturer and material.
- B. Storage: Store materials indoors in a clean, dry area protected from damage and in accordance with manufacturer's instructions.
- C. Handling: Protect materials during handling and installation to prevent damage

**PART 2 - PRODUCTS**

2.01 MANUFACTURER

- A. Basis of Design: Nystrom, 9300 73rd Ave N, Minneapolis, MN 55428, PH: 800.547.2635, [www.nystrom.com](http://www.nystrom.com)
- B. Substitutions are allowed provided they meet the technical aspects of the specifications and drawings.

2.02 CORNER GUARD, STAINLESS STEEL, SURFACE MOUNT

- A. Surface mount stainless steel corner guards and end wall protection with variable wings and inside dimensions.
  - 1. Dimensions: see drawings
  - 2. Material
    - a. Stainless Steel Type #304, 16 Gauge Stainless Steel, Satin #4 Finish with rounded edged and protective coating
  - 3. Mounting:
    - a. Mastic Adhesive
      - 1. Contact manufacturer for finish options

- b. Stainless Steel Type #430, 16 gauge Stainless Steel, Satin #4 Finish with rounded edged and protective coating

**PART 3 - EXECUTION**

**3.01 EXAMINATION**

- A. Verify by examination that wall surface is acceptable to receive the specified bumper guard. Notify the Architect in writing if wall surfaces are not acceptable. Do not begin installation until unacceptable conditions have been corrected.

**3.02 INSTALLATION**

- A. Install corner guards to wall securely in accordance with manufacturer's written instructions.
- B. Install corner guards accurately in location, alignment, and elevation.
- C. Provide horizontal steel stud back up in drywall stud cavity to accept fasteners.

**END OF SECTION**

**SECTION 10 28 13**  
**TOILET ACCESSORIES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Accessories for toilet rooms, shower, and utility rooms.
- B. Grab bars.

**1.02 RELATED SECTIONS**

- A. Section 06 10 00 - Rough Carpentry: Wood Blocking and placement of concealed anchor devices.
- B. Section 10 21 13 - Plastic Toilet Compartments.

**1.03 REFERENCES**

- A. ASTM A 269 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2004.
- B. ASTM A 666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2003.
- C. ASTM C 1036 - Standard Specification for Flat Glass; 2001.
- D. GSA CID A-A-3002 - Mirrors, Glass; U.S. General Services Administration; 1996.

**1.04 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on accessories describing size, finish, details of function, attachment methods.
- C. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention.

**1.05 COORDINATION**

- A. Coordinate the work with the placement of internal wall reinforcement to receive anchor attachments.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Toilet Accessories:
  - 1. American Specialties, Inc: [www.americanspecialties.com](http://www.americanspecialties.com). (Basis of Design)
  - 2. Bobrick Washroom Equipment, Inc.: [www.bobrick.com](http://www.bobrick.com).

3. A & J Washroom Accessories Inc: [www.ajwashroom.com](http://www.ajwashroom.com).
4. Bradley Corporation: [www.bradleycorp.com](http://www.bradleycorp.com).
5. Substitutions: Section 01 60 00 - Product Requirements.

B. All items of each type to be made by the same manufacturer.

C. Underlatory Guards:

1. Brocar Products, Inc.
2. Truebro, Inc.

## 2.02 MATERIALS

- A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
1. Grind welded joints smooth.
  2. Fabricate units made of metal sheet of seamless sheets, with flat surfaces.
- B. Keys: Provide three keys for each accessory to Owner; master key all lockable accessories.
- C. Stainless Steel Sheet: ASTM A 666, Type 304.
- D. Stainless Steel Tubing: ASTM A 269, Type 304 or 316.
- E. Mirror Glass: Float glass, ASTM C 1036 Type I, Class 1, Quality Q2, with silvering, copper coating, and suitable protective organic coating to copper backing in accordance with GSA CID A-A-3002.
- F. Adhesive: Two component epoxy type, waterproof.
- G. Fasteners, Screws, and Bolts: Hot dip galvanized, tamper-proof, security type.

## 2.03 FINISHES

- A. Stainless Steel: No. 4 satin brushed finish, unless otherwise noted

## 2.04 TOILET ROOM ACCESSORIES

- A. Mirrors: Stainless steel framed, 6 mm thick float glass mirror.
1. Size: as shown on drawings
  2. Frame: 0.05 inch angle shapes, with mitered and welded and ground corners, and tamperproof hanging system; satin finish.
  3. Backing: Full-mirror sized, minimum 0.03 inch galvanized steel sheet and nonabsorptive filler material.
  4. Mirror with Stainless Steel Angle Frame: 0600 Series manufactured by ASI.
- B. Grab Bars: Stainless steel, 1-1/2 inches outside diameter, minimum 0.05 inch wall thickness, nonslip grasping surface satin finish, concealed flange mounting; 1-1/2 inches clearance between wall and inside of grab bar.
1. Length and configuration: As indicated on drawings.
  2. Product: 3000 Series manufactured by ASI.

- C. Sanitary Napkin Disposal Unit: Stainless steel, self-closing door, locking bottom panel with full-length heavy-duty stainless steel multi-staked piano hinge, removable receptacle.
  - a. Mounting: As indicated in product listing.
  - b. Cabinet and Door: Fully welded, 22 gauge, 0.03 inch (0.8 mm) thick sheet.
  - c. Products:
    - i. Model 20852 - Roval Collection - Sanitary Waste Receptacle - Surface-mounted.
    - ii. Substitutions: Section 016000 - Product Requirements.
- D. Shower Curtain:
  - a. Material: Opaque vinyl, 0.008 inch (0.2 mm) thick, matte finish, with antibacterial treatment, flameproof and stain resistant.
  - b. Material: Cotton, machine washable, and mildew resistant.
  - c. Size: 36 by 72 inches (914 by 1830 mm), hemmed edges.
  - d. Grommets: Stainless steel; pierced through top hem on 6 inch (150 mm) centers.
  - e. Color: White.
  - f. Shower Curtain Hooks: Chrome-plated or stainless steel spring wire designed for snap closure.
  - g. Products:
    - i. Model 1200-SHU - Shower Curtain Hook - Stainless Steel.
    - ii. Substitutions: Section 016000 - Product Requirements.
- E. Shower Curtain Rod: Stainless steel tube, 1 inch (25 mm) OD, 18 gauge, satin-finished, with 2 satin-finished stainless steel flanges, for installation with exposed fasteners.
  - a. Products:
    - i. Model 1201-B - Opposite Wall Installation - Shower Curtain Rod, Curved with Mounting Brackets.
    - ii. Substitutions: Section 016000 - Product Requirements.
- F. Double Robe Hook: 304 stainless steel, double-prong, circular-shaped bracket and backplate for concealed attachment, satin finish.
  - a. Products:
    - i. Model 7312 - Robe Hook - Double.
    - ii. Substitutions: Section 016000 - Product Requirements.
- G.
- D. Mop holder with shelf, surface mounted.
  - 1. Size: 36" L x 8" D x 6"H
  - 2. 4 mop holders, 3 hooks, 1 rod.
  - 3. Product: B-224 manufactured by Bobrick.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify exact location of accessories for installation.
- C. Verify that field measurements are as indicated on drawings.

- D. See Section 06 10 00 – Rough Carpentry for installation of blocking, reinforcing plates, and concealed anchors in walls, and ceilings.

### 3.02 PREPARATION

- A. Deliver inserts and rough-in frames to site for timely installation.
- B. Provide templates and rough-in measurements as required.

### 3.03 INSTALLATION

- A. Install accessories in accordance with manufacturers' instructions.
- B. Install plumb and level, securely and rigidly anchored to substrate.
- C. Mounting Heights and Locations: As required by accessibility regulations and as indicated on drawings. Coordinate with architect.

**END OF SECTION 10 28 13**

## **SECTION 10 44 00**

### **FIRE EXTINGUISHERS, CABINETS AND ACCESSORIES**

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Fire extinguishers.
- B. Fire extinguisher cabinets.
- C. Accessories.

##### **1.02 REFERENCES**

- A. NFPA 10 - Standard for Portable Fire Extinguishers; National Fire Protection Association; 2002.
- B. UL (FPED) - Fire Protection Equipment Directory; Underwriters Laboratories Inc.; current edition.

##### **1.03 PERFORMANCE REQUIREMENTS**

- A. Conform to NFPA 10.
- B. Provide extinguishers classified and labeled by Underwriters Laboratories Inc. for the purpose specified and indicated.

##### **1.04 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide extinguisher operational features, color and finish, and anchorage details.
- C. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

##### **1.05 ENVIRONMENTAL REQUIREMENTS**

- A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

##### **1.06 EXTRA MATERIALS**

- A. Provide five (5) additional fire extinguishers with wall bracket for placement at locations designated by the Architect.

#### **PART 2 PRODUCTS**

##### **2.01 MANUFACTURERS**

- A. Fire Extinguishers, Cabinets and Accessories:
  - 1. JL Industries, Inc: [www.jlindustries.com](http://www.jlindustries.com).
  - 2. Larsen's Manufacturing Co: [www.larsensmfg.com](http://www.larsensmfg.com).
  - 3. Potter-Roemer: [www.potterroemer.com](http://www.potterroemer.com).
  - 4. Substitutions: See Section 01 60 00 - Product Requirements.



## 2.02 FIRE EXTINGUISHERS

- A. Dry Chemical Type: Cast steel tank, with pressure gage.
  - 1. Class B:C.
  - 2. Size 10.
  - 3. Size and classification as scheduled.
  - 4. Finish: Baked enamel, color as selected.

## 2.03 FIRE EXTINGUISHER CABINETS

- A. Metal: Formed steel sheet; 12 gage door and frame, 16 gage tub.
- B. Cabinet Configuration: Semi-recessed type.
  - 1. Sized to accommodate accessories.
  - 2. Form cabinet enclosure with right angle inside corners and seams. Form perimeter trim and door stiles.
- C. Door: 0.105 inch thick, reinforced for flatness and rigidity; latch. Hinge doors for 180 degree opening with two butt hinge. Provide roller type catch.
- D. Door Glazing: Glass, clear, 1/4 inch thick tempered. Set in resilient channel gasket glazing.
- E. Cabinet Mounting Hardware: Appropriate to cabinet. Pre-drill for anchors.
- F. Weld, fill, and grind components smooth.
- G. Finish of Cabinet Exterior Trim and Door: Stainless Steel.
- H. Finish of Cabinet Interior: Stainless Steel.

## 2.04 ACCESSORIES

- A. Extinguisher Brackets: Formed steel, galvanized and enamel finished.

# PART 3 EXECUTION

## 3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify rough openings for cabinet are correctly sized and located.

## 3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Secure rigidly in place.
- C. Place extinguishers and accessories in cabinets and on wall brackets.

**END OF SECTION 10 44 00**

**SECTION 10 51 13**  
**HEAVY-DUTY STEEL LOCKERS**

**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

- A. Heavy-duty steel lockers.
- B. Athletic lockers
- C. Locker Room Benches

**1.2 RELATED SECTIONS**

- A. Section 03300 (03 30 00) – Cast-in-Place Concrete: Concrete bases.
- B. Section 06100 (06 10 00) – Rough Carpentry: Wood ground and furring for anchoring lockers.
- C. Section 09650 (09 65 13.13) – Resilient Base.

**1.3 REFERENCES**

- A. ASTM A 653 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- B. ASTM A 1008 – Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.

**1.4 SUBMITTALS**

- A. Comply with Section 01330 (01 33 00) – Submittal Procedures.
- B. Product Data: Submit manufacturer's product data and installation instructions.
- C. Shop Drawings: Submit manufacturer's shop drawings, indicating construction, materials, dimensions, door frames, doors, handles, locks, ventilation, options, accessories, locker benches, finish, locker layout, anchoring, and installation details.
- D. Samples: Submit manufacturer's standard color samples.
- E. Warranty: Submit manufacturer's standard warranty.

**1.5 QUALITY ASSURANCE**

- A. Pre-installation Meeting: Convene pre-installation meeting 2 weeks before start of installation of lockers. Require attendance of parties directly affecting work of this section, including Contractor, Architect, installer, and manufacturer's representative. Review installation, adjusting, cleaning, protection, and coordination with other work.

**1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- B. Storage: Store materials in clean, dry area indoors in accordance with manufacturer's instructions.
- C. Handling: Protect materials and finish during handling and installation to prevent damage.

**PART 2 PRODUCTS**

**2.1 MANUFACTURER**

- A. Lyon LLC, PO Box 671, Aurora, Illinois 60507. Toll Free (800) 323-0082. Phone (630) 892-8941. Fax (800) 367-6681. Web Site [www.lyonworkspace.com](http://www.lyonworkspace.com). E-Mail [lyon@lyonworkspace.com](mailto:lyon@lyonworkspace.com).

## 2.2 HEAVY-DUTY STEEL LOCKERS

### A. Model: Heavy Duty Ventilated Lockers

1. Style: As indicated on the Drawings.
2. Locker Size: As indicated on the Drawings.
3. Locker Configuration: As indicated on the Drawings
4. Construction: Fully assembled.
5. Material:
  - a. Steel: ASTM A 1008, Class I, mild-annealed, cold-rolled steel, free from surface imperfections
  - b. Bolts: Zinc plated or other comparable rust-retardant treatment.
6. Body:
  - a. 16-gauge steel.
  - b. Flanged to give double thickness of metal at seams, joints, and corners.
  - c. Back: 18-gauge steel
7. Door Frame:
  - a. 16-gauge formed-steel channels.
  - b. Vertical Members: Additional flange to form continuous door strike.
  - c. Corners: Lapped and welded into rigid assembly.
  - d. Bottom Cross Members: Tang at each end that fits through slot in rear flange of upright frame member to prevent twisting out of alignment.
  - e. Top and Bottom Cross Members: Provide support for front edge of locker top and bottom.
8. Doors:
  - a. 1-piece, 14-gauge steel.
  - b. Single, Double, and Triple-Tier Locker Doors: Both vertical edges formed into channel-shaped formation. Top and bottom flanged at 90-degree angle.
  - c. Multiple-Tier Locker Doors: Hinge side formed into channel-shaped formation with other 3 sides flanged at 90-degree angle.
9. Ventilation:
  - d. Single-Tier Lockers: 2 groups of diamond-shaped perforations for each door. Sides and shall be punched with diamond shape perforations.
10. Hinges:
  - a. Height: Minimum of 2 inches.
  - b. Type: 0.050-inch thick steel, 5-knuckle, full-loop hinge forming double thickness on each leaf.
  - c. Attachment: Set hinges in slot in door and frame and projection welded to frame and securely attached to door.
  - d. Hinge Pin: Spun over at ends to resist removal.
  - e. Single-Tier Lockers, 48 Inches and Higher: 3 hinges.
  - f. All Other Tiers: 2 hinges.
  - g. Mounting: Right-hand side of door.
11. Multi-Point Locking Device:
  - a. Single-Tier Lockers, 48 Inches and Higher, Locking Device: Engage frame at 3 points.
  - b. Double and Triple-Tier Locking Device: Engage frame at 2 points.
  - c. Channel-Shaped Locking Device:
    - d. Full-length reinforcing ribs.
    - e. Quiet design using nylon-guide inserts to reduce metal-to-metal contact.
    - f. Lock Bar: Enclosed on 3 sides and operate within channel formation of door.
    - g. Locking Device: Prelocking so mechanism can be locked in open position. Door locking automatically when closed.
  - h. Door Jambs:
    - i. Single-Tier Lockers, 48 Inches and Higher: 3 door jambs.
    - ii. Double and Triple-Tier Lockers: 2 jambs welded to side of door frames to engage locking device.
    - iii. Safety Reverse Nose for Each Jamb: Eliminate hazard of sharp-pointed edges protruding into locker.
    - iv. Easily replaceable soft rubber bumper for each jamb.
  - i. Multiple-Tier Lockers: 14-gauge steel lock clip for attaching padlock.
  - j. Doors: Provided with lock hole filler to permit use of built-in key or combination lock.

12. Handles:

- a. Recessed Handles:
  - i. Single, double, and triple-tier lockers and 2-person lockers.
  - ii. 4-1/8 inches wide by 6-1/16 inches high by 1-1/4 inches deep.
  - iii. Flush-front appearance.
  - iv. Finger lift activates door lock.

13. Shelves:

- a. Single-tier lockers.
- b. 1 shelf, approximately 9 inches below top.
- c. Single sheet, 16-gauge steel.
- d. Flanged on 4 sides.
- e. Safety Front Flange: Double flanged with second bend turned 45 degrees.
- f. Attachment: Minimum of 2 points through each side flange.

14. Coat Hooks:

- a. Single, double, and triple-tier lockers.
- b. 1 double-prong ceiling hook and 3 single-prong wall hooks.
- c. Steel rod stock with ball points for snag-free use.
- d. Attachment: 2 bolts.
- e. Finish: Zinc-plated or comparable rust-retardant treatment.

B. Model: Victory Locker; Athletic Lockers

- 1. Style: As indicated on the Drawings.
- 2. Locker Size: As indicated on the Drawings.
- 3. Locker Configuration: Provide Footlocker
- 4. Construction: Fully assembled.
- 5. Material:
  - a. Steel: ASTM A 1008, Class I, mild-annealed, cold-rolled steel, free from surface imperfections
  - b. Bolts: Zinc plated or other comparable rust-retardant treatment.
- 6. Body:
  - a. 16-gauge steel.
  - b. Flanged to give double thickness of metal at seams, joints, and corners.
  - c. Back: 18-gauge steel
- 7. Door Frame:
  - a. 16-gauge formed-steel channels.
  - b. Vertical Members: Additional flange to form continuous door strike.
  - c. Corners: Lapped and welded into rigid assembly.
  - d. Bottom Cross Members: Tang at each end that fits through slot in rear flange of upright frame member to prevent twisting out of alignment.
  - e. Top and Bottom Cross Members: Provide support for front edge of locker top and bottom.
- 8. Doors:
  - a. 1-piece, 14-gauge steel.
  - b. Single, Double, and Triple-Tier Locker Doors: Both vertical edges formed into channel-shaped formation. Top and bottom flanged at 90-degree angle.
  - c. Multiple-Tier Locker Doors: Hinge side formed into channel-shaped formation with other 3 sides flanged at 90-degree angle.
- 9. Ventilation:
  - a. Diamond-shaped perforations at each side
- 10. Shelves:
  - a. 1 upper shelf, approximately 12 inches below top.
  - b. Single sheet, 16-gauge steel.
  - c. Flanged on 4 sides.
  - d. Full width 2" high steel name plate
  - e. Attachment: Minimum of 2 points through each side flange.
- 11. Coat Hooks:
  - a. Steel coat rod with 4 hooks
  - b. Finish: Zinc-plated or comparable rust-retardant treatment.
- 12. Foot Locker:
  - a. Extends 9" past main locker frame
  - b. Height: 18"

- c. Lid Hinge: Full width piano hinge.

## 2.3 ACCESSORIES

- A. Number Plates:
  - 1. Aluminum.
  - 2. Size: 2-3/4 inches wide by 1 inch high.
  - 3. Numbers: Clearly etched numbers a minimum of 3/8 inch high.
  - 4. Attachment: Attach in prepunched holes near top of doors.
- B. Tops: Flat.
- C. Bottoms: Painted galvanized steel, 16 gauge
- D. Bases: None.
- E. Floor Anchoring: Anchor lockers to floor in accordance with manufacturer's instructions.
- F. Closures and Fillers:
  - 1. Top closures, closure strips, front expansion fillers, and corner fillers.
  - 2. Fill spaces between 2 lockers or between lockers and walls as required for proper fit.
- G. End Panels:
  - 1. End Cover Panels: 14-gauge steel, construction bolt heads exposed at perimeter.
  - 2. End Finishing Panels: 16-gauge steel, no bolt heads exposed.
- H. Recess Trim:
  - 1. End and Top Recess Trim for Lockers to be Placed in Wall Recesses: 18-gauge formed steel with 2-3/4-inch wide face. Bolted to locker frames.
  - 2. Top Recess Trim: Approximately 5'-0" lengths with formed splice cap to cover joints and to hold top recess trim in alignment.
  - 3. End Recess Trim: 2-3/4 inches higher than lockers and lap over ends of top recess trim for neat joint at top of corners.

## 2.4 LOCKER BENCHES

- A. Laminated Hardwood Benches:
  - 1. Top: Laminated hardwood with clear coat finish.
    - a. Size: 9-1/2 inches wide by 1-1/4 inches thick. See drawings for lengths
    - b. Finish: Acrylic, 2 coats.
  - 2. Pedestals: 14-gauge enameled steel with 1-5/8-inch tubing uprights
    - a. Finish: To be selected by Architect.

## 2.5 FINISH

- A. General: Factory apply finish in accordance with manufacturer's instructions.
- B. Standard Finish: Exposed steel parts shall be thoroughly cleaned, given bonding and rust-inhibitive phosphate treatment, and electrostatically sprayed with powder coat. Baked-on finish.
- C. Antimicrobial Finish: Apply antimicrobial finish.
- D. Color:
  - 1. Exterior Color: To be selected by Architect .
  - 2. Interior Color: Match exterior color.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Examine areas to receive lockers. Notify Architect if areas are not acceptable. Do not begin installation until unacceptable conditions have been corrected.

### 3.2 INSTALLATION

- A. Install lockers in accordance with manufacturer's instructions at locations indicated on the Drawings.
- B. Install lockers plumb, level, square, rigid, with flush installation.

- C. Use manufacturer's supplied hardware.
- D. Anchoring: Anchor lockers to floors and walls as indicated on the Drawings.
- E. Sloping Hoods and Metal Fillers: Install sloping hoods and metal fillers using concealed fasteners.
- F. Joints: Provide flush hairline joints against adjacent surfaces.
- G. Number Plates: Attach number plates to face of doors level with 2 aluminum rivets. Attach in sequence as indicated on the Drawings.
- H. Locker Benches: Install locker benches by fastening bench tops to pedestals and securely anchoring to floor using appropriate anchors.
- I. Repair minor damages to finish in accordance with manufacturer's instructions and as approved by Architect.
- J. Remove and replace defective or damaged components that cannot be successfully repaired as determined by Architect.

### 3.3 ADJUSTING

- A. Adjust doors, locks, and operating hardware to function properly and for smooth operation without binding.

### 3.4 CLEANING

- A. Clean surfaces promptly after installation in accordance with manufacturer's instructions.
- B. Do not use harsh cleaning materials or methods that could damage finish.

### 3.5 PROTECTION

- A. Protect installed lockers from damage during construction.

**END OF SECTION**

**SECTION 11 48 10**  
**BASKETBALL EQUIPMENT**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section includes: Ceiling suspended, forward folding, electrically operated basketball backstops with backboard, goal, winch, height adjuster, backboard edge padding, and net.
- B. Related sections:
  - 1. Section 05 12 00 – Structural Framing: Structural roof framing to receive ceiling suspended backstops.
  - 2. Section 09 65 66 – Resilient Athletic Flooring: Layout of court lines to be coordinated with installation of basketball backstops.
  - 4. Section 11 66 23 - Gymnasium Protection Accessories: Wall mounted protection pads at backstop locations.
  - 2. Section 26 00 01 - Electrical supply, conduit, and wiring for motorized winch.

**1.2 REFERENCES**

- A. ANSI A208 - Particleboard, Mat-Formed Wood.
- B. ASTM A500 - Formed Welded Seamless Structural Tubing in Rounds and Shapes.
- C. ASTM F3731 - Standard Guide for Ceiling Suspended and Wall Mounted Basketball Backstop.
- D. ASTM B85 - Aluminum-Alloy Die Castings.
- E. ASTM B221 - Aluminum-Alloy Extruded Bar, Rod, Wire, Shape, and Tube.

**1.3 SUBMITTALS**

- A. Submit in accordance with Section 01 33 00 - Submittal Procedures:
  - 1. List of proposed products and product data.
  - 2. Shop drawings showing layout, elevations, dimensions, fabrication details, method of attachment, requirements for supplemental bracing or structural support members and necessary electrical wiring diagrams.
  - 3. Calculations for actual vertical and horizontal loads to be transmitted to structural [walls] [roof framing] supporting backstop assemblies.

4. Manufacturer to provide calculations and reports for tests performed by an independent testing laboratory accredited by the American Association of Laboratory Accreditation (A2LA) that demonstrates compliance with minimum safety factors required by these specifications.
5. Copy of warranties required by Paragraph 1.5 for review by Architect.
6. Manufacturer's installation instructions.

#### 1.4QUALITY ASSURANCE

- A. All components including framing, backboard, goals, [electric] winches, [controls,] and accessories for basketball backstop assemblies as well as all other related gymnasium equipment products shall be products of a single manufacturer.
- B. Backstops shall be designed, fabricated, and installed to comply with National Collegiate Athletic Association (NCAA) and National Federation of State High School Associations (NFHS) regulations.
- C. Backstops shall meet ASTM F3731 – Standard Guide for Ceiling Suspended and Wall Mounted Basketball Backstops.

#### 1.5WARRANTY

- A. Provide under provisions of Section 01 78 00 - Closeout Procedures:
  1. 25 years warranty for basketball backstop structure.
  2. Lifetime warranty against breakage for backboards installed with goal brace.
  3. 8 years warranty for bolt-on safety edge padding.

### **PARTS 2 - PRODUCTS**

#### 2.1ACCEPTABLE MANUFACTURERS

- A. Acceptable Manufacturer: Draper, Inc. Sales offices and manufacturing facility located at 411 South Pearl Street, Spiceland, Indiana 47385-0425; 765-987-7999.
- B. Manufacturers of equivalent products submitted and approved in accordance with Section 01630 - Product Substitution Procedures.

#### 2.2 MATERIALS

- A. Structural steel tubing: Steel, mechanical, round tubing conforming to ASTM A500.
- B. Clamps:
  1. Beam clamps: Split-A type with 7 square inches minimum beam flange contact area and secured with 2 all thread bolts at each attachment point. Clamps shall be designed to be capable of supporting a minimum of 20,000 Lbs. each. Superstructure shall be designed with a minimum of four attachment clamps to produce a combined minimum attachment point safety factor of 75 to 1. Superstructure tubes shall be reinforced with



bridging and/or bracing when truss centers exceed 10 feet (3.048 m).

2. Component attachment clamps: Full surface type fabricated from [1/4 inch] [6 mm] thick steel or saddle style utilizing serrated clamping surface and minimum 5/8" U-Bolt.
  3. Goal brace: Type attaching behind goal mounting plate and directly to backstop main stem transferring load directly to structural frame.
- C. Extruded aluminum: ASTM B221, alloy 6063 Temper T5.
- D. Aluminum castings: ASTM B85.
- E. Particleboard: Solid core, 55 pounds per cubic foot density industrial grade complying with ASTM A208, Type 1, Grade 1-M-3 factory finished with phenolic resin sheet thermally fused to front and back surfaces.
- F. Finish: Factory applied white powder coat for steel parts.

## 2.3 CEILING SUSPENDED SIDE FOLDING BACKSTOP

- A. Type: Ceiling suspended, side folding, side braced basketball backstop; Model EZ Fold TBS-26-B as manufactured by Draper, Inc. Backstop to comply with ASTM F3731 – Standard Guide for Ceiling Suspended and Wall Mounted Basketball Backstops. Non-compliant backstops shall not be acceptable substitutes.
- B. Distance from court floor to backstop attachment at roof structure: As indicated on Drawings.
- C. Main frame: Rigid T triangular design constructed by bolting together steel tubing of the following outside diameters and gauges. Parallelogram frames are not acceptable.
1. Main center stem: 6 inches diameter, 11 gauge of length sufficient to allow backstop height adjustment of plus or minus 6 inches.
  1. Top member of T frame: 4 inches diameter, 11 gauge.
  3. Diagonal rear brace: Adjustable brace constructed from 2-1/2 inches diameter, 13 gauge outer tube and 2-1/4 inches diameter, 14 gauge inner tube.
  4. Folding side brace: Jackknife type, fully adjustable, self-locking in down position constructed from 2-1/2 inches diameter, 13 gauge outer tube and 2-1/4 inches diameter, 14 gauge inner tube.
- D. Pivot point: 1-1/4 inches diameter solid steel shaft and 1/2 inch steel plate hangers.

## 2.4 ELECTRIC WINCH

- E. Provide for each folding basketball backstop separate electric winch mechanism.
- F. Type: Fully enclosed, direct drive, worm gear, electric winch designed to hold backstop at any position during raising and lowering; Model 503285 Motorized Winch as manufactured by Draper, Inc.
1. Motor: 3/4 HP, 11.5 AMP, capacitor type, 60 cycle, 115 volt, single phase with automatic thermal overload protection manufactured in compliance with NEMA

specifications.

2. Hoist cable: 1/4 inch diameter, 7 by 19, galvanized aircraft cable with 7,000 pounds ultimate breaking strength.
  3. Roller: Spring-load providing tensioning pressure to ensure cable tracks evenly on grooved drum.
  4. Limit switches: Rotary counting up and down type, pre-wired to motor as integral part of winch.
  5. Winch to comply with ASTM F3731 – Standard Guide for Ceiling Suspended and Wall Mounted Basketball Backstops. Non-compliant backstops shall not be acceptable substitutes.
- G. Controls: Provide key lock, 3 position, momentary contact wall control switch to lower, raise, and stop backstop.
1. Provide two keys.
  2. Provide with stainless steel cover plate.

## 2.5 SAFETY BELT AND LOCK

- A. Provide each front and rear folding basketball backstop with safety belt and lock test to withstand 1750 pounds free fall load.
- B. Safety lock: Inertia sensitive to automatically lock backstop in position at any time during storage, raising, or lowering. Sudden increase in either tension or speed shall activate lock.
- C. Safety belt: 2 inches wide nylon belt rated at 6000 pounds breaking strength; Safety Belt 503229 as manufactured by Draper, Inc.
- D. Belt shall extend (36 feet-503229) and shall be automatically retracted and stored on reel equipped with constant force spring. Operation and locking action shall be activated by centrifugal force to lock backstop before unit travels 12 feet of free fall.
- D. Unit shall incorporate automatic reset not requiring poles, ropes, levers, or buttons for resetting.
- E. Backstop must include Safety Strap to comply with ASTM F3731.

## 2.6 BACKBOARD

- A. Type: Rectangular, glass, official size backboard with center strut; Model 503138 as manufactured by Draper, Inc.
- B. Size: 72 inches wide by 42 inches high.
- C. Construction: 1/2 inch thick fully tempered glass in extruded aluminum frame with mitered corners and vertical aluminum strut in center on back side to alleviate stress on glass. Provide steel gusset type mounting corner brackets with slots for mounting backboard to support structure.
- D. Goal mounting assembly: Steel assembly secured to aluminum frame and equipped with

steel sleeves through glass allowing rear structure to be secured to front mounting plate. Provide with holes and studs to secure backboard and goal directly to goal brace. Front plate provided with holes for goal attachment.

- E. Equip frame and goal mounting assembly with neoprene shock absorbing cushions.
- F. Permanently etch official white border and target area on front side of glass.

## 2.7 GOALS

- A. Type: Breakaway goal with standard no-tie net attachment and designed to withstand shock loads from player slam dunking or hanging on rim; Model 503576 as manufactured by Draper, Inc.
- B. Rim shall deflect down when 230 pounds static load is applied and return to playing position when load is removed. Breakaway point shall be adjustable from 160 to 230 pounds.
- C. Ring shall have rebound characteristics identical to those of non-moveable ring. Factory set proper flex and rebound requirements. Goal features easy-adjust system to allow users to adjust the breakaway point from 160 pounds to 230 lbs.
- D. Ring: Fabricated from [5/8 inch] [16 mm] diameter steel rod formed into 18 inches ring. Rigidly brace with die cut steel braces welded to rim.
- E. Mounting plate: Heavy duty steel plate bracket with mounting holes and designed to position inside of ring 6 inches from backboard.
- F. Rim shall be provided with 12 formed wire "no-tie" net attachment clips on which the net securely hooks.
- G. Finish: Powder coated orange paint.
- H. Anti-whip net: Top half made of durable fibers encased in nylon to prevent net from whipping up on rim. Lower half all nylon. Color white.
- I. Mounting hardware: Zinc plated.

## 2.8 HEIGHT ADJUSTER

- A. Type: Mechanism for electrically adjusting height of rectangular backboard and goal; Model 503093 Height Adjuster as manufactured by Draper, Inc.
- B. Adjustment range: Goal position from 8 to 10 feet above court floor.
- C. Construction: Steel angle frame attaching to backboard, double slip tube guide assembly, clamp type connectors, and other required attachment hardware.
- D. Operation: Provide electric, reversible, linear actuator with cam style limit switches, key switch, and cover plate

## 2.9SAFETY EDGE PADDING

- A. Type: Foam padding for bottom edge and corners of backboard to provide safety protection to meet NCAA and NFHS requirements; Model 5032XX Safe-Edge Padding as manufactured by Draper, Inc.
- B. Construction: Molded foam, 2 inches wide and wrapping around edges 3/4 inch. Equip with molded-in steel track and bolt-on attachment system. Padding shall cover bottom edge of backboard and extend 15 inches up sides.
- C. Color: As Selected by Architect.
- D. Backstop to comply with ASTM F3731 – Standard Guide for Ceiling Suspended and Wall Mounted Basketball Backstops. Non-compliant backstops shall not be acceptable substitutes.

## 2.15 ACCESSORIES

- A. Provide backstop with backstop hangers, clamps, brackets, fasteners, and all other hardware required for complete, functional, rigid assembly and installation.

## PART 3 - EXECUTION

### 3.1COORDINATION

- A. Coordinate provision of basketball backstops with construction of [wall] [roof and ceiling framing] supporting basketball backstop to ensure proper support and method of attachment.
- B. Coordinate support of backstops to ensure proper distribution of loads and adequacy of attachment points. Provide additional structural framing members as required.
- C. Coordinate electrical requirements for electrically operated winch & height adjuster to ensure proper power source, conduit, wiring, and boxes for keyed switches.
- D. Prior to installation, verify exact locations of backstops.

### 3.2INSTALLATION

- A. Install folding basketball backstops in accordance with approved shop drawings and manufacturer's instructions.
- B. Install backstops, backboards, and goals plumb, level, and rigid. Attach to [wall] [roof] framing with anchors of size and type recommended by manufacturer.
- C. Install backboards such that goal is 10 feet above court floor. After installing, verify that mounting height is correct.
- D. Install electrically operated winches, hoisting cables, safety belt and lock securely to operate properly and smoothly to safely lower and raise folding backstops.

### 3.3FIELD QUALITY CONTROL

- A. Operate each folding basketball backstop a minimum of three times to ensure proper lifting and lowering. Adjust as required to ensure smooth operation and accurate positioning.

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- B. Operate each backboard and goal height adjuster to ensure proper movement. Adjust limit switches and mechanism as required to ensure smooth operation and accurate positioning.

3.4CLEANING

- A. Remove protective wrappings, wash surfaces, and attach nets.

3.5DEMONSTRATION

- A. Demonstrate to Owner's designated representative complete operation and required maintenance for folding basketball backstops.
- B. Submit operation and maintenance manuals in accordance with Section 01 78 00 - Closeout Procedures.

**END OF SECTION**

## **SECTION 11 48 30**

### **GYMNASIUM VOLLEYBALL SYSTEMS**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

- A. Section includes: Volleyball equipment for gymnasiums and other interior installations:
  - 1. Floor sleeves and cover plates.
  - 2. Floor anchors.
  - 3. Telescoping standards.
  - 4. Volleyball nets, rope tensioners, boundary markers, and antennae.
  - 5. Volleyball equipment transporters and wall storage hooks.
- B. Related sections:
  - 1. Section 033000 - Cast-in-Place Concrete: Concrete floor slabs and footings to receive floor sleeves.
  - 2. Section 096566 – Resilient Athletic Flooring: Layout of court lines to be coordinated with installation of floor sleeves.

##### **1.2 REFERENCES**

- A. ASTM A500 - Formed Welded Seamless Structural Tubing in Rounds and Shapes.
- B. ASTM B85 - Aluminum-Alloy Die Castings.
- C. ASTM B221 - Aluminum-Alloy Extruded Bar, Rod, Wire, Shape, and Tube.

##### **1.3 SUBMITTALS**

- A. Submit in accordance with Section 01330 - Submittal Procedures:
  - 1. List of proposed products and product data.
  - 2. Shop drawings showing volleyball court layout and floor [sleeve] [anchor] locations, dimensions, and method of installation.
  - 3. Manufacturer's installation instructions.

##### **1.4 QUALITY ASSURANCE**

- A. All volleyball equipment, components, and accessories shall be products of a single manufacturer.

- B. Volleyball equipment shall be designed, fabricated, and installed to comply with requirements for competition play of the following associations:
  - 1. Federation Internationale de Volleyball (FIVB).
  - 2. National Collegiate Athletic Association (NCAA).
  - 3. National Federation of State High School Associations (NFHS).
  - 4. USA Volleyball (USAV).

## **PARTS 2 - PRODUCTS**

### **2.1ACCEPTABLE MANUFACTURERS**

- A. Draper, Inc., 411 South Pearl Street, Spiceland, Indiana 47385-0425; 765-987-7999.
- B. Manufacturers of equivalent products submitted and approved in accordance with Section 01630 - Product Substitution Procedures.

### **2.2 MATERIALS**

- A. Structural steel tubing: Steel, mechanical, round tubing conforming to ASTM A500.
- B. Extruded aluminum tubing: Schedule 80, ASTM B221, alloy 6063 Temper T5.
- C. Aluminum castings: ASTM B85.

### **2.3FLOOR SLEEVES AND COVERS**

- A. Floor sleeve: Round, mechanical steel tube sleeve welded to steel anchor plate for casting in concrete floor to receive volleyball standard; Floor Sleeve 501006 as manufactured by Draper, Inc.
- B. Size: 3-1/2 inches inside diameter by 8-1/2 inches tube and 4 inches square anchor plate.
- C. Cover plate: 7-1/2 inches brass floor plate mounting flange; Cover Plate 501035 as manufactured by Draper, Inc.
  - 1. Cover installed with flat head wood screws.
  - 2. Locking mechanism to prevent bouncing of cover plate.
  - 3. Opening diameter: 4-3/8 inches.

### **2.4SPRING ASSIST TELESCOPING ALUMINUM STANDARDS**

- A. Types: Telescoping standards fabricated from Schedule 80 aluminum bottom and upper tubes and capable of adjusting from 73 inches to 100 inches in 1 inch increments to meet all age group height settings.

High School Renovation Standard EVS-01 500041 as manufactured by Draper, Inc.: Pair of standards, one with tensioning winch and other with adjustable cable anchoring collar. Both standards equipped with single pulley sheave on upper telescoping tube section. Spring assist with infinite height adjustment.

- B. Bottom tube section: 3-1/2 inches diameter with 0.30 inch wall thickness, 72 inches high. Bottom provided with rubber foot to protect floors.
- C. Upper telescoping tube section: 2-7/8 inches diameter with 0.28 inch wall thickness.
- D. Pulley sheaves: 4 inches diameter pulley and oilite bushing attached to top of upper telescoping tube.
- E. Tensioning winch: Heavy-duty, self-locking worm-gear mechanism.
  - 1. Position winch on outside of bottom tube.
  - 2. Equip winch with 2 inches wide, high tensile nylon strap with sling ring and spring-hook for connection to net cable.
  - 3. Winch operated by folding handle.

## 2.5 VOLLEYBALL NET

- A. Type: Fabricated from high quality 4 inches square mesh made with 2.5 mm black knotless nylon; Net 500004 as manufactured by Draper, Inc.
- B. Size: 32 feet long by 39-3/8 inches high.
- C. Provide double stitched, vinyl coated polyester hem around perimeter of net. At net ends, provide hem with pocket containing 1/2 inch diameter fiberglass dowel.
- D. Net cable: 1/8 inch diameter, 2000 pounds] minimum breaking strength, galvanized aircraft cable with nylon coating. Equip ends with loops formed with heavy swaged type fittings. Run cable through top hem.
- E. Rope tensioner: Provide bottom hem with 1/4 inch braided nylon rope and ratchet style tensioner.
- F. Provide each net end with three 1 inch wide polypropylene tension straps with buckles for tightening net.
- G. Combination Boundary Markers and Antennae: Pair of 2 inches wide, white, polyester reinforced vinyl strips to attach with snap fasteners to ends of net at boundary lines; Pair of 3/8 inch diameter fiberglass rods with red and white strips to extend above net 32-1/2 inches; 500016 Boundary Markers and Antenna as manufactured by Draper, Inc.

## 2.6 ACCESSORIES

- A. Transporter: Heavy-duty unit with swivel casters designed to store and transport standards, net, protection pads, and other components and accessories required for setting up volleyball court; Volleyball Transporter 501016 as manufactured by Draper, Inc.
- B. Wall storage hooks: Pair of steel hooks mounted to wall with flat head screws to provide means for storing volleyball standards; Wall Hooks 501017 as manufactured by Draper, Inc.



- C. Vertical storage rack: Pair of steel vertical storage brackets constructed of 1/4 inch flat steel and 3/16 inch thick angle. Posts secured with nylon straps with hook and loop fastener. Vertical Storage Rack 501015 as manufactured by Draper, Inc.

### **PART 3 - EXECUTION**

#### **3.1VOLLEYBALL EQUIPMENT SCHEDULE**

- A. Provide and install equipment items as listed in Volleyball Equipment Schedule on Drawings.

#### **3.2COORDINATION**

- A. Coordinate layout of volleyball courts and location of floor [sleeves] [anchors] with installation of floor surfacing and application of game lines and boundaries.
- B. Coordinate location of sleeves and required size of sleeve footing with trade responsible for placing concrete. Provide sleeves in adequate time to allow casting in concrete floor slabs. Ensure that setting of sleeve compensates for type of floor finish to be provided.
- C. Ensure that sleeves for each volleyball court are spaced at [36'-0"] [10.97 m] on center.

#### **3.3INSTALLATION**

- A. Floor cover plates: Install centered directly over floor sleeves in accordance with manufacturer's instructions. Route out floor to ensure cover is flush with finished floor. Install cover with flat head screws.
- B. Wall storage hooks: Rigidly install at locations indicated on Drawings with anchors and fasteners adequate for type of substrate. Ensure pairs of hooks are aligned horizontally and spacing does not exceed length of standard.

#### **3.4FIELD QUALITY CONTROL**

- A. [Insert standards in sleeves] [Secure portable standards to floor anchors] and attach nets, boundary markers, antennae, judge's platform, protection padding, and other accessories. Verify that all items have been provided and are as required for complete installation.
- B. Verify that standards are vertical and rigid. [Operate telescoping feature.] Verify net height settings are accurate.
- C. Provide missing items and correct deficiencies.

#### **3.5CLEANING AND DEMONSTRATION**

- A. Remove protective wrappings and wash surfaces.
- B. Review installed volleyball system with Owner's designated representatives. Demonstrate installation of equipment and operational features.

**END OF SECTION**

## **SECTION 11 66 23**

### **GYMNASIUM PROTECTION ACCESSORIES**

#### **PART 1 GENERAL**

##### **1.1 SUMMARY**

- A. Section includes: Wall mounted protection pads suitable for gymnasium installations.

##### **1.2 SUBMITTALS**

- A. Submit in accordance with Section 01 33 00 - Submittal Procedures:
  - 1. List of proposed products and product data.
  - 2. Shop drawings showing elevations, dimensions, fabrication details, and method of attachment.
  - 3. Samples of protection pad cover fabrics for selection by Architect.
  - 4. Manufacturer's installation and maintenance instructions.

#### **PART 2 PRODUCTS**

##### **2.1 ACCEPTABLE MANUFACTURERS**

- A. Draper, Inc., 411 South Pearl Street, Spiceland, Indiana 47385-0425; 765-987-7999.
- B. Manufacturers of equivalent products submitted and approved in accordance with Section 01 60 00 - Product Substitution Procedures.

##### **2.2 UL GREENGUARD GOLD CERTIFIED, CLASS A FLAME RETARDANT WALL PROTECTION PADS**

- A. Type: UL GREENGUARD Gold certified, Class A Flame Retardant fabric covered foam wall protection pads; Wall Pads as manufactured by Draper, Inc.
- B. Pad shape and size: Sizes and shapes as indicated on Drawing Elevations.
  - 1. Flat, rectangular pads: 48 by 96 inches.
  - 2. C shaped pads: 96 high, width varies. Field Verify.
- C. Cushioning material: 2 inches thick, flame retardant open cell neoprene foam with 6 pounds density.
- D. Backer: 7/16 inch urea-formaldehyde free Oriented Strand Board. Pads that wrap around columns or are curved shall be provided without solid backer.
- E. Cover: Solid vinyl coated polyester fabric with embossed pattern:

1. Weight: 14 ounces per SY.
  2. Breaking strength: 350 PSI.
  3. Tear resistance: 65 pounds.
  4. Resistant to rot, mildew, and ultraviolet light.
  5. Flammability: Rated self extinguishing in accordance with California State Fire Code F-230.
  6. Color: Selected by Architect from manufacturer's standard range.
- F. UL GREENGUARD Gold Certification: Entire wall pad assembly shall have been submitted to indoor air quality evaluation (IAQ) evaluation in accordance with UL 2811 test method to show compliance with emissions limits on UL 2818 Section 7.1 and 7.2. Materials are tested in accordance with ANSI/BIFMA M7.1-2011 and determined to comply with ANSI/BFMA X7.1-2011 and ANSI/BIFMA e3-2014e credit 7.6.1, 7.6.2 and 7.6.3. Material of emissions of total volatile organic compounds of < 0.22 mg/m<sup>3</sup>, formaldehyde < 0.0135 ppm, total aldehydes < 0.043 ppm, individual volatile organic compounds < 1/1000 TLV and < ½ chronic REL and total phthalates < 0.01 mg/m<sup>3</sup>. Manufacturer must be able to provide independent lab and test reports to verify compliance.
- G. Fire Rating: Entire pad assembly has been tested and meets the requirements of NFPA 101 Life Safety Code for class A rating (flame spread 0-25 and smoke development 0-450) when tested in accordance with ASTM E-84 (also published as NFPA-255, ANSI 2.5, UBC 8-1 (42-1) and UL 723). Entire pad assembly has been tested and meets the criteria set forth in the 2003 IBC section 803.2.1 when tested in accordance with NFPA 286. NFPA 286 does not publish pass/fail criteria.
- H. ASTM: Pads shall meet all requirements of ASTM 2440-04. Manufacturer must be able to provide independent lab and test reports to verify compliance.
- I. Construction: Cushioning material adhered to backer [with liner positioned on top of foam] and panel fully wrapped with fabric which is stapled to backer such that backer is not exposed on front or sides.
- J. Provide Z clips at bottom and top for wall mounting panels.
- K. Attachment: Provide pads without solid backing with hook and loop strips at top of pad.
- L. 3" x 5" Wall Pad Cut-Out Kit for Single Gang openings.
  1. Color: Grey
  2. Number of Kits: Field Verify
- M. 7" x 7" Wall Pad Cut-Out Kit for Dual Gang openings/Fire Alarm Pull Stations.
  1. Color: Grey
  2. Number of Kits: Field Verify
- N. Large Wall Pad Cut-Out Kit for large items including fire extinguishers, water fountains, or similar fixtures. consist of molded inside corners, outside corners, straight strips and splices to allow for almost any size and shape of cutout necessary. Straight Strips and Corners are molded from a custom flame resistant thermoplastic elastomer formulation and have a Shore-A durometer hardness of approximately 89. Strips and corners can be field cut to

exact required dimensions.

### **PART 3 EXECUTION**

#### **3.1 PREPARATION**

- A. Field verify dimensions prior to fabrication.
- B. Coordinate fabrication of wall protection pads with size and location of switches, electrical outlets, and other wall mounted items; structural framing and bracing projecting from wall surface; and door and other wall openings.
- C. For pads placed around structural columns coordinate required shapes and sizes with actual dimensions of structural members.
- D. Coordinate installation of scoreboard protector with size and placement of scoreboard.

#### **3.2 INSTALLATION**

- A. Install in accordance with manufacturer's written instructions and shop drawings.
- B. Protection mats:
  - 1. Mount protection pads 4 inches above finished floor.
  - 2. Secure to wall with fasteners along bottom and Z clips along top. Type, size and spacing of fasteners as recommended by manufacturer.
  - 3. Neatly make cutouts for switches, electrical outlets, and other items on wall and seal with matching vinyl fabric.

**END OF SECTION**

## **SECTION 11 66 53**

### **GYMNASIUM PRACTICE CAGES**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

- A. Section includes: Electrically operated net gymnasium practice cage lowered from ceiling to provide interior space for indoor athletic practice activities.
- B. Related sections:
  - 1. Section 051200 – Structural Steel Framing: Structural steel framing to support gymnasium practice cage.
  - 2. Section 260010: Electrical supply, conduit, and wiring for motorized gymnasium practice cage.

##### **1.2 SUBMITTALS**

- A. Submit in accordance with Section 01 33 00 - Submittal Procedures:
  - 1. List of proposed products and product data.
  - 2. Loads to be transmitted to building structural members and requirements for supplementary bracing and structural support members.
  - 3. Shop drawings showing layout, elevations, dimensions, fabrication details, method of attachment, and electrical wiring diagrams.
  - 4. Samples of fabric net.
  - 5. Manufacturer's installation and maintenance instructions.

##### **1.3 QUALITY ASSURANCE**

- A. Source limitation: All components including frame, netting, suspension system, electric winches, and controls for practice cage shall be products of a single manufacturer.

##### **1.4 DELIVERY, STORAGE, AND HANDLING**

- A. Do not deliver practice cage until building is enclosed and, other construction within gymnasium is substantially complete.

#### **PARTS 2 - PRODUCTS**

##### **2.1 ACCEPTABLE MANUFACTURERS**

- A. Acceptable Manufacturer: Draper, Inc. Sales offices and manufacturing facility located at: 411 South Pearl Street, Spiceland, Indiana 47385-0425; 765-987-7999.

## High School Renovation

- B. Manufacturers of equivalent products submitted and approved in accordance with Section 01630 - Product Substitution Procedures.

## 2.2GYMNASIUM PRACTICE CAGE

- A. Type: Electrically operated, gymnasium practice cage including motor, cables, controls, clamps for attachment to building structure, threaded rod supports, and other components required for complete functional installation; Practice Cage as manufactured by Draper, Inc.
- B. Operation: Netting and cage frame moved up and down by [1/8 inch] [3.2 mm] 7/19 galvanized aircraft cables wound onto overhead rotating drive pipe operated by electrical motor. Cables pass through d-rings on nylon belts allowing belt to accordion fold. Lift cables pass through links attached to netting at approximately [12 inches] [305 mm] c about [12 inches] [305 mm] causing netting to lift to the cage frame as the entire assembly is lifted to the ceiling.
- B. Configuration: Rectangular shape 10 feet high by 12 feet wide by 70 feet long.
- C. Frame: Constructed of 1-5/8 inches diameter steel tubing with 0.109 inch wall thickness. Assemble frame with malleable iron galvanized fittings with case hardened set screws.
- D. Operating mechanism: Drive pipe mechanism shall consist of a 3/4 HP, 110VAC, 60 cycle, single-phase, reversible capacitor with built-in thermal overload protection. The motor and load holding worm gear reducer shall provide speed reduction in the winch. Remote control operation with integral limit switches to control the upper and lower limit of cage travel.
- E. Attachment: Attach to structural support with beam clamps, hanger brackets, and 1/2 inch diameter threaded rods. Attach at 10 feet centers.
- F. Hoist lines: 1/8 inch diameter steel galvanized cable with 2,000 pounds minimum breaking strength. Space lines at approximately 10 feet.
- H. Drive pipe is located at one side of practice cage and there shall swivel pulley assemblies to guide lifting cable to the other side of cage. Lift cables pass through guides at the cage frame then terminate at cable weights that are suspended at about 12 inches above playing surface.

## 2.3NETTING

- A. Type: 3/4 inch square, knotless, White (Standard), nylon mesh.
- B. Material: #252 knotless nylon with 95 pounds breaking strength.
- C. Minimum weight: 0.05 pounds PSF.
- D. Perimeter of netting sections: Sewn with 3/4 inch poly tape binding.
- E. Provide zippers at two corners for access to cage.
- F. Size of netting to be sufficient to allow 12 inches of material to rest on floor in use position.

## 2.4PRACTICE CAGE SAFETY DEVICE

- A. Provide Draper Model 504301 Curtain Lok safety device. Curtain Lok to be directly speed sensitive to automatically lock divider curtain in position at any time during storage or

High School Renovation. In the event of an over-speed situation (greater than 1.5 feet per second) caused by malfunction of the hoisting apparatus, whether sudden or gradual, device will immediately activate. Curtain Lok works regardless of direction of rotation and automatically resets when load is reversed or removed.

## 2.5 CONTROLS

- A. Provide key lock, 3-position, momentary contact wall control switch to lower, raise, and stop gymnasium practice cage. Provide with stainless steel cover plate.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Coordinate support of practice cage with roof structure to ensure proper distribution of loads and adequacy of attachment points. Ensure that building structure has been designed for loads of practice cage. Provide additional structural framing members as required in accordance with Section 051200 – Structural Steel Framing.
- B. Coordinate configuration, size, and installation of practice cage with height, slope, and type of building structure and lighting fixtures, mechanical equipment, ductwork, fire-suppression system, bleachers, athletic equipment, and other potential obstructions.
- C. Field verify dimensions prior to fabrication.
- D. Coordinate electrical requirements for motorized operating mechanism to ensure proper power source, conduit, wiring, and boxes for keyed switches. Prior to installation, verify type and location of power supply.
- E. For installations made after wood gymnasium flooring is installed, provide protection and exercise care not to damage flooring.

### 3.2 INSTALLATION

- A. Install in accordance with manufacturer's written instructions and shop drawings.
- B. Install even and level with netting hanging straight in down position.
- C. Install control switch such that operator has view of complete practice cage during lowering and raising.
- D. Adjust limit switches of electric winch to ensure accurate position in both stored and lowered positions.

### 3.3 TESTING AND DEMONSTRATION

- A. Operate practice cage to ensure proper lifting and lowering. Adjust as required to ensure smooth operation and accurate positioning.
- B. Demonstrate to Owner's designated representatives complete operation and required maintenance.

**END OF SECTION**

## **SECTION 12 24 13**

### **MANUALLY-OPERATED WINDOW SHADES**

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Manually-operated window shades and accessories.

##### **1.02 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's catalog data, product descriptions, installation instructions, detail sheets, and specifications for each type system specified.
- C. Samples for Selection: Manufacturer's color chart and sample set.
- D. Shop Drawings: Prepared specifically for this project; show dimensions and interface with other products.
  - 1. Room schedule including field-verified dimensions of each opening to receive window shade systems.
  - 2. Shades are to be provided at all exterior windows except for corridors. Provide shades at all classroom exterior doors. Submittals should indicate all applicable locations.
  - 3. Indicate System Series, operator, fabric selection, and mounting type.

##### **1.03 QUALITY ASSURANCE**

- A. Installer: Approved by manufacturer.

##### **1.04 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver products to project site in manufacturer's original cartons.
- B. Individually package and mark shades with room number and opening number.
- C. Inspect the materials upon delivery to assure that specified products have been received.
- D. Store and handle shades to prevent damage to fabrics, finishes, and operators prior to installation.

#### **PART 2 PRODUCTS**

##### **2.01 MANUFACTURERS**

- A. MechoShade Systems, Inc.: [www.mechoshade.com](http://www.mechoshade.com) (Basis of Design).
- B. Draper Inc.: [www.draperinc.com](http://www.draperinc.com)
- C. Shade Techniques, Inc.: [www.shadetechniques.com](http://www.shadetechniques.com)
- D. Substitutions: See Section 01 60 00 - Product Requirements.
- E. Provide window shade systems from a single manufacturer.



## 2.02 MANUFACTURED UNITS

- A. Manually-Operated Shades:
  - 1. Bead/Chain Operation: Bi-directional, wrap spring clutch made of high-strength fiberglass-reinforced polyester and high carbon steel.
  - 2. Product: MechoShade Mecho/5 Slimline or Standard drive end bracket.
- C. Visually Transparent Single-Fabric Shadecloth: Product MechoShade ThermoVeil group – Extra-Dense Linear Weave “0900 Series”, 0-1 percent visually translucent linear weave, single thickness, non-raveling, 0.030 inch thick vinyl fabric, woven from 0.018 inch diameter extruded vinyl yarn; 21 percent polyester, 79 percent reinforced vinyl.
  - 1. Color: As selected by Architect from manufacturer's standards colors.

## 2.03 COMPONENTS

- A. Drive Chain: No. 10 stainless steel chain rated for 90 lbs. minimum breaking strength. Nickel plate chain is not permitted.
  - 1. Provide Chain Guide to prevent choking hazard.
- B. Rollers: Roller assembly easily removable.
  - 1. Provide a roller tube of a diameter and wall thickness required to support shade fabric without excessive deflection.
  - 2. Diameter: Greater than 1.54 inches for manual shades.
  - 3. Provide positive mechanical attachment of shade band material to roller band.
- C. Roller Idler Assembly for Manual Shades: Clutch operated rollers incorporating high-strength fiberglass-reinforced polyester gudgeon, which snaps-locks fascia.
- D. Fascia: Continuous, removable aluminum fascia that snap locks into shade bracket.
  - 1. Install across window width of shade band in one piece.
  - 2. Fully conceals brackets, shade roller and fabric on the tube.
  - 3. Provide end caps where mounting conditions expose outside of roller shade brackets.
  - 4. Notching of fascia for manual chain is not permitted.
- E. Multiple Shade Bands: Provide shade hardware system that allows for operation of multiple shade bands by a single chain operator, subject to manufacturer's design criteria.
- F. Multiple Shade Radial Band: Provide shade hardware system that allows multi-banded manually operated shades capable of smooth operation when the axis is offset a maximum of 6 degrees on each side of the plane perpendicular to the radial line of the curve, for a 12 degree total offset.
- G. Intermediate Brackets: UHMW plastic twist-locks into carrier bracket, allowing continuous roller operation with multiple shades.
- H. Access and Material Requirements:
  - 1. Provide shade hardware allowing for the removal of shade roller tube from brackets without removing hardware from window opening and without requiring end and center supports to be removed.
  - 2. Provide shade hardware that allows for removal and re-mounting of the shade bands without removal of shade tube, drive or operating support brackets.

### **PART 3 EXECUTION**

#### **3.01 INSTALLATION**

- A. Install window shade systems in accordance with manufacturer's instructions and these specifications.
- B. Assume responsibility for all field dimensions and mounting surfaces.
- C. Adjust window shade systems for proper operation.

#### **1.02 CLEANING**

- A. See Section 01 19 13 – Process Cleaning.
- B. Remove and recycle excess material & packaging as required. See Section 01 74 19 – Construction Waste Management and Disposal.

**END OF SECTION 12 24 13**

## **SECTION 12 32 16**

### **PLASTIC-LAMINATE-CLAD CASEWORK**

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Plastic-laminate-faced wood cabinets.

##### **1.02 RELATED SECTIONS**

- A. Section 09 21 16 - Gypsum Board Assemblies; for reinforcements in gypsum board partitions for anchoring casework.
- B. Section 09 65 00 - Resilient Flooring; for resilient base applied to casework.

##### **1.03 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details for casework. Include plans, elevations, sections, details, and attachments to other Work.
- C. Samples: For cabinet finishes and for each type of top material indicated.
- D. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

##### **1.04 QUALITY ASSURANCE**

- A. Installer Qualifications: An authorized representative of casework manufacturer for installation and maintenance of units required for this Project.
- B. Source Limitations: Obtain casework through single source and from single manufacturer.
- C. Quality Standard: Unless otherwise indicated, comply with Architectural Woodwork Institute (AWI) Quality Standards, Eighth Edition, Section 01 60 00.
  - 1. Provide AWI Quality Certification Program certificate indicating that casework complies with requirements.
- D. Fire-Test-Response Characteristics: Provide materials with the following fire-test-response characteristics as determined by UL, or Warnock Hersey testing, or other agency acceptable to authorities having jurisdiction.
  - 1. Surface-Burning Characteristics: Not exceeding values indicated below; in compliance with ASTM E 84.
    - a. Flame Spread: 200, maximum.
    - b. Smoke Developed: 450, maximum.

- E. All wood products designated as “FSC certified” in this specification shall be certified according to the rules of the Forest Stewardship Council ([www.fscus.org](http://www.fscus.org)).

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver casework only after painting, utility roughing-in, wet-work is completed, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period. All operations that could damage, soil, or deteriorate casework have been completed in installation areas.
- A. Protect surfaces during handling and installation.

#### 1.06 PROJECT CONDITIONS

- A. Field Measurements: Where casework is indicated to fit to other construction, verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings.

#### 1.07 COORDINATION

- A. Coordinate layout and installation of metal framing and reinforcements in gypsum board assemblies for support of casework.

#### 1.08 WARRANTY

- A. Manufacturer's warranty to repair or replace components of casework that fail in materials or workmanship within five years from date of Substantial Completion.

### **PART 2 PRODUCTS**

#### 2.01 MANUFACTURERS

- A. Plastic-Laminate Faced Casework:
  - 1. Strata Design
  - 2. Britton Woodworks
  - 3. Mastercraft
  - 4. Thomas & Milliken
  - 5. Substitutions: See Section 01 60 00 - Product Requirements.

#### 2.02 MATERIALS

- A. Wood-based Components:
  - 1. Wood fabricated from old growth timber is not permitted.
  - 2. Certification: Forest Stewardship Council (FSC) Certified.
  - 3. Composite wood and agrifiber products shall meet the standards specified in the applicable LEED Reference Guide for low-emitting materials.
  - 4. Composite wood and agrifiber products shall contain no added urea-formaldehyde resins.
- B. Adhesives: Type recommended by fabricator to suit application. Low VOC, low odor, solvent-free, water-based contact adhesives meeting the requirements set forth in the applicable LEED Reference Guide. See the applicable LEED Reference Guide for the most current VOC limits for adhesives, paints, and coatings.
- C. Maximum Moisture Content for Lumber: 7% for hardwood and 12% for softwood.

- D. Particleboard: ANSI A208.1, Grade M-3, minimum 47 lb/cu. ft. density.
- E. Medium-Density Fiberboard: ANSI A208.2, Grade MD-Exterior Glue.
- F. Hardboard: AHA A135.4, Class 1 Tempered.
- G. Plastic Laminate: High-pressure decorative laminate complying with NEMA LD 3.
  - 1. Laminate Sheet, Unless Otherwise Indicated: NEMA LD 3 Grade HGS, 0.048 inch nominal thickness.
    - a. Surface Burning Characteristics: Flame spread 25, maximum; smoke developed 450, maximum; when tested in accordance with ASTM E 84.
    - b. Wear Resistance: In addition to specified grade, comply with NEMA LD 3 High Wear Grade requirements for wear resistance.
    - c. Finish: Matte or suede, gloss rating of 5 to 20.
    - d. Surface Color and Pattern: As selected by architect from manufacturer's full range.
    - e. Manufacturers:
      - 1) Formica Corporation: [www.formica.com](http://www.formica.com).
      - 2) Nevamar Company: [www.nevamar.com](http://www.nevamar.com).
      - 3) Panolam Industries: [www.pionitelaminates.com](http://www.pionitelaminates.com).
      - 4) Wilsonart International, Inc: [www.wilsonart.com](http://www.wilsonart.com).
      - 5) Substitutions: See Section 01 60 00 - Product Requirements.
  - 2. Fabricate in accordance with AWI/AWMAC Quality Standards Illustrated Custom Grade
- H. Edge banding: Same material as top, on front surface of countertop, on front edge of shelving, on top of back splashes, and ends of splashes.
- I. Design: Full Overlay.
- J. Color, Patterns, and Finishes:
  - 1. Melamine-Faced: As selected by the Architect from the manufacturer's full range of color, finishes, and patterns.
  - 2. Plastic-Laminate Faced: As selected by the Architect from the manufacturer's full range of color, finishes, and patterns.

## 2.03 COMPONENTS

- A. Exposed Cabinet:
  - 1. Plastic Laminate: Type VGS.
    - a. Unless otherwise indicated, provide plastic laminate for exposed surfaces.
- B. Semi-exposed Cabinet:
  - 1. Plastic Laminate: Type CLS 0.020-inch thick.
    - a. Provide plastic laminate for interior faces of doors and drawer fronts, where required to balance exterior cabinet panel, and where indicated.
  - 2. Melamine-Faced Particleboard: Particleboard with decorative surface of thermally fused, melamine-impregnated web and complying with LMA SAT-1.
    - a. Provide melamine-faced particleboard for semiexposed surfaces, unless otherwise indicated.
- C. Concealed Cabinet:
  - 1. Solid Wood: Any hardwood or softwood species, without defects affecting strength or utility.
  - 2. Plastic Laminate: Type BKL.

## 2.04 CABINET FABRICATION

- A. Shop-cut openings for hardware, appliances, plumbing fixtures, and similar items to greatest extent possible. Locate openings accurately using templates or rough in diagrams. Smooth edges of cutouts and, where located in countertops and similar exposures, seal edges with a water-resistant coating.
- B. Plastic-Laminate-Faced Casework Construction:
  - 1. Bottoms and Ends of Cabinets, Shelves, and Tops of Wall Cabinets and Tall Cabinets: 3/4-inch particleboard, plastic-laminate faced on exposed surfaces, melamine faced on semiexposed surfaces.
  - 2. Concealed Backs of Cabinets: Minimum 3/8-inch particleboard, melamine faced. Back shall be inset from rear of body and fully dadoed on all four sides. Provide stiffeners fastened to back and body. Back perimeter shall be toe-nailed with mechanical fasteners.
  - 3. Base Cabinet Top: 3/4-inch melamine face particleboard solid from front to back. Front and rear spreaders are not acceptable.
  - 4. Structural Cabinet Support: Cabinet sub-base shall be separate and continuous 4-inch high ladder-type platform design leveled and floor mounted prior to cabinet body placement. Material shall be exterior grade plywood. Provide 2 1/2 inch recess at front of cabinet and 3/8 inch recess at exposed ends. No cabinet sides to floor will be allowed.
  - 5. Interior Structure: All cabinets 36 inches and wider shall have mechanically fastened and removable vertical divider to reduce horizontal shelf deflection. If these are not mechanically fastened, all shelves, tops, and bottoms shall be 1 inch thick with fixed intermediate support. Wall cabinets shall have minimum clear inside depth of 12 inches unless indicated otherwise.
  - 6. Shelf Loading: Shelves shall meet the loading and deflection standards of the National Particleboard Association.
  - 7. Door and Drawer Front Rail: Minimum 3/4 inch by 6 inch by full horizontal width of cabinet body rails immediately behind joints between any combination of doors or drawers.
    - a. a. Edge Banding: Rigid PVC extrusions, through color with satin finish, 3 mm thick.
  - 8. Drawer Fronts: 3/4 inch particleboard, plastic-laminate faced on both sides.
  - 9. Drawer Sides and Backs: 1/2 inch melamine-faced particleboard, with glued dovetail or multiple-dowel joints.
  - 10. Drawer Bottoms: 1/2 inch melamine-faced particleboard glued and dadoed into front, back, and sides of drawers with 1/2 inch recess. Provide half inch by half inch mechanically fastened under body stiffeners from front to back of drawer for drawer widths as follows:
    - a. a. 24 inches to 35 inches: One required.
    - b. b. 36 inches to 47 inches: Two required.
    - c. c. 48 inches or more: Three required.
  - 11. Doors: 3/4 inch particleboard or medium-density fiberboard, plastic-laminate faced on both sides.
- C. Filler Strips: Provide as needed to close spaces between cabinets and walls, ceilings, and indicated equipment. Fabricate from same material and with same finish as cabinets.

## 2.05 HARDWARE

- A. Provide manufacturer's standard powder-coated, commercial-quality, heavy-duty hardware complying with requirements indicated.
  - 1. Use threaded metal or plastic inserts with machine screws for fastening to particleboard except where hardware is through-bolted from back side.
  - 2. Exposed Metal Finish: Satin chrome plated BHMA 626 for brass or bronze base, BHMA 652 for steel base, and BHMA 630 for satin stainless steel.

- B. Butt Hinges: Powder-coated, semiconcealed, 5-knuckle hinges complying with BHMA A156.9, Grade 1, with antifriction bearings and rounded tips. Provide 2 hinges for doors less than 48 inches high and 3 hinges for doors more than 48 inches high.
- C. Pulls: Solid aluminum, stainless-steel, or chrome-plated brass wire pulls, fastened from back with two screws. For sliding doors, provide recessed stainless-steel or chrome-plated flush-pulls. Provide 2 pulls for drawers more than 24 inches wide.
- D. Door Catches: Powder-coated, dual, self-aligning, permanent magnet catch. Provide 2 catches on doors more than 48 inches high.
- E. Drawer Slides: Powder-coated, metal-channel, self-closing drawer slides, with positive out stop, in stop, and outkeeper, designed to prevent rebound when drawers are closed, with nylon-tired, ball-bearing rollers, and complying with BHMA A156.9, Type B05091, and rated for the following dynamic loads:
  - 1. Box Drawer Slides: 100 lbf rated for 50,000 cycles.
  - 2. File Drawer Slides: 150 lbf full extension.
  - 3. Pencil Drawer Slides: 45 lbf.
  - 4. Keyboard Slide: 75 lbf.
  - 5. Trash Bin Slides: 150 lbf.
  - 6. Paper Storage Drawers: 3 part progressive opening slide 100 lbf.
- F. Label Holders: Stainless steel or chrome plated, sized to receive standard label cards approximately 1 by 2 inches, attached with screws or brads.
  - 1. Provide where indicated.
- G. Drawer and Cupboard Locks: Cylindrical (cam) type, 5-pin tumbler, brass with chrome-plated finish, complying with BHMA A156.11, Grade 1.
  - 1. Provide a minimum of two keys per lock and six master keys.
  - 2. Provide locks where indicated.
  - 3. Provide spring loaded elbow catch and strike plate behind none-locking door, polished nickel finish.
- H. Sliding-Door Hardware Sets: Manufacturer's standard, to suit type and size of sliding-door units.
- I. Adjustable Shelf Supports: 2 pin locking plastic shelf rests complying with BHMA A156.9, Type B04013. Load rating shall be minimum 300 lb per support.
- J. Grommets for Cable Passage: Nominal 2 inch outside diameter molded plastic grommets with nominal 1 3/4 inch hole and plastic cap with slot for wire passage.

## 2.06 COUNTERTOPS

- A. See Section 06 41 19.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of reinforcements, and other conditions affecting performance of institutional casework.
  - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02 INSTALLATION OF CASEWORK

- A. Install plumb, level, and true; shim as required, using concealed shims. Where casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.
- B. Base Cabinets: Set cabinets straight, level, and plumb. Adjust subtops within 1/16 inch of a single plane. Fasten cabinets to partition framing, wood blocking, or reinforcements in partitions with fasteners spaced 24 inches 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. Where base cabinets are not installed adjacent to walls, fasten to floor at toe space with fasteners spaced 24 inches o.c. Secure sides of cabinets to floor, where they do not adjoin other cabinets, with not less than two fasteners.
- C. Wall Cabinets: Hang cabinets straight, level, and plumb. Adjust fronts and bottoms within 1/16 inch of a single plane. Fasten to hanging strips, masonry, partition framing, blocking, or reinforcements in partitions. Align similar adjoining doors to a tolerance of 1/16 inch.
  - 1. Fasten through back, near top and bottom, at ends, and not more than 16 inches o.c. with fasteners appropriate for substrate.
- D. 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.
- E. Adjust casework and hardware so doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

### 3.03 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 plastic or other suitable water-resistant covering over countertop surfaces. Tape to underside of countertop at a minimum of 48 inches o.c. Remove protection at Substantial Completion.

**END OF SECTION 12 32 16**



**SECTION 14 21 00**  
**ELECTRIC TRACTION ELEVATORS**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. This section specifies electric traction elevators.
- B. Work Required
  - 1- The work required under this section consists of all labor, materials and services required for the complete installation (including operational verification) of all the equipment required for the elevator(s) as herein specified.
  - 2- All work shall be performed in a first class, safe and workmanlike manner.
  - 3- In all cases where a device or part of the equipment is herein referred to in the singular, it is intended that such reference shall apply to as many of such devices or parts as required to make complete installation.

**1.02 RELATED SECTIONS**

- A. The following sections contain requirements that relate to this section and are performed by trades other than the elevator manufacturer/installer.
  - 1- Section 01 50 00 – Temporary Facilities and Controls: protection of floor openings and personnel barriers; temporary power and lighting.
  - 2- Section 03 30 00 – Cast-In-Place Concrete: elevator pit and elevator machine foundation.
  - 3- Section 04 20 00 – Unit Masonry: masonry hoistway enclosure, building-in and grouting hoistway doorframes, and grouting of sills.
  - 4- Section 05 50 00 – Metal Fabrications: pit ladder, divider beams, supports for entrances and rails, and hoisting beam at top of elevator hoistway.
  - 5- Section 07 16 00 – Cementitious Waterproofing: waterproofing of elevator pit.
  - 6- Section 23 50 00 – Heat Generation Equipment: ventilation and temperature control of elevator equipment areas.
  - 7- Section 26 05 00 – Common Work Results for Electrical:
    - a. Main disconnects for each elevator.
    - b. Electrical power for elevator installation and testing.
    - c. Disconnecting device to elevator equipment prior to activation of sprinkler system.
    - d. The installation of dedicated GFCI receptacles in the pit and overhead.
    - e. Lighting in controller area, machine area and pit.
  - 8- Wiring for telephone service to controller.
  - 9- Section 26 30 00 – Emergency (Standby) Power Supply Systems: emergency generator for elevator operation.
  - 10- Section 27 30 00 – Voice Communications: ADAAG-required emergency communications equipment.
  - 11- Section 28 31 00 – Fire Alarm Systems: fire and smoke detectors at required locations and interconnecting devices; fire alarm signal lines to contacts in the machine area.
  - 12- Section 31 10 00 – Site Clearing: excavation for elevator pit.

### 1.03 REFERENCES

- A. Comply with applicable building and elevator codes at the project site, including but not limited to the following:
  - 1- ASME A17.1/CSA B44, Safety Code for Elevators and Escalators.
  - 2- ASME A17.7/CSA B44, Performance-Based Safety Code for Elevators and Escalators.
  - 3- ADAAG, American Disabilities Act Accessibility Guidelines.
  - 4- ANSI A117.1, Building and Facilities, Providing Accessibility and Usability for Physically Handicapped People.
  - 5- ANSI/NFPA 70, (NEC) National Electrical Code.
  - 6- CAN/CSA C22.1, (CEC) Canadian Electrical Code.
  - 7- ANSI/UL 10B, Standard for Fire Test of Door Assemblies.
  - 8- CAN/ULC-S104-10, Standard Method for Fire Test of Door Assemblies.
  - 9- ANSI/NFPA 80, Standard for Fire Doors and Other Opening Protectives.
  - 10- Building Codes IBC or NBCC.
  - 11- All Local Jurisdictional applicable codes.

### 1.04 SYSTEM DESCRIPTION

- A. Equipment Description: Gen3 Edge™ gearless machine-room less elevator where all components fit inside the hoistway with the controller in the top landing entrance frame.
- A- Equipment Control: Otis GCS Controller.
- B. Drive: Regenerative
- C. Quantity of Elevators: 1
- D. Elevator Stop Designations: 1, 2, 3
- E. Stops: 3
- F. Openings: Front Only
- G. Travel: 21'-2"
- H. Rated Capacity: 4000
- I. Rated Speed: 150 fpm
- J. Hoistway Size: See Drawings
- K. Clear Inside Dimensions: 5'-5 9/16" x 7'-4 7/8"
- L. Cab Height: 93"
- M. Clear Cab Height: 7'-4 5/16" (2243 mm)
- N. Entrance Type and Width: Center Opening - 4'0"
- O. Entrance Height: 84"
- P. Main Power Supply: 480 volts □ 5% of normal, three-phase, with a separate equipment grounding conductor.
- Q. Car Lighting Power Supply: 120 volts, single-phase, 15 amps, 60 Hz.
- R. Machine Location: Inside the hoistway at the top of the hoistway.
- S. Signal Fixtures: Manufacturer's standard with metal button targets (excluding CA).
- T. Controller Location:

U. Performance:

- 1- Car Speed:  $\square$  3 % of contract speed under any loading condition or direction of travel.
- 2- Car Capacity: Safely lower, stop and hold up to 120% of rated load (code required).
- 3- Ride Quality:
  - a. Vertical Vibration (maximum): 20 milli-g
  - b. Horizontal Vibration (maximum): 12 milli-g
  - c. Vertical Jerk (maximum):  $4.59 \square 1.0 \text{ ft./ sec}^3$
  - d. Acceleration/Deceleration (maximum):  $2.62 \text{ ft./ sec}^2$
  - e. In Car Noise: 55 – 60 dB(A)
  - f. Stopping Accuracy:  $\square$  0.375 in. max,  $\square$  0.25 in. Typical
  - g. Re-leveling Distance:  $\square$  0.5 in. ( $\square$  12 mm)

V. Operation: **Simplex Collective Operation:** Using a microprocessor-based controller, operation shall be automatic by means of the car and hall buttons. If all calls in the system have been answered, the car shall park at the last landing served.

W. Operation Features – Standard

- 1- Full Collective Operation
- 2- Anti-nuisance.
- 3- Fan and Light Protection.
- 4- Load Weighing Bypass.
- 5- Independent Service.
- 6- Firefighters' Service Phase I and Phase II (USA only); or Special Emergency Service Phase I and II – Emergency Recall and In-Car Emergency Operation (Canada only).
- 7- Top of Car Inspection.

X. Operation Features – Optional

- 1- Zoned Access at Bottom Landing.
- 2- Zoned Access at Upper Landing.
- 3- Express Priority Service with key-switch(es)
- 4- Emergency Hospital Service.
- 5- Automatic Rescue Operation
- 6- Automatic Standby Power Operation with Manual Override.

Y. Door Control Features:

- 1- Door control to open doors automatically when car arrives at a landing in response to a normal hall or car call.
- 2- Elevator doors shall be provided with a reopening device that will stop and reopen the car door(s) and hoistway door(s) automatically should the door(s) become obstructed by an object or person.
- 3- Door protection shall consist of a two-dimensional, multi-beam array projecting across the car door opening.
- 4- Door nudging operation to occur if doors are prevented from closing for an adjustable period of time.

Z. Provide equipment for seismic conditions: No

1.05 Submittals

- A. Product Data: Submit manufacturer's product data for each system proposed for use. Include the following:
  - 1- Signal and operating fixtures, operating panels and indicators.
  - 2- Cab design, dimensions and layout.
  - 3- Hoistway-door and frame details.
  - 4- Electrical characteristics and connection requirements.
  - 5- Expected heat dissipation of elevator equipment in hoistway (BTU).
  - 6- Color selection chart for Cab and Entrances.
- B. Shop Drawings: Submit approval layout drawings. Include the following:
  - 1- Car, guide rails, buffers, and other components in hoistway.
  - 2- Maximum rail bracket spacing.
  - 3- Maximum loads imposed on guide rails requiring load transfer to building structure.
  - 4- Clearances and travel of car.
  - 5- Clear inside hoistway and pit dimensions.
  - 6- Location and sizes of access doors, hoistway entrances and frames.
- C. Operations and Maintenance Manuals: Provide manufacturer's standard operations and maintenance manual.

1.06 Quality Assurance

- A. Manufacturer: Elevator manufacturer shall be ISO 9001 certified.
- B. Manufacturer shall have a minimum of fifteen years of experience in the fabrication, installation and service of elevators.
- C. Installer: Elevators shall be installed by the manufacturer.
- D. Permits, Inspections and Certificates: The Elevator Contractor shall obtain and pay for necessary Municipal or State Inspection and permit as required by the elevator inspection authority, and make such tests as are called for by the regulations of such authorities. These tests shall be made in the presence of such authorities or their authorized representatives.

1.07 Delivery, Storage, and Handling

- A. Should the building or the site not be prepared to receive the elevator equipment at the agreed upon date, the General Contractor will be responsible to provide a proper and suitable storage area on or off the premises.
- B. Should the storage area be off-site, and the equipment not yet delivered, then the elevator contractor, upon notification from the General Contractor, will divert the elevator equipment to the storage area. If the equipment has already been delivered to the site, then the General Contractor shall transport the elevator equipment to the storage area. The cost of elevator equipment taken to storage by either party, storage, and redeliver to the job site shall not be at the expense of the elevator contractor.

1.08 Warranty

- A. The elevator contractor's acceptance is conditional on the understanding that their warranty covers defective material and workmanship. The warranty period shall not extend longer than one (1) year from the date of completion or acceptance thereof by beneficial use, whichever is earlier, of each elevator. The warranty excludes: ordinary wear and tear, improper use, vandalism, abuse, misuse, or neglect or any other causes beyond the control of the elevator contractor and this express warranty is in lieu of all other warranties, express or implied, including any warranty of merchantability or fitness for a particular purpose.

1.09 Maintenance and Service

- A. Maintenance service consisting of regular examinations and adjustments of the elevator equipment shall be provided by the elevator contractor for a period of 12 Months after the elevator has been turned over for the customer's use. This service shall not be subcontracted but shall be performed by the elevator contractor. All work shall be performed by competent employees during regular working hours of regular working days. This service shall not cover adjustments, repairs, or replacement of parts due to negligence, misuse, abuse or accidents caused by persons other than the elevator contractor. Only genuine parts and supplies as used in the manufacture and installation of the original equipment shall be provided.
- B. The periodic lubrication of elevator components shall not be required, including Sheaves, Rails, Belts, Ropes, Car and CWT guides, etc.
- C. The elevator control system must:
  - 1- Provide in the controller the necessary devices to run the elevator on inspection operation.
  - 2- Provide on top of the car the necessary devices to run the elevator in inspection operation.
  - 3- Provide in the controller an emergency stop switch. This emergency stop switch when opened disconnects power from the brake and prevents the motor from running.
  - 4- Provide in the event of a power outage, means from the controller to electrically lift and control the elevator brake to safely bring the elevator to the nearest available landing.
  - 5- Provide the means from the controller to reset the governor over speed switch and also trip the governor.
  - 6- Provide the means from the controller to reset the emergency brake when set because of an unintended car movement or ascending car over speed.
  - 7- (Optional) Provide the means from the controller to reset elevator earthquake operation.
- D. Provide system capabilities to enable a remote expert to create a live, interactive connection with the elevator system to enable the following functions:
  - 1- Remotely diagnose elevator issues with a remote team of experts
  - 2- Remotely return an elevator to service
  - 3- Provide real-time status updates via email
  - 4- Remotely make changes to selected elevator functions including:
    - a. Control building traffic: Restrict floor access, remove car from group operation, shut down elevator, select up peak/down peak mode and activate independent service.
    - b. Conserve energy: Activate cab light energy save mode, activate fan energy save mode, shut down car(s).
    - c. Improve passenger experience: Extend door open times, change parking floor, activate auto car full, activate anti-nuisance, advance door opening, door nudging, extend specific floor extended opening time, release trapped passengers.

**PART 2 - PRODUCTS**

2.01 Manufacturer

- A. Manufacturer: Design based upon Otis Elevator's Gen3™ machine room-less elevator system.

2.02 Design and Specifications

- A. Provide machine-roomless Gen3™ traction passenger elevators from Otis Elevator Company. The control system and car design based on materials and systems manufactured by Otis Elevator Company. Specifically, the system shall consist of the following components:

- 1- Controller located entirely inside the hoistway.
- 2- An AC gearless machine using embedded permanent magnets mounted at the top of the hoistway.
- 3- Polyurethane Coated-Steel Belts for elevator hoisting purposes.
- 4- Regenerative drive that captures normally wasted energy and feeds clean power back into the building's power grid.
- 5- LED lighting standard in ceiling lights and elevator fixtures.
- 6- Sleep mode operation for LED ceiling lights and car fan.

B. Approved Installer: Otis Elevator Company

#### 2.03 Equipment: Controller Components

A. Controller: A microcomputer-based control system shall be provided to perform all of the functions of safe elevator operation. The system shall also perform car and group operational control.

- 1- All high voltage (110V or above) contact points inside the controller shall be protected from accidental contact when the controller doors are open.
- 2- Controller shall be separated into two distinct halves: Motor Drive side and Control side. High voltage motor power conductors shall be routed so as to be physically segregated from the rest of the controller.
- 3- Field conductor terminations points shall be segregated; high voltage (>30 volts DC and 110 VAC,) and low voltage (< 30 volts DC)
- 4- Controllers shall be designed and tested for Electromagnetic Interference (EMI) immunity according to the EN 12016 (May 1998): "EMC Product Family Standards for lifts, escalators, and passenger conveyors Part 2 – immunity"
- 5- Controller shall be located inside the wall next to the top landing entrance frame. Emergency access shall be provided through an access panel in the entrance frame secured by a key lock.
- 6- A separate control room, space or closet is an option.

B. Drive: A Variable Voltage Variable Frequency AC drive system shall be provided. The drive shall be set up for regeneration of AC power back to the building grid.

#### 2.04 Equipment: Hoistway Components

A. Machine: AC gearless machine, with a synchronous permanent-magnet motor, dual solenoid service and emergency disc brakes, mounted at the top of the hoistway.

B. Governor: The governor shall be a tension type car-mounted governor.

C. Buffers, Car, and Counterweight: Polyurethane type buffers shall be used for speeds of 150 and 200 feet per minute. Oil buffers shall be used for a speed of 350 feet per minute.

D. Hoistway Operating Devices:

- 1- Emergency stop switch in the pit.
- 2- Terminal stopping switches.

E. Positioning System: Consists of an encoder, reader box, and door zone vanes.

F. Guide Rails and Attachments: Guide rails shall be Tee-section steel rails with brackets and fasteners. Side counterweight arrangements shall have a dual-purpose bracket that combines both counterweight guide rails, and one of the car guide rails to building fastening.

G. Coated-Steel Belts: Polyurethane coated belts with high-tensile-grade, zinc-plated steel cords and a flat profile on the running surface and the backside of the belt. The belts shall have an FT-1 rating as referenced by NFPA 13. All driving sheaves and deflector sheaves should

- have a crowned profile to ensure center tracking of the belts. A continuous 24/7 monitoring system using resistance-based technology has to be installed to continuously monitor the integrity of the coated steel belts and provide advanced notice of belt wear.
- H. Governor Rope: Shall be steel and shall consist of at least eight strands wound about a sisal core center.
  - I. Fascia: Galvanized sheet steel shall be provided at the front of the hoistway.
  - J. Hoistway Entrances:
    - 1- Frames: Entrance frames shall be of bolted construction for complete one-piece unit assembly. All frames shall be securely fastened to fixing angles mounted in the hoistway and shall be of UL fire rated steel.
    - 2- Sills shall be extruded: Aluminum
    - 3- Doors: Entrance doors shall be of metal construction with vertical channel reinforcements.
    - 4- Fire Rating: Entrance and doors shall be UL fire rated for 1-1/2 hour
    - 5- Entrance Finish: Satin Stainless Steel
    - 6- Entrance Marking Plates: Entrance jambs shall be marked with 4" x 4" (102 mm x 102 mm) plates having raised floor markings with Braille located adjacent to the floor marking. Marking plates shall be provided on both sides of the entrance.
    - 7- Sight Guards: Sight guards will be furnished with all doors painted to match with painted doors, painted black for stainless steel doors.
- 2.05 Equipment: Car Components
- C. Car Frame and Safety: A car frame fabricated from formed or structural steel members shall be provided with adequate bracing to support the platform and car enclosures. The car safety shall be integral to the car frame and shall be Type "B", flexible guide clamp type.
  - D. Cab: Steel Shell Cab with stainless steel wall panels

Note: Paints and laminate to be selected from manufacturer's catalog of choices. Brushed Stainless Steel finished base plate located at top and bottom.

Brushed Stainless Steel finished vertical trim pieces are optional.

Note: Laminate to be selected from manufacturer's catalog of choices. Brushed Stainless Steel finished base plate located at top and bottom.
  - E. Car Front Finish: Satin Stainless Steel.
  - F. Car Door Finish: Satin Stainless Steel.
  - G. Ceiling Type: Dropped ceiling with LED lights
  - H. Car Front Finish: Satin Stainless Steel.
  - I. Car Door Finish: Satin Stainless Steel.
  - J. Ceiling Finish: Brushed Steel Finish
  - K. Emergency Car Lighting: An emergency power unit employing a 6-volt sealed rechargeable battery and totally static circuits shall be provided to illuminate the elevator car in the event of building power failure.
  - L. Fan: A one-speed 120 VAC fan will be mounted to the ceiling to facilitate in-car air circulation, meeting A17.1 code requirements. The fan shall be rubber mounted to prevent the transmission of structural vibration and will include a baffle to diffuse audible noise. A switch shall be provided in the car-operating panel to control the fan.
  - M. Handrails: Brushed steel finish, 3/8" x 2" flat tubular bar handrails shall be provided on the side walls.

- A. Threshold: Aluminum
- N. Emergency Exit Contact: An electrical contact shall be provided on the car-top exit.
- O. Guides: The car shall have 3" diameter roller guides at top and bottom and the counterweight shall have slide type guides at the top and the bottom. Optional counterweight guides available.
- P. Platform: The car platform shall be constructed of metal. Load weighing device shall be mounted on the belts at the top of the hoistway.
- Q. The LED ceiling lights, and the fan should automatically shut off when the system is not in use and be powered back up after a passenger calls the elevator and pushes a hall button.  
*Note: Below are optional.*
- R. Certificate frame: Provide a Certificate frame with a satin stainless steel finish.
- S. Otis cab UVC light purification device
- T. Otis cab air purifier

2.06 Equipment: Signal Devices and Fixtures

- A. Car Operating Panel: A standard applied car operating panel shall be provided which contains all push buttons, key switches, and message indicators for elevator operation. The car operating panel shall have a satin stainless steel finish. (An optional Luxury Swing COP is available. A second COP is available)
  - 1- The car operating panel shall contain a bank of round stainless steel, mechanical LED illuminated buttons, flush mounted to the panel and marked to correspond to the landings served. All buttons to have raised numerals and Braille markings with:
  - 2- The car operating panel shall be equipped with the following features:
    - a. Raised markings and Braille to the left-hand side of each push-button.
    - b. Car Position Indicator at the top of and integral to the car operating panel.
    - c. Door open and door close buttons.
    - d. Inspection key-switch.
    - e. Elevator Data Plate marked with elevator capacity and car number.
    - f. Help Button: The help button shall initiate two-way communication between the car and a location inside the building, switching over to another location if the call is unanswered, where personnel are available who can take the appropriate action. Visual indicators are provided for call initiation and call acknowledgement.
    - g. Landing Passing Signal: A chime bell shall sound in the car to signal that the car is either stopping at or passing a floor served by the elevator.
    - h. Landing Passing Signal: A chime bell shall sound in the car to signal that the car is either stopping at or passing a floor served by the elevator.
    - i. In car stop switch (toggle or key unless local code prohibits use)
    - j. Firefighter's hat (standard USA)
    - k. Firefighter's Phase II Key-switch (standard USA)
    - l. Call Cancel Button (standard USA)
    - m. Firefighter's Phase II Emergency In-Car Operating Instructions: worded according to A17.1 2000, Article 2.27.7.2.
    - n. Please Exit Symbol: provided with emergency hospital service, or express priority in the hall.



- B. Car Position Indicator: A digital, LED car position indicator shall be integral to the car operating panel.
- C. Hall Fixtures: Hall fixtures shall be provided with necessary push buttons and key switches for elevator operation.
  - 1- Integral Hall fixtures shall feature round stainless steel, mechanical buttons marked to correspond to the landings. Hall fixtures to be located in the entrance frame face. Buttons shall be in vertically mounted fixture. Fixture shall be satin stainless steel finish.
  - 2- Button: Flat flush mounted, satin stainless steel button with blue or white LED illuminating halo
  - 3- Car Lantern and Chime: A directional lantern visible from the corridor shall be provided in the car entrance. When the car stops and the doors are opening, the lantern shall indicate the direction in which the car is to travel, and a chime will sound.
- D. Provide Card Reader Provision

### **PART 3 - EXECUTION**

#### **3.01 Preparation**

- A. Take field dimensions and examine conditions of substrates, supports, and other conditions under which this work is to be performed. Do not proceed with work until unsatisfactory conditions are corrected.

#### **3.02 Installation**

- A. Installation of all elevator components except as specifically provided for elsewhere by others.

#### **3.03 Demonstration**

- A. The elevator contractor shall make a final check of each elevator operation with the Owner or Owner's representative present prior to turning each elevator over for use. The elevator contractor shall determine that control systems and operating devices are functioning properly.

### **END OF SECTION**

**SECTION 21 05 00  
COMMON WORK RESULTS FOR FIRE SUPPRESSION**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Pipe, fittings, sleeves, escutcheons, seals, and connections for sprinkler systems.
- B. Expansion joints.

**1.02 RELATED REQUIREMENTS**

- A. Section 07 84 00 - Firestopping.
- B. Section 21 12 00 - Fire-Suppression Standpipes: Standpipe design.
- C. Section 21 13 00 - Fire-Suppression Sprinkler Systems: Sprinkler systems design.

**1.03 REFERENCE STANDARDS**

- A. ASME A112.18.1 - Plumbing Supply Fittings; 2012.
- B. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Welding, Brazing, and Fusing Qualifications; 2015.
- C. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2010.
- D. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2011.
- E. ASME B16.4 - Gray Iron Threaded Fittings: Classes 125 and 250; 2011.
- F. ASME B16.9 - Factory-Made Wrought Butt welding Fittings; 2012.
- G. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999 (Reapproved 2014).
- H. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.
- I. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984 (Reapproved 2014).
- J. ASTM A795/A795M - Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use; 2013.
- K. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2013.
- L. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops; 2013a.
- M. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015.
- N. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; 2010.
- O. AWWA C606 - Grooved and Shouldered Joints; 2011.
- P. FM (AG) - FM Approval Guide; current edition.
- Q. ITS (DIR) - Directory of Listed Products; current edition.
- R. NFPA 13 - Standard for the Installation of Sprinkler Systems; 2016.
- S. NFPA 14 - Standard for the Installation of Standpipe and Hose Systems; 2013.
- T. UL (DIR) - Online Certifications Directory; current listings at [database.ul.com](http://database.ul.com).

**1.04 SUBMITTALS**

- A. Product Data: Provide manufacturers catalogue information. Indicate valve data and ratings.
- 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.
  - 2. Approved by manufacturer.
- B. Valves: Bear FM (AG), UL (DIR), and ITS (DIR) or Warnock Hersey product listing label or marking. Provide manufacturer's name and pressure rating marked on valve body.
- C. Products Requiring Electrical Connection: Listed and classified as suitable for the purpose specified and indicated.
- D. 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. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

### **1.07 WARRANTY**

- A. Correct defective Work within a five year period after Date of Substantial Completion.

## **PART 2 PRODUCTS**

### **2.01 FIRE PROTECTION SYSTEMS**

- A. Sprinkler Systems: Comply with NFPA 13.
- B. Standpipe and Hose Systems: Comply with NFPA 14.
- C. Welding Materials and Procedures: Comply with ASME BPVC-IX.

### **2.02 BURIED PIPING**

- A. Steel Pipe: ASTM A53/A53M Schedule 40, black, with AWWA C105/A21.5 polyethylene jacket, or double layer, half-lapped polyethylene tape.
  - 1. Cast Iron Fittings: ASME B16.1, flanges and flanged fittings.
  - 2. Joints: Welded in accordance with AWS D1.1/D1.1M.
  - 3. Casing: Polyurethane insulation with high density polyethylene jacket and heat shrink sleeves.

### **2.03 ABOVE GROUND PIPING**

- A. Steel Pipe: ASTM A795 Schedule 10 or ASTM A53 Schedule 40, black.
  - 1. Steel Fittings: ASME B16.9 wrought steel, butt welded.
  - 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.

### **2.04 PIPE SLEEVES**

- A. Vertical Piping:
  - 1. Sleeve Length: 1 inch (25 mm) above finished floor.
  - 2. Provide sealant for watertight joint.
  - 3. Drilled Penetrations: Provide 1-1/2 inch (40 mm) angle ring or square set in silicone adhesive around penetration.
- B. Pipe Passing Through Below Grade Exterior Walls:
  - 1. Zinc coated or cast iron pipe.
  - 2. Provide watertight space with link rubber or modular seal between sleeve and pipe on both pipe ends.

- C. Not required for wall hydrants for fire department connections or in drywall construction.
- D. Clearances:
  - 1. Wall, Floor, Floor, Partitions, and Beam Flanges: 1 inch (25 mm) greater than external; pipe diameter.
  - 2. Rated Openings: Caulked tight with fire stopping material complying with ASTM E814 in accordance with Section 07 84 00 to prevent the spread of fire, smoke, and gases.

## **2.05 ESCUTCHEONS**

- A. Manufacturers:
  - 1. Fire Protection Products, Inc: [www.fppi.com.com](http://www.fppi.com.com).
  - 2. Tyco Fire Protection Products: [www.tyco-fire.com](http://www.tyco-fire.com).
  - 3. Viking Group Inc: [www.vikinggroupinc.com](http://www.vikinggroupinc.com).
- B. Material:
  - 1. Fabricate from nonferrous metal.
  - 2. Chrome-plated.
  - 3. Metals and Finish: Comply with ASME A112.18.1.
- C. Construction:
  - 1. One-piece for mounting on chrome-plated tubing or pipe and one-piece or split-pattern type elsewhere.
  - 2. Internal spring tension devices or setscrews to maintain a fixed position against a surface.

## **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.
- B. Hangers for Pipe Sizes 2 inches (50 mm) and Over: Carbon steel, adjustable, clevis.
- C. Wall Support for Pipe Sizes to 3 inches (80 mm): Cast iron hook.
- D. Wall Support for Pipe Sizes 4 inches (100 mm) and Over: Welded steel bracket and wrought steel clamp.
- E. Vertical Support: Steel riser clamp.

## **2.07 MECHANICAL COUPLINGS**

- A. Manufacturers:
  - 1. Tyco Fire Protection Products; Grinnell G-Fire Figure 705 Grooved Flexible Couplings: [www.tyco-fire.com/#sle](http://www.tyco-fire.com/#sle).
  - 2. Victaulic Company; FireLock Style 009H: [www.victaulic.com/#sle](http://www.victaulic.com/#sle).
- 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.

## **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. Install standpipe piping, hangers, and supports in accordance with NFPA 14.
- C. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- D. Install piping to conserve building space, to not interfere with use of space and other work.
- E. Group piping whenever practical at common elevations.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- G. Inserts:
  - 1. Provide inserts for placement in concrete formwork.
  - 2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- H. 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.
  - 6. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- I. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.
- J. 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.
- K. Structural Considerations:
  - 1. Do not penetrate building structural members unless indicated.
- L. Provide sleeves when penetrating footings, floors, walls, and partitions. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.
  - 1. Underground Piping: Caulk pipe sleeve watertight with lead and oakum or mechanically expandable chloroprene inserts with bitumen sealed metal components.
  - 2. 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.
  - 3. All Rated Openings: Caulk tight with fire stopping material complying with ASTM E814 in accordance with Section 07 84 00 to prevent the spread of fire, smoke, and gases.
  - 4. Caulk exterior wall sleeves watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed components.
- M. Escutcheons:
  - 1. Install and firmly attach escutcheons at piping penetrations into finished spaces.
  - 2. Provide escutcheons on both sides of partitions separating finished areas through which piping passes.
  - 3. Attach plates at the underside only of suspended ceilings.

- 4. Use chrome plated escutcheons in occupied spaces and to conceal openings in construction.
- N. 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**

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**SECTION 22 00 00**  
**PLUMBING GENERAL PROVISIONS**

**PART 1 - GENERAL**

**1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other General Requirements specified in the Architectural, Electrical, Structural, and Fire Protection Specifications apply to this Section.

**1.02 SUMMARY OF WORK**

- A. Furnish all materials, labor, equipment, tools, supervision, permits, and incidentals necessary to complete installation and successfully test, start-up, and operate, in a practical and efficient manner, all plumbing systems as described in Contract Documents.
- B. It is the intent of these specifications that the systems specified herein are to be complete and operational before being turned over to the owner. During the bidding process, the contractor is to ask questions or call to the engineer's attention any items that are not shown or may be required to make the system complete and operational. Once the project is bid and the contractor has accepted the contract, it is his responsibility to furnish and install all equipment and parts necessary to provide a complete and operational system without additional cost to the owner. The work shall also include any items which, while not specifically included in the Contract Documents, are reasonable and are accepted trade practices or necessary for the proper completion of the systems.
- C. Furnish and install fire stopping materials to seal penetrations through fire rated structures and draft stops.

**1.03 DRAWINGS AND SPECIFICATIONS**

- A. Drawings are diagrammatic and are intended to convey a general arrangement and scope of the work included in the contract. Should drawings contradict themselves or the Specifications, the better quality or greater quantity of work shall be included.
- B. The Plumbing Contractor shall be familiar with all Architectural, Civil, Structural, Fire Protection, Mechanical and Electrical Drawings and Specification Sections, and shall follow any special requirements or directions included in these areas.
- C. Drawings and Specifications are intended to include all work and materials necessary for completion of the work. Any incidental item of material, labor or detail required for the proper execution and completion of the work and omitted from either the drawings and specifications or both, but required by governing codes local regulations, trade practices, operational functions, and good workmanship, shall be provided as part of the Contract Work without extra charge, even though not specifically detailed or specified.
- D. Should there be any question as to the scope of work for which the Plumbing Contractor is responsible, they should request an interpretation before submitting their bid. After contracts are awarded, the Owner shall not be responsible for claims for extras for work that was not included because the Plumbing Contractor was unsure if they should include given work in their bid.

**1.04 SUBMITTALS**

- A. Proposal Supplement:
  - 1. Contractor to submit ONE (1) copy of Proposal Supplement - SECTION 22 00 10 - PLUMBING EQUIPMENT AND MATERIALS, at the time of Bid opening, listing the manufacturers upon which his bid was based, including all items being provided by Sub-Contractors.
  - 2. After Proposal Supplement and Sub-Contractors are approved, no deviation shall be permitted without written approval of Engineer



- B. Product Data & Shop Drawings:
  - 1. Submit Portable Document Format (PDF) files of shop drawings on all equipment and materials indicated on the Drawings for approval, prior to placing delivery orders (also refer to Architectural Specifications for shop drawing requirements). PDF files shall be e-mailed to the Construction Manager.
  - 2. At the time of submittal for review by the Engineer, shop drawings shall include signatures or stamps indicating that the Contractor and/or the Sub-Contractor has reviewed the submittals and has coordinated the required space, quantities required, services and work of other trades for the equipment or system being submitted.
  - 3. Hard copy submittals shall be in the form of bound folders with the name of the Project, Architect, Engineer and the submitting Contractor indicated on the cover. Submittals requiring drawings too large to be bound into the folder shall be folded and inserted in pockets bound into the folder.
  - 4. Provide shop drawings of all manufactured equipment and materials except pipe, pipe fittings. Drawings shall include equipment capacities, weights, dimensions, construction details, installation, controls, wiring diagrams, and motor data.
  - 5. Mark literature to indicate specific item with applicable data clearly identified.
  - 6. Engineer's review of shop drawings is a service for general application only and is not considered as a guarantee of total compliance with or as relieving the Plumbing Contractor of basic responsibilities under all contract documents and does not approve changes in time or cost.
  - 7. After review, the Plumbing Contractor and its subcontractors are responsible to provide information to all other trades involved in, or affected by, the installation of the Plumbing equipment.
- C. Record (As-Built) Drawings:
  - 1. At substantial completion of construction, furnish record (as-built) plans to the Engineer for approval. As part of the Final Punch List/Close-out, approved as-built plans shall be provided to the Owner.
  - 2. Record drawings shall include, at the minimum:
  - 3. The location and performance data on each piece of equipment.
    - a. The general configuration of pipe distribution systems, including sizes.
- D. Operating and Maintenance Manuals:
  - 1. The Plumbing Contractor and sub-contractors shall provide a set of operating and maintenance instructions to the Engineer for review as part of the Final Punch List/Close-out. The Engineer will provide approved manuals to the Owner.
  - 2. These manuals shall be in accordance with industry-accepted standards and shall include, at the minimum:
    - a. Submittal data stating equipment size and selected options for each piece of equipment requiring maintenance.
    - b. Operation and Maintenance manuals for each piece of equipment requiring maintenance. Required routine maintenance actions shall be clearly identified.

#### **1.05 STANDARDS, CODES AND PERMITS:**

- A. Refer to Division 01, General Requirements and Supplementary Conditions.
- B. All work shall comply with the latest edition of applicable standards and codes of following
  - ASA - American Standards Association
  - ASME - American Society of Mechanical Engineers
  - ASTM - American Society of Testing Materials
  - ANSI - American National Standards Institute
  - AWWA - American Water Works Association
  - CISPI - Cast Iron Soil Pipe Institute
  - HI - Hydronics Institute
  - NFPA - National Fire Protection Association
  - AWS - American Welding Society

UL - Underwriter's Laboratories  
NEMA - National Electric Manufacturers Association  
NEC - National Electric Code  
ARA - American Refrigeration Association  
OSHA - Occupational Safety and Health Act  
International Plumbing Code 2015 (with Michigan Amendments)

- C. All work shall be provided and tested in accordance with all applicable local county, state laws, ordinances, codes, rules and regulations.
- D. No work shall be covered or enclosed by walls, ceilings, or other, until the work is tested in accordance with applicable codes and regulations, and successful tests witnessed and approved by authorized inspection authority. Written approvals shall be secured by the Plumbing Contractor and submitted to Engineer before final acceptance of work will be granted.

#### **1.06 QUALITY ASSURANCE AND COORDINATION**

- A. Electrical Characteristics for Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.
- B. All work to meet currently enforced local plumbing code. In the case of discrepancies between the project contract documents and the currently enforced local code, the most stringent shall govern.

#### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

### **PART 2 - PRODUCTS**

#### **2.01 EQUIPMENT AND MATERIALS:**

- A. All equipment and materials shall be furnished in strict accordance with the equipment named and according to Specification requirements. Each bid shall be based upon one of the materials or manufacturers specified.
- B. Equipment and materials specified shall be considered to have prior approval, but submittal for approval is required. Furnish construction drawings to other Contractors when required to coordinate construction.
- C. Where multiple manufacturers are named the drawings and specifications are based on the requirements and layouts for the equipment of the first named manufacturer. Any change required by the use of other named manufacturers such as revisions to foundations, bases, piping, controls, wiring, openings, and appurtenances shall be made by the Contractor at no additional cost to the Owner.

#### **2.02 PIPE, TUBE, AND FITTINGS - GENERAL**

- A. Refer to individual Division 22 Piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

#### **2.03 GROUT**

- A. Description: ASTM C 1107, Grade B, non-shrink and nonmetallic, dry hydraulic-cement grout.
  - 1. Characteristics: Post-hardening, volume-adjusting, non-staining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
  - 2. Design Mix: 5000-psi, 28-day compressive strength.
  - 3. Packaging: Premixed and factory packaged.

## **PART 3 - EXECUTION**

### **3.01 COORDINATION**

- A. Submission of a bid proposal is considered evidence that the Plumbing Contractor and its Sub-Contractors are fully capable of providing the following and have included the following in their bid proposal:
  - 1. Fully proficient and experienced to do the work described in the contract documents.
  - 2. Knowledgeable of all federal, state, and local standards, codes, ordinances, permits, and regulations that pertain to the work described in the contract documents.
  - 3. Have properly estimated the time and workforce, including sub-contractors, needed to complete the job by the due date.
  - 4. Have included all material, equipment, and labor costs for completion of the job, including all sub-contractor's costs.
  - 5. Have all the equipment, tools, supplies, vehicles, and trailers to complete the job.
  - 6. Have included all travel, food and lodging expenses.
- B. Contractor shall coordinate the work of the different trades so that interference between piping, equipment, structural and electrical work will be avoided. All necessary offsets in piping and ductwork, and all fittings, and other components, required to install the work properly shall be furnished complete in place at no additional cost.
- C. Unless otherwise stipulated under a particular heading, the following rules relative to responsibilities of the Contractors and Subcontractors will apply:
  - 1. Make-up water piping connections shall be provided by the Plumbing Contractor to within five (5) feet of the required point of connection to the equipment and there terminated with a shut-off valve. Each trade shall make the final connection to the equipment it installs.
  - 2. Ceiling access panels will be installed by the General Contractor at locations determined by the Plumbing Contractor.
  - 3. The Plumbing Contractor or subcontractor shall install all roughing-in pertaining to his trade for each item of equipment furnished under another Section of the Specifications or by the Owner.
  - 4. The Plumbing Contractor shall make final connections of equipment to rough-ins.

### **3.02 PLUMBING DEMOLITION (WHEN INDICATED ON THE DRAWINGS)**

- A. Refer to applicable Division 01 Section covering cutting and patching and applicable Division 02 Section covering selective structure demolition for general demolition requirements and procedures.
- B. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.
- C. All unused waste, water and vent that is no longer in service shall be removed from ceilings, walls and floors. No dead piping will be allowed to stay. Underground piping shall also be removed. If piping cannot be removed underground it shall be capped at the main and the pipe shall be pumped and filled with a flowable fill.
- D. A MOP will be required when filling abandoned sewers, old water mains or any plumbing piping that is buried in the ground.
- E. Before abandoning any plumbing piping underground, the piping shall be inspected, video recorded, mapped on an as built and FMDC and FMO shall approve abandoning the piping.
- F. After completion of all work, all of the sewer systems involved with the project in their entirety, shall be thoroughly cleaned out to remove all grit, or other foreign matter. This process shall be video-recorded by the plumbing contractor and electronic copies of the video recording:
  - 1. Shall be contained on an external storage media of the Owner's choice and shall be included with the close out documents.OR

2. Shall be made available with the close out documents in electronic format thru other means agreeable to the Owner.

### 3.03 INSTALLATION

#### A. PIPING SYSTEMS - COMMON REQUIREMENTS

1. All materials and/or equipment shall be installed per manufacturer's recommendations and instructions.
2. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
3. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

#### B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

#### C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

1. Piping shall not project beyond walls or steel lines nor shall it hang below slabs more than is absolutely necessary. Particular attention shall be paid to the required clearances.
2. Offset piping where required to avoid interference with other work, to provide greater headroom or clearance, or to conceal pipe more readily. Offsets shall be properly drained or trapped where necessary.
3. Provide swing joints and expansion bends wherever required to allow the piping to expand without undue stress to connections or equipment.
4. Exposed piping around fixtures or in other conspicuous places shall not show tool marks at fittings.
5. Isolate pipe from the building construction to prevent transmission of vibration to the structure and to eliminate noise.
6. Install piping such that any equipment connected to piping may be removed by disconnecting two (2) flanges or unions and removing only one or two pipe sections. All equipment shall have bolted or screwed flanges or unions at pipe connections.
7. Install fittings for changes in direction and branch connections. T-drill system for mechanically formed tee connections and couplings, and Victaulic hole cut piping system are not allowed.
8. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment.
9. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
10. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
11. Install piping to permit valve servicing.
12. Install piping at indicated slopes.
13. Install piping free of sags and bends.
14. Install piping to allow application of insulation.
15. Eccentric reducing couplings shall be provided in all cases where air or water pockets would otherwise occur due to a reduction in pipe size.
16. Cap and plug all openings in pipes during construction with suitable metal plugs or cap to keep out dirt and rubbish until equipment is connected.
17. Install drains, consisting of a tee fitting, NPS 3/4 full port-ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
18. Select system components with pressure rating equal to or greater than system operating pressure.

19. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
  20. Verify final equipment locations for roughing-in.
  21. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
  22. Provide proper access to materials and equipment that require inspection, repair, service, or maintenance.
  23. Minimum service access size for materials equipment/components above ceilings shall be 24" square.
- D. PIPING JOINT CONSTRUCTION
1. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
  2. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
  3. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
  4. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
    - a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
    - b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- E. PIPING CONNECTIONS
1. Pipe sizes indicated shall be carried full size to equipment served. Any change of size to match equipment connection shall be made within one foot of the equipment. At temperature control valves with sizes smaller than connected lines, reduction shall be made immediately adjacent to valves.
- F. EQUIPMENT INSTALLATION - COMMON REQUIREMENTS
1. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated.
  2. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
  3. Install Plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
  4. Install equipment to allow right of way for piping installed at required slope.
- G. CONCRETE BASES
1. Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
  2. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit. Install dowel rods to connect concrete base to concrete floor.
  3. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
  4. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
  5. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  6. Install anchor bolts to elevations required for proper attachment to supported equipment.
  7. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

8. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete"

#### H. ERECTION OF METAL SUPPORTS AND ANCHORAGES

1. Refer to Division 05 Section "Metal Fabrications" for structural steel.
2. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor Plumbing materials and equipment.
3. Field Welding: Comply with AWS D1.1.

#### I. GROUTING

1. Mix and install grout for Plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.
2. Clean surfaces that will come into contact with grout.
3. Provide forms as required for placement of grout.
4. Avoid air entrapment during placement of grout.
5. Place grout, completely filling equipment bases.
6. Place grout on concrete bases and provide smooth bearing surface for equipment.
7. Place grout around anchors.
8. Cure placed grout.

### 3.04 EQUIPMENT START-UP

- A. Start-up of all plumbing equipment shall be video-recorded by the plumbing contractor. Electronic copies of the video recording:
  1. Shall be contained on an external storage media of the Owner's choice and shall be turned over to the Owner's maintenance staff.OR
  2. Shall be made available to the Owner and/or Owner's maintenance staff in electronic format thru other means agreeable to the Owner.

### 3.05 TESTING AND REPAIR

- A. All piping and ductwork systems shall be thoroughly cleaned and flushed prior to final testing.
- B. Pressure testing shall be completed for the following piping systems:
  1. Domestic water, sanitary and vent, storm and gas piping systems, and other systems as noted on the plans.
- C. All testing must be witnessed and accurately recorded noting methods of testing, times, dates, and results.
- D. Any damage as a result of tests shall be repaired or damaged materials replaced at no cost to the Owner.

### 3.06 FINAL COMPLETION

- A. All work shall be cleaned prior to issuance of Substantial Completion.
- B. Retouch or repaint factory painted prime and finish coats where scratched or damaged.
- C. Deliver any equipment as required by this Specification to Owner and obtained signed receipts of delivery.
- D. Clean equipment, restore damaged materials, and leave the Work in acceptable condition.
- E. Remove all site tools, equipment, surplus materials and rubbish continuously at no additional cost to the Owner.
- F. Contractor shall submit written certificates warranting each item of equipment.

**END OF SECTION 22 0000**

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**SECTION 22 00 10  
PLUMBING EQUIPMENT AND MATERIALS**

**PART 1 GENERAL**

**1.01 INSTRUCTION:**

- A. The Plumbing Contractor is to either copy or remove this specification section from the spec book and complete as follows:
  - 1. Indicate the specific manufacturer on which the bidder's base bid price is based in the blank space provided.
  - 2. All equipment is to be bid as specified. Material or equipment from another manufacturer may be bid as a Voluntary Alternate, but the dollar amount must be shown as an "Add" or "Deduct" to the base bid. Provide the name of the alternate manufacturer in the space provided.
  - 3. Insert the name(s) of each subcontractor used in your bid in the space provided in Part 3.
  - 4. This form shall be submitted with the bid.

**1.02 RELATED DOCUMENTS:**

- A. The other Contract Documents complement the requirements of this Section. The General Requirements apply to the work of this section.

**1.03 DEVIATIONS FROM SPECIFIED MATERIAL:**

- A. See SECTION 22 00 00, Part 2, Paragraph 2.02 - Substitutions and Changes. Base bid shall be based on manufacturers listed in this specification or on the drawings.

**PART 2 PRODUCTS**

**2.01 THE FOLLOWING IS A LIST OF APPROVED MANUFACTURERS, GROUPED ACCORDING TO TYPES OF MATERIALS OR EQUIPMENT.**

- A. Water Closets(s):
  - 1. Sloan, American Standard, Kohler, and Zurn
    - a. Voluntary alternate \_\_\_\_\_
    - b. Add \$ Deduct \$ \_\_\_\_\_
- B. Urinal(s):
  - 1. Kohler, American Standard, Sloan, and Zurn
    - a. Voluntary alternate \_\_\_\_\_
    - b. Add \$ Deduct \$ \_\_\_\_\_
- C. Flush Valve(s):
  - 1. Sloan, Toto, and Zurn
    - a. Voluntary Alternate \_\_\_\_\_
    - b. Add \$ Deduct \$ \_\_\_\_\_
- D. Lavatories:
  - 1. American Standard, Bradley, Kohler, and Sloan
    - a. Voluntary alternate \_\_\_\_\_
    - b. Add \$ Deduct \$ \_\_\_\_\_
- E. Sinks:
  - 1. American Standard, Elkay, and Kohler
    - a. Voluntary Alternate \_\_\_\_\_
    - b. Add \$ Deduct \$ \_\_\_\_\_
- F. Service Sink(s):
  - 1. Bradley, FIAT Products, Florestone, Mustee, and Zurn
    - a. Voluntary Alternate \_\_\_\_\_
    - b. Add \$ Deduct \$ \_\_\_\_\_



- G. Faucets:
1. American Standard, Chicago Faucets, Elkay, Kohler, and Zurn
    - a. Voluntary Alternate \_\_\_\_\_
    - b. Add \$ Deduct \$ \_\_\_\_\_
- H. Shower(s):
1. Kohler, Zurn, Aquatic, and Oasis
    - a. Voluntary Alternate \_\_\_\_\_
    - b. Add \$ Deduct \$ \_\_\_\_\_
- I. Electric Water Cooler(s), Bottle-Filler(s):
1. Elkay and Murdock
    - a. Voluntary Alternate \_\_\_\_\_
    - b. Add \$ Deduct \$ \_\_\_\_\_
- J. Drain(s):
1. JR Smith, Sioux Chief, and Zurn
    - a. Voluntary Alternate \_\_\_\_\_
    - b. Add \$ Deduct \$ \_\_\_\_\_
- K. Sump(s):
1. Bell & Gossett and Topp
    - a. Voluntary Alternate \_\_\_\_\_
    - b. Add \$ Deduct \$ \_\_\_\_\_
- L. Ejector Pump(s):
1. Bell & Gossett, Goulds, Grundfos, and Zoeller
    - a. Voluntary Alternate \_\_\_\_\_
    - b. Add \$ Deduct \$ \_\_\_\_\_

### **PART 3 SUB-CONTRACTORS**

#### **3.01 INSERT THE NAME OF EACH SUB-CONTRACTOR AND WORK TO BE PERFORMED BELOW:**

- A. Subcontractor Work Performed \_\_\_\_\_
- B. Subcontractor Work Performed \_\_\_\_\_
- C. Subcontractor Work Performed \_\_\_\_\_

**END OF SECTION**

**SECTION 22 05 53**  
**IDENTIFICATION FOR PLUMBING 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. ASME A13.1 - Scheme for the Identification of Piping Systems; 2007.

**PART 2 PRODUCTS**

**2.01 IDENTIFICATION APPLICATIONS**

- A. Piping: Pipe markers.
- B. Small-sized Equipment: Tags.
- C. Tanks: Nameplates.
- D. Valves: Tags and ceiling tacks where located above lay-in ceiling.

**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](http://www.seton.com).
  - 4. Letter Color: White.
  - 5. Letter Height: 1/4 inch (6 mm).
  - 6. Background Color: Black.
  - 7. 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. 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).
- B. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch (40 mm) diameter.

**2.04 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. Kolbi Pipe Marker Co: [www.kolbipipemarkers.com/#sle](http://www.kolbipipemarkers.com/#sle).
  - 4. MIFAB, Inc: [www.mifab.com/#sle](http://www.mifab.com/#sle).
  - 5. Seton Identification Products: [www.seton.com/#sle](http://www.seton.com/#sle).
- B. 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. Color code as follows:
  - 1. Potable, Cooling, Boiler, Feed, Other Water: Green with white letters.
  - 2. Fire Quenching Fluids: Red with white letters.
  - 3. Flammable Fluids: Yellow with black letters.

## **2.05 CEILING TACKS**

- A. Description: Steel with 3/4 inch (20 mm) diameter color coded head.
- B. Color code as follows:
  - 1. Plumbing Valves: Green.

## **PART 3 EXECUTION**

### **3.01 PREPARATION**

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

### **3.02 INSTALLATION**

- A. Install plastic 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. Apply stencil painting in accordance with Section 09 91 23.
- D. Install plastic pipe markers in accordance with manufacturer's instructions.
- E. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
- F. Use tags on piping 3/4 inch (20 mm) diameter and smaller.
  - 1. Identify service, flow direction, and pressure.
  - 2. Install in clear view and align with axis of piping.
  - 3. 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.
- G. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.
- H. Identify control panels and major control components outside panels with plastic nameplates.
- I. Identify thermostats relating to terminal boxes or valves with nameplates.
- J. Identify valves in main and branch piping with tags.
- K. Identify air terminal units and radiator valves with numbered tags.
- L. Tag automatic controls, instruments, and relays. Key to control schematic.
- M. Identify piping, concealed or exposed, with plastic pipe markers. Use tags on piping 3/4 inch (20 mm) diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. 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.
- N. Install ductwork with plastic nameplates. 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.
- O. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

## **END OF SECTION**

**SECTION 22 07 19  
PLUMBING PIPING INSULATION**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Glass fiber insulation.
- B. Jacketing and accessories.

**1.02 RELATED REQUIREMENTS**

- A. Section 22 10 05 - Plumbing Piping: Placement of hangers and hanger inserts.

**1.03 REFERENCE STANDARDS**

- A. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2014.
- B. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2015.
- C. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation; 2015.
- D. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2013).
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- F. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2014.
- G. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

**1.04 SUBMITTALS**

- A. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

**1.05 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, UL 723, ASTM E84, or UL 723.

**2.02 GLASS FIBER INSULATION**

- A. Manufacturers:
  - 1. Johns Manville Corporation
  - 2. Knauf Insulation
  - 3. Owens Corning Corporation
  - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Insulation: Class 1, ASTM C547 and ASTM C795; rigid, preformed pipe insulation, 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: Factory applied, 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.

## **2.03 JACKETING AND ACCESSORIES**

- A. PVC Plastic Jacket:
  - 1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
    - a. Minimum Service Temperature: 0 degrees F (Minus 18 degrees C).
    - b. Maximum Service Temperature: 150 degrees F (66 degrees C).
    - c. Moisture Vapor Permeability: 0.002 perm inch (0.0029 ng/(Pa s m)), maximum, when tested in accordance with ASTM E96/E96M.
    - d. Thickness: 10 mil, 0.010 inch (0.25 mm).
    - e. Connections: Brush on welding adhesive.
  - 2. Covering Adhesive Mastic: Compatible with insulation.

## **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. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
- E. Glass fiber insulated pipes conveying fluids below 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 molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.
- F. 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.
- G. 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.
- H. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, see Section 07 84 00.
- I. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet (3 meters) above finished floor): Finish with PVC jacket and fitting covers.

### **3.03 SCHEDULES**

- A. Insulation type and thickness:
  - 1. Domestic Hot Water Supply and Return above grade:
    - a. Glass Fiber Insulation:
      - 1) Pipe Size Range: Less than 1-1/2.  
(a) Thickness: 1 inch.
      - 2) Pipe Size Range: 1-1/2" and larger.  
(a) Thickness: 1.5 inch.
  - 2. Domestic Cold Water above grade:
    - a. Glass Fiber Insulation:
      - 1) Pipe Size Range: All sizes.
      - 2) Thickness: 1 inch.
  - 3. Horizontal Storm Piping above grade:
    - a. Glass Fiber Insulation:
      - 1) Pipe Size Range: All sizes.
      - 2) Thickness: 1 inch.
  - 4. Exposed Pan of Roof Drain inside of building:
    - a. Glass Fiber Insulation:
      - 1) Drain Size: All sizes.
      - 2) Thickness: 1 inch.
  - 5. Supplies & Traps at Barrier Free Lavatories:
    - a. Glass Fiber Insulation:
      - 1) Pipe Size Range: All sizes.
      - 2) Thickness: 1/2 inch.

**END OF SECTION**

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**SECTION 22 10 05  
PLUMBING PIPING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Pipe, pipe fittings, specialties, and connections for piping systems.
  - 1. Sanitary sewer.
  - 2. Domestic water.
  - 3. Storm water.
  - 4. Flanges, unions, and couplings.
  - 5. Pipe hangers and supports.
  - 6. Valves.
  - 7. Flow controls.
  - 8. Check.
  - 9. Relief valves.
  - 10. Strainers.

**1.02 RELATED REQUIREMENTS**

- A. Section 22 05 53 - Identification for Plumbing Piping and Equipment.
- B. Section 22 07 19 - Plumbing Piping Insulation.
- C. Section 33 01 10.58 - Disinfection of Water Utility Piping Systems.

**1.03 REFERENCE STANDARDS**

- A. ANSI Z21.22 - American National Standard for Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems; 1999, and addenda A&B (R2004).
- B. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2011.
- C. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2012.
- D. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2013.
- E. ASME B31.1 - Power Piping; 2014.
- F. ASME B31.9 - Building Services Piping; 2014.
- G. ASME BPVC-IV - Boiler and Pressure Vessel Code, Section IV - Rules for Construction of Heating Boilers; 2015.
- H. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Welding, Brazing, and Fusing Qualifications; 2015.
- I. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999 (Reapproved 2014).
- J. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.
- K. AWWA C606 - Grooved and Shouldered Joints; 2011.
- L. NSF 61 - Drinking Water System Components - Health Effects; 2014 (Errata 2015).
- M. NSF 372 - Drinking Water System Components - Lead Content; 2011.

**1.04 SUBMITTALS**

- A. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

**1.05 QUALITY ASSURANCE**

- A. Perform work in accordance with applicable codes and standards.

**1.06 REGULATORY REQUIREMENTS**

- A. Perform Work in accordance with State of Michigan plumbing code.



- B. Conform to applicable code for installation of backflow prevention devices.
- C. Provide certificate of compliance from authority having jurisdiction indicating approval of installation of backflow prevention devices.

### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- 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.
- D. 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 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.

### **2.02 SANITARY SEWER PIPING, BURIED WITHIN 5 FEET (1500 MM) OF BUILDING**

- A. PVC Pipe: ASTM D2665 or ASTM D3034.
  - 1. Fittings: PVC.
  - 2. Joints: Solvent welded, with ASTM D2564 solvent cement.

### **2.03 SANITARY SEWER PIPING, ABOVE GRADE**

- A. Cast Iron Pipe: CISPI 301, hubless, service weight.
  - 1. Fittings: Cast iron.
  - 2. Joints: CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies.

### **2.04 DOMESTIC WATER PIPING, BURIED WITHIN 5 FEET (1500 MM) OF BUILDING**

- A. Copper Pipe: ASTM B42, annealed.
  - 1. Fittings: ASME B16.26, cast bronze.
  - 2. Joints: Flared.
- B. Cross-Linked Polyethylene (PEX) Pipe: ASTM F876 or ASTM F877.
  - 1. Type:
    - a. Pex-A or Pex-B; \_\_\_\_\_:
  - 2. PPI TR-4 Pressure Design Basis:
    - a. 100 psig (689 kPa) at maximum 180 degrees F (82 degrees C).
  - 3. Fittings: Brass and engineered polymer (EP) ASTM F1960.
  - 4. Joints: ASTM F1960 cold-expansion fittings.

### **2.05 DOMESTIC WATER PIPING, ABOVE GRADE**

- A. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), 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.
  - 3. Mechanical Press Sealed Fittings: Double pressed type, NSF 61 and NSF 372 approved or certified, utilizing EPDM, non toxic synthetic rubber sealing elements.

### **2.06 STORM WATER PIPING, BURIED WITHIN 5 FEET (1500 MM) OF BUILDING**

- A. PVC Pipe: ASTM D2665 or ASTM D3034.
  - 1. Fittings: PVC.
  - 2. Joints: Solvent welded, with ASTM D2564 solvent cement.

### **2.07 STORM WATER PIPING, ABOVE GRADE**

- A. Cast Iron Pipe: CISPI 301, hubless, service weight.
  - 1. Fittings: Cast iron.

2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies.

## **2.08 FLANGES, UNIONS, AND COUPLINGS**

- A. Unions for Pipe Sizes 3 Inches (80 mm) and Under:
  1. Copper tube and pipe: Class 150 bronze unions with soldered joints.
- 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. Housing Material: Provide ASTM A47/A47M malleable iron, ductile iron, or \_\_\_\_\_, galvanized.
  3. Bolts and Nuts: Hot dipped galvanized or zinc-electroplated steel.
  4. When pipe is field grooved, provide coupling manufacturer's grooving tools.
- C. Grooved and Shouldered Pipe End Couplings:
  1. Housing: Malleable iron clamps to engage and lock, designed to permit some angular deflection, contraction, and expansion; steel bolts, nuts, and washers; galvanized for galvanized pipe.
  2. Sealing gasket: "C" shape composition sealing gasket.

## **2.09 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. 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.
- B. Plumbing Piping - Drain, Waste, and Vent:
  1. Hangers for Pipe Sizes 1/2 Inch (15 mm) to 1-1/2 Inches (40 mm): Malleable iron, adjustable swivel, split ring.
  2. Hangers for Pipe Sizes 2 Inches (50 mm) and Over: Carbon steel, adjustable, clevis.
  3. Wall Support for Pipe Sizes to 3 Inches (80 mm): Cast iron hook.
- C. Plumbing Piping - Water:
  1. Hangers for Pipe Sizes 1/2 Inch (15 mm) to 1-1/2 Inches (40 mm): Malleable iron, adjustable swivel, split ring.
  2. Hangers for Cold Pipe Sizes 2 Inches (50 mm) and Over: Carbon steel, adjustable, clevis.
  3. Hangers for Hot Pipe Sizes 2 Inches (50 mm) to 4 Inches (100 mm): Carbon steel, adjustable, clevis.
  4. Hangers for Hot Pipe Sizes 6 Inches (150 mm) and Over: Adjustable steel yoke, cast iron pipe roll, double hanger.
- D. Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
  1. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
  2. Masonry Screw Type Anchors: Complying with ICC-ES AC106.

## **2.10 BALL VALVES**

- A. Manufacturers:
  1. Grinnell Products, a Tyco Business:
  2. Nibco, Inc:
  3. Uponor, Inc:
  4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Construction, 4 Inches (100 mm) and Smaller: MSS SP-110, Class 150, 400 psi (2760 kPa) CWP, bronze or ductile iron body, 304 stainless steel or chrome plated brass ball, regular port,

teflon seats and stuffing box ring, blow-out proof stem, lever handle with balancing stops, threaded or grooved ends with union.

## **2.11 PIPING SPECIALTIES**

- A. Flow Controls:
  - 1. Manufacturers:
    - a. ITT Bell & Gossett:
    - b. Taco, Inc:
  - 2. 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.
  - 3. Calibration: Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 3.5 psi (24 kPa).

## **2.12 RELIEF VALVES**

- A. Pressure:
  - 1. ANSI Z21.22, AGA certified, bronze body, teflon seat, steel stem and springs, automatic, direct pressure actuated.
- B. Temperature and Pressure:
  - 1. ANSI Z21.22, AGA certified, bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, temperature relief maximum 210 degrees F (98.9 degrees C), capacity ASME BPVC-IV certified and labelled.

## **2.13 STRAINERS**

- A. Size 2 inch (50 mm) and Under:
  - 1. Threaded brass body for 175 psi (1200 kPa) CWP, Y pattern with 1/32 inch (0.8 mm) stainless steel perforated screen.
  - 2. Class 150, threaded bronze body 300 psi (2070 kPa) CWP, Y pattern with 1/32 inch (0.8 mm) stainless steel perforated screen.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that excavations are to required grade, dry, and not over-excavated.

### **3.02 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Group piping whenever practical at common elevations.
- C. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 22 05 16.
- D. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
- E. 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.
- F. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.
- G. Sleeve pipes passing through partitions, walls and floors.
- H. Pipe Hangers and Supports:
  - 1. Install in accordance with ASME B31.9.
  - 2. Support horizontal piping as indicated.
  - 3. Install hangers to provide minimum 1/2 inch (15 mm) space between finished covering and adjacent work.
  - 4. Place hangers within 12 inches (300 mm) of each horizontal elbow.

5. Use hangers with 1-1/2 inch (40 mm) minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
6. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
7. Use nylock nuts on loop hangers and clevis hangers.
8. Provide copper plated hangers and supports for copper piping.

### **3.03 APPLICATION**

- A. Install unions downstream of valves and at equipment or apparatus connections.
- B. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- C. Install globe valves for throttling, bypass, or manual flow control services.
- D. Provide flow controls in water recirculating systems where indicated.

### **3.04 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM**

- A. Disinfect water distribution system in accordance with Section 33 01 10.58.
- B. Prior to starting work, verify system is complete, flushed and clean.
- C. 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).
- D. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.
- E. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.
- F. Maintain disinfectant in system for 24 hours.
- G. If final disinfectant residual tests less than 25 mg/L, repeat treatment.
- H. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.
- I. 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.

### **3.05 SCHEDULES**

- A. Pipe Hanger Spacing (must meet the requirements in the MPC or as listed below, whichever is more stringent):
  1. Metal Piping:
    - a. Pipe Size: 1/2 inches (15 mm) to 1-1/4 inches (32 mm):
      - 1) Maximum Hanger Spacing: 6.5 ft (2 m).
      - 2) Hanger Rod Diameter: 3/8 inches (9 mm).
    - b. Pipe Size: 1-1/2 inches (40 mm) to 2 inches (50 mm):
      - 1) Maximum Hanger Spacing: 10 ft (3 m).
      - 2) Hanger Rod Diameter: 3/8 inch (9 mm).
    - c. Pipe Size: 2-1/2 inches (65 mm) to 3 inches (75 mm):
      - 1) Maximum Hanger Spacing: 10 ft (3 m).
      - 2) Hanger Rod Diameter: 1/2 inch (13 mm).
  2. Plastic Piping:
    - a. All Sizes:
      - 1) Maximum Hanger Spacing: 6 ft (1.8 m).
      - 2) Hanger Rod Diameter: 3/8 inch (9 mm).

**END OF SECTION**

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**SECTION 22 10 06**  
**PLUMBING PIPING SPECIALTIES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Cleanouts.
- B. Backflow preventers.
- C. Water hammer arrestors.
- D. Sanitary waste interceptors.
- E. Mixing valves.

**1.02 REFERENCE STANDARDS**

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ASME A112.6.3 - Floor and Trench Drains; 2001 (R2007).
- C. ASME A112.6.4 - Roof, Deck, and Balcony Drains; 2003.
- D. ASSE 1011 - Hose Connection Vacuum Breakers; 2004.
- E. ASSE 1012 - Backflow Preventer with Intermediate Atmospheric Vent; 2009.
- F. ASSE 1013 - Reduced Pressure Principle Backflow Preventers and Reduced Pressure Principle Fire Protection Backflow Preventers; 2011.
- G. ASSE 1019 - Performance Requirements for Wall Hydrant with Backflow Protection and Freeze Resistance; 2011.
- H. NSF 61 - Drinking Water System Components - Health Effects; 2014 (Errata 2015).
- I. NSF 372 - Drinking Water System Components - Lead Content; 2011.
- J. PDI-WH 201 - Water Hammer Arresters; 2010.

**1.03 SUBMITTALS**

- A. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.
- B. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.
- C. Certificates: Certify that grease interceptors meet or exceed specified requirements.
- D. Manufacturer's Instructions: Indicate Manufacturer's Installation Instructions: Indicate assembly and support requirements.
- E. Operation Data: Indicate frequency of treatment required for interceptors.
- F. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

**1.04 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years documented experience.

**1.05 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:
  - 2. Josam Company:

3. Zurn Industries, LLC:
- B. Cleanouts at Exterior Surfaced Areas:
  1. Round cast nickel bronze access frame and non-skid cover.
- C. Cleanouts at Exterior Unsurfaced Areas:
  1. Line type with lacquered cast iron body and round epoxy coated gasketed cover.
- D. Cleanouts at Interior Finished Floor Areas :
  1. Lacquered cast iron body with anchor flange, reversible clamping collar, threaded top assembly, and round gasketed scored cover in service areas and round gasketed depressed cover to accept floor finish in finished floor areas.
- E. Cleanouts at Interior Finished Wall Areas:
  1. Line type with lacquered cast iron body and round epoxy coated gasketed cover, and round stainless steel access cover secured with machine screw.
- F. Cleanouts at Interior Unfinished Accessible Areas: Calked or threaded type. Provide bolted stack cleanouts on vertical rainwater leaders.

## **2.03 WASHING MACHINE BOXES AND VALVES**

- A. Box Manufacturers:
  1. IPS Corporation/Water-Tite: [www.ipscorp.com/#sle](http://www.ipscorp.com/#sle).
  2. Oatey Supply Chain Services, Inc: [www.oatey.com/#sle](http://www.oatey.com/#sle).
- B. Description: Plastic preformed rough-in box with brass valves with single lever handle, socket for 2 inch (50 mm) waste, slip in finishing cover.

## **2.04 BACKFLOW PREVENTERS**

- A. Manufacturers:
  1. Conbraco Industries, Inc
  2. Watts Regulator Company, a part of Watts Water Technologies
  3. Zurn Industries, LLC
- B. Reduced Pressure Backflow Preventers:
  1. ASSE 1013; bronze body with bronze internal parts 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; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks.

## **2.05 WATER HAMMER ARRESTORS**

- A. Manufacturers:
  1. Jay R. Smith Manufacturing Company
  2. Watts Regulator Company, a part of Watts Water Technologies
  3. Zurn Industries, LLC
- B. Water Hammer Arrestors:
  1. Copper construction, bellows type sized in accordance with PDI-WH 201, precharged suitable for operation in temperature range 34 to 250 degrees F (1 to 120 degrees C) and maximum 150 psi (1000 kPa) working pressure.

## **2.06 SUMPS**

- A. Glass fiber reinforced with required openings and drainage fittings.
- B. Cover: 3/8 inch (9 mm) thick checkered steel plate with gasket seal frames and anchor bolts.

## **2.07 MIXING VALVES**

- A. Thermostatic Mixing Valves:
  - 1. Manufacturers:
    - a. Leonard Valve Company; \_\_\_\_\_
    - b. Apollo.
    - c. Lawler.
  - 2. Valve: ASSE 1070.
- B. Pressure Balanced Mixing Valves:
  - 1. Manufacturers:
    - a. Delta Faucet Company
    - b. Bradley.
  - 2. Valve: ASSE 1016.

## **2.08 AIR VENTS**

- A. Manual Type: Short vertical sections of 2 inch (50 mm) diameter pipe to form air chamber, with 1/8 inch (3 mm) brass needle valve at top of chamber.
- B. Float Type:
  - 1. Brass or semi-steel body, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Install floor cleanouts at elevation to accommodate finished floor.
- C. Install approved portable 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.
- D. Pipe relief from backflow preventer to nearest drain.
- E. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to washing machine outlets.
- F. Install air chambers on hot and cold water supply piping to each fixture or group of fixtures (each washroom). Fabricate same size as supply pipe or 3/4 inch (20 mm) minimum, and minimum 18 inches (450 mm) long.

**END OF SECTION**



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**SECTION 22 40 00  
PLUMBING FIXTURES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Water closets.
- B. Urinals.
- C. Lavatories.
- D. Sinks.
- E. Service sinks.
- F. Under-lavatory pipe supply covers.
- G. Electric water coolers.
- H. Showers.

**1.02 REFERENCE STANDARDS**

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ASHRAE Std 18 - Methods of Testing for Rating Drinking-Water Coolers with Self-Contained Mechanical Refrigeration.; 2008.
- C. ASME A112.18.1 - Plumbing Supply Fittings; 2012.
- D. ASME A112.18.9 - Protectors/Insulators for Exposed Waste and Supplies on Accessible Fixtures; 2011.
- E. ASME A112.19.2 - Ceramic Plumbing Fixtures; 2013.
- F. ASME A112.19.3 - Stainless Steel Plumbing Fixtures (Designed for Residential Use); 2008 (R2013).
- G. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2009.
- H. NSF 61 - Drinking Water System Components - Health Effects; 2014 (Errata 2015).
- I. NSF 372 - Drinking Water System Components - Lead Content; 2011.
- J. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

**1.03 SUBMITTALS**

- A. Product Data: Provide catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.
- B. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

**1.04 WARRANTY**

- A. Provide five year manufacturer warranty for electric water cooler.

**PART 2 PRODUCTS**

**2.01 GENERAL REQUIREMENTS**

- A. Potable Water Systems: Provide plumbing fittings and faucets that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

**2.02 REGULATORY REQUIREMENTS**

- A. Comply with applicable codes for installation of plumbing systems.
- B. Comply with UL (DIR) requirements.
- C. Perform work in accordance with local health department regulations.
- D. Provide certificate of compliance from Authority Having Jurisdiction indicating approval of installation.

**2.03 FLUSH VALVE WATER CLOSETS - SEE PLUMBING FIXTURE SCHEDULE ON DRAWING SHEETS**

**2.04 WALL HUNG URINALS - SEE PLUMBING FIXTURE SCHEDULE ON DRAWING SHEETS**

**2.05 LAVATORIES - SEE PLUMBING FIXTURE SCHEDULE ON DRAWING SHEETS**

- A. Thermostatic Mixing Valve: Thermostatic mixing valve, ASSE 1070 listed, with combination stop, strainer, and check valves, and flexible stainless steel connectors.

**2.06 UNDER-LAVATORY PIPE SUPPLY COVERS**

- A. General:
  - 1. Insulate exposed drainage piping including hot, cold and tempered water supplies under lavatories or sinks per ADA Standards.
  - 2. Construction: 1/8 inch (3.2 mm) PVC with antimicrobial, antifungal and UV resistant properties.
    - a. Comply with ASME A112.18.9 for covers on accessible lavatory piping.
    - b. Comply with ICC A117.1.

**2.07 SHOWERS - SEE PLUMBING FIXTURE SCHEDULE ON DRAWING SHEETS**

**2.08 BI-LEVEL, ELECTRIC WATER COOLERS - SEE PLUMBING FIXTURE SCHEDULE ON DRAWING SHEETS**

**2.09 SERVICE SINKS - SEE PLUMBING FIXTURE SCHEDULE ON DRAWING SHEETS**

**PART 3 EXECUTION**

**3.01 EXAMINATION**

- A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.
- B. Verify that electric power is available and of the correct characteristics.
- C. Confirm that millwork is constructed with adequate provision for the installation of counter top lavatories and sinks.

**3.02 PREPARATION**

- A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

**3.03 INSTALLATION**

- A. Install each fixture with trap, easily removable for servicing and cleaning.
- B. Provide chrome plated rigid or flexible supplies to fixtures with loose key stops, reducers, and escutcheons.
- C. Install components level and plumb.
- D. Install and secure fixtures in place with wall carriers and bolts.
- E. Solidly attach water closets to floor with lag screws. Lead flashing is not intended hold fixture in place.

**3.04 INTERFACE WITH WORK OF OTHER SECTIONS**

- A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

**3.05 ADJUSTING**

- A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

**3.06 CLEANING**

- A. Clean plumbing fixtures and equipment.

### **3.07 PROTECTION**

- A. Protect installed products from damage due to subsequent construction operations.
- B. Do not permit use of fixtures by construction personnel.
- C. Repair or replace damaged products before Date of Substantial Completion.
- D. Do not permit use of fixtures.

### **3.08 SCHEDULES**

- A. Fixture Heights: Reference architectural heights for fixtures.

**END OF SECTION**

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**SECTION 23 00 00**  
**MECHANICAL GENERAL PROVISIONS**

**PART 1 GENERAL**

**1.01 DESCRIPTION OF WORK**

- A. This Division includes all materials, labor, equipment, tools, supervision, permits, and incidentals necessary to complete installation and successfully test, start-up, and operate, in a practical and efficient manner, all mechanical systems indicated on the Mechanical Drawings and described in this Division. The work shall also include any items which, while not specifically included in the Contract Documents, are reasonable and are accepted trade practices or necessary for the proper completion of the systems.
- B. The General Provisions of this Contract, including General and Supplementary Conditions and other General Requirements specified in the Architectural, Electrical, Structural, and Fire Protection Specifications apply to the work specified in this Section.
- C. This section is not intended to supersede, but to clarify the definitions in Division 01, General Requirements.

**1.02 DRAWINGS AND SPECIFICATIONS**

- A. Drawings are diagrammatic and are intended to convey a general arrangement and scope of the work included in the contract. Should drawings contradict themselves or the Specifications, the better quality or greater quantity of work shall be included.
- B. The Mechanical Contractor shall be familiar with all Architectural, Structural, Fire Protection, and Electrical Drawings and Specification Sections, and shall follow any special requirements or directions included in these areas.
- C. Drawings and Specifications are intended to include all work and materials necessary for completion of the work. Any incidental item of material, labor or detail required for the proper execution and completion of the work and omitted from either the drawings and specifications or both, but required by governing codes local regulations, trade practices, operational functions, and good workmanship, shall be provided as part of the Contract Work without extra charge, even though not specifically detailed or specified.
- D. Should there be any question as to the scope of work for which the Mechanical Contractor is responsible, they should request an interpretation before submitting their bid. After contracts are awarded, the Owner shall not be responsible for claims for extras for work that was not included because the Mechanical Contractor was unsure if they should include given work in their bid.

**1.03 SITE AND PROJECT DOCUMENT EXAMINATION**

- A. Submission of a bid proposal is considered evidence that the Mechanical Contractor has completed the following:
  - 1. Visited the site.
  - 2. Informed themselves of the site conditions.
  - 3. Examined Drawings and Specifications of all trades including Architectural, Structural and Electrical, and is proficient, experienced and knowledgeable of all standards, codes, ordinances, permits and regulations which affect his respective trade, and that all costs are included in his proposal.
- B. The Mechanical Contractor and/or Sub-Contractor shall insure all required permits, and assessments have been obtained prior to any work beginning. Contractor shall verify requirement to include privilege fees, plan review fees, and permits as part of his formal bid.
- C. Field Changes:
  - 1. This Mechanical Contractor shall not make any field changes that affect the system design, equipment manufacturer, timing, costs, or performance without written approval from the Mechanical and Plumbing Engineer. Approval shall be in the form of a written Field Change Request or Change Order, or supplemental memorandum addressed to the

Engineer. All Change Orders shall be directed through the General Contractor and Architect.

2. The Contractor assumes liability for any additional costs for changes requested. Should any unauthorized change be determined by the Engineer and Architect as lessening the value of the project, a credit will be request, and shall be issued as a change to the contract.

#### **1.04 STANDARDS, CODES, AND PERMITS**

- A. Refer to Division 01, General Requirements and Supplementary Conditions.
- B. All work shall comply with the latest edition of applicable standards and codes of following:
  1. ASA - American Standards Association
  2. ASME - American Society of Mechanical Engineers
  3. ASTM - American Society of Testing Materials
  4. ANSI - American National Standards Institute
  5. AGA - American Gas Association
  6. ASHRAE - American Society of Heating, Refrigerating, and Air Conditioning Engineers
  7. AWWA - American Water Works Association
  8. NFPA - National Fire Protection Association
  9. IBR - Institute of Boiler and Radiator Manufacturers
  10. AWS - American Welding Society
  11. UL - Underwriter's Laboratories
  12. NEMA - National Electric Manufacturers Association
  13. NEC - National Electric Code
  14. ARA - American Refrigeration Association
  15. OSHA - Occupational Safety and Health Act
  16. ABMA - American Boiler Manufacturers Association
  17. International Mechanical Code 2021
  18. International Plumbing Code 2021 (with Michigan Ammendments)
  19. Michigan Mechanical Code 2021
- C. All work shall be provided and tested in accordance with all applicable local county, state laws, ordinances, codes, rules and regulations.
- D. No work shall be covered or enclosed by walls, ceilings, or other, until the work is tested in accordance with applicable codes and regulations, and successful tests witnessed and approved by authorized inspection authority. Written approvals shall be secured by the Mechanical Contractor and submitted to Engineer before final acceptance of work will be granted.

#### **1.05 SUBMITTALS**

- A. Proposal Supplement:
  1. Contractor to submit ONE (1) copy of Proposal Supplement - SECTION 23 00 10 - MECHANICAL EQUIPMENT AND MATERIALS, at the time of Bid opening, listing the manufacturers upon which his bid was based, including all items being provided by Sub-Contractors.
  2. After Proposal Supplement and Sub-Contractors are approved, no deviation shall be permitted without written approval of Engineer.
- B. Shop Drawings:
  1. Submit shop drawings on all equipment and materials indicated on the Drawings for approval, prior to placing delivery orders (also refer to Architectural Specifications for shop drawing requirements).
  2. At the time of submittal for review by the Engineer, shop drawings shall include signatures or stamps indicating that the Contractor and/or the Sub-Contractor has reviewed the submittals and has coordinated the required space, quantities required, services and work of other trades for the equipment or system being submitted.

3. Submittals shall be in the form of bound folders with the name of the Project, Architect, Engineer and the submitting Contractor indicated on the cover. Submittals requiring drawings too large to be bound into the folder shall be folded and inserted in pockets bound into the folder.
  4. Provide shop drawings of all manufactured equipment and materials except pipe, pipe fittings and galvanized ductwork. Drawings shall include equipment capacities, weights, dimensions, construction details, installation, controls, wiring diagrams, and motor data.
  5. Engineer's approval of shop drawings is for general application only and is a service only and not considered as a guarantee of total compliance with or as relieving the Mechanical Contractor of basic responsibilities under all contract documents, and does not approve changes in time or cost.
  6. After approval, the Mechanical Contractor and its subcontractors are responsible to provide information to all other trades involved in, or affected by, the installation of the Mechanical and Plumbing equipment.
- C. Record (As-Built) Drawings:
1. At substantial completion of construction, furnish record (as-built) plans to the Engineer for approval. As part of the Final Punch List/Close-out, approved as-built plans shall be provided to the Owner.
  2. Record drawings shall include, at the minimum:
    - a. The location and performance data on each piece of equipment.
    - b. The general configuration of duct and pipe distribution systems, including sizes.
    - c. The terminal air or water design flow rates.
- D. Operating and Maintenance Manuals:
1. The Mechanical Contractor and subcontractors shall provide TWO (2) bound and indexed (with tabs for each section) sets of operating and maintenance instructions to the Engineer for review as part of the Final Punch List/Close-out. The Engineer will provide approved manuals to the Owner.
  2. These manuals shall be in accordance with industry-accepted standards and shall include, at the minimum:
    - a. Submittal data stating equipment size and selected options for each piece of equipment requiring maintenance.
    - b. Operation and Maintenance manuals for each piece of equipment requiring maintenance. Required routine maintenance actions shall be clearly identified.

## **PART II PRODUCTS**

### **2.01 STANDARDS**

- A. All products shall be furnished by established manufacturers regularly engaged in making the type of materials to be provided and complete with all parts, accessories, connections, etc. as specified or as recommended and/or required by the manufacturer.
- B. All material where applicable shall be labeled or listed by Underwriters Laboratories, Inc.
- C. All materials and equipment shall be installed in strict compliance with manufacturer's installation instructions. Where special installations or deviations are required, written approval from the manufacturer is required, and shall not void the manufacturer warranty.

### **2.02 SUBSTITUTIONS AND CHANGES**

- A. The Contractor and/or Equipment Supplier may propose alternate equipment or materials of EQUAL or better quality, function, performance, durability and appearance. This information is to be submitted to the Engineer's Office TEN (10) working days prior to bid due date to allow for proper review time and to issue an addendum incorporating the acceptable substitution(s). It is the submitter's responsibility to provide sufficient material for review as required by Engineer's Office. Acceptance and approval is the responsibility of the Engineer.
- B. The Contractor and/or Equipment Supplier is liable for any added costs to himself or others and is responsible for verifying dimensions, clearance and roughing-in requirements, when product



not named as the basis of design are used and is responsible for advising other Contractors of variations and submit revised drawing layout for approval of Engineer.

- C. See SECTION 23 00 10 for voluntary alternates.
  - 1. No substitutions will be accepted after bids are received.
  - 2. When only one manufacturer is listed within the description of the mechanical equipment, the design engineering or project requirements will not allow substitution of other manufacturers.
  - 3. Contractor will be responsible for ALL costs (engineering time, manufacturer's costs, distributor costs, etc.) incurred to replace equipment not approved if substitutions are made by the distributor, manufacturer's rep., contractor or subcontractor.
- D. Equipment not listed in the Mechanical Schedules or this Division 23, or not approved in writing by the Engineer, shall be separated from the Base Bid and shall be listed as a Voluntary Alternate only. Before acceptance, all Voluntary Alternates must be approved by the Engineer and Architect, and must be approved for use by any special Specifications related to the job.
- E. The Mechanical Contractor is responsible and liable for any added costs to themselves or others that may be a result from use of Approved Alternates or Voluntary Alternates.
- F. The Mechanical Contractor is responsible for bidding the Mechanical and Plumbing materials such as pipe and ductwork materials as listed on the Mechanical Drawings and this Division 23 Specification. Alternate materials or value engineering must be pre-approved by the Engineer, prior to bid submittal. Approval of alternate materials must be shared with the Architect, Owner, and other bidders.

## **2.03 ELECTRICAL REQUIREMENTS AND CONNECTIONS**

- A. General:
  - 1. When the Mechanical equipment not named as the basis of design is approved for use, the Mechanical Contractor is responsible for any costs incurred by other trades, including revisions to the Electrical requirements such as conduit, wire, starters, heaters, fused switches, disconnects, or circuit breakers.
  - 2. Electrical items furnished shall bear the Underwriter's Laboratories label and the installation shall comply with requirements of the National Electric Code, ANSI, IPCEA, IRI, and local codes, ordinances and regulations.
- B. Motor Starters and Controls:
  - 1. The Electrical Contractor shall provide all manual or magnetic motor starters as required for all motors as indicated on all Electrical Drawings.
  - 2. The Mechanical Contractor shall provide factory installed motor starters integral with packaged equipment containing thermal overcurrent protection in all underground conductors with heater coils selected for specific motor usage for all motors.
- C. Electrical Wiring and Controls:
  - 1. The Mechanical Contractor shall furnish and install all motors, drives, controllers integral to equipment and factory mounted controls for all mechanical equipment.
  - 2. The Mechanical Contractor or Temperature Control Contractor shall furnish and install all electrical devices requiring mechanical connections, and/or electrical connections, such as thermostats, UL rated temperature control cabinets, etc., as listed in the Division 23 Contract Documents.
  - 3. The Temperature Control Contractor or Mechanical Contractor shall furnish and install all power and Class 2 and 3 wiring (low voltage), conduit, and electrical boxes associated with the Temperature Control System. Verify with Mechanical and Electrical Engineer whether plenum-rated, low voltage wiring is required.
  - 4. The Electrical Contractor shall install all Class 1 (120 volt and greater) power wiring, conduit to motors and/or factory mounted control panels as indicated on Electrical Drawings or as indicated in Specifications.
  - 5. All electrical wiring work by the Mechanical Contractor and Temperature Control Contractor shall be in accordance with Division 26 requirements.

## **PART III EXECUTION**

### **3.01 COORDINATION OF MECHANICAL WORK**

- A. Responsibility:
  - 1. The Mechanical Contractor shall be responsible for all Sub-Contractors and Suppliers, and include in his bid all materials, labor and equipment involved in accordance with all local regulations, jurisdictional awards, decisions, and secure compliance of all parts of the Specifications and Drawings regardless of sectional inclusion in these Specifications.
  - 2. The Mechanical Contractor and Sub-Contractors shall be responsible for all parts applicable to the job in accordance with the Specifications and Drawings, and shall be responsible for coordinating locations and arrangements of all Mechanical and Plumbing work with all other relevant Architectural, Structural, Electrical, and fire protection Mechanical Drawings, shop drawings, and Specifications.
- B. Submission of a bid proposal is considered evidence that the Mechanical Contractor and its Sub-Contractors are fully capable of providing the following and have included the following in their bid proposal:
  - 1. Fully proficient and experienced to do the work described in the contract documents.
  - 2. Knowledgeable of all federal, state, and local standards, codes, ordinances, permits, and regulations that pertain to the work described in the contract documents.
  - 3. Have properly estimated the time and workforce, including subcontractors, needed to complete the job by the due date.
  - 4. Have included all material, equipment, and labor costs for completion of the job, including all subcontractors costs.
  - 5. Have all the equipment, tools, supplies, vehicles, and trailers to complete the job.
  - 6. Have included all travel, food and lodging expenses.
- C. Installation of Mechanical Systems:
  - 1. Install all Mechanical equipment as shown on the Mechanical Drawings. Deviations of the Mechanical systems and/or installation locations shall be approved by the Engineer.
  - 2. Changes or deviations of the Mechanical systems design and/or installation locations may require redrawing and resubmittal of the Mechanical Drawings to the state or local Mechanical or building inspector.
  - 3. Any costs associated with re-drawing and resubmittal of the Mechanical and Plumbing Drawings, that did not have pre-approval from the Mechanical Engineer, may be charged to the Mechanical Contractor or Mechanical subcontractors. All costs shall be based on a time and materials basis.
  - 4. Minor deviations from the original design will be accepted, but a written request or courtesy call to the Engineer is required. The Engineer may request a written report of the situation and a written request for record.

### **3.02 EQUIPMENT CLEARANCE**

- A. The Mechanical Contractor shall coordinate with the Electrical Contractor's equipment location to insure adequate clearance is maintained as required by the National Electrical Code and applicable state and local codes, as well as accessibility for future maintenance and operation.
- B. Mechanical work shall be arranged with building construction to provide minimum 6'-8" overhead clearance where possible.
- C. Install equipment in a neat and workmanlike manner. Install, align, and level all Mechanical equipment so that it may be easily accessed, adjusted, serviced, and balanced.
- D. Install equipment so that filters, valves, and controls may be easily accessed.
- E. Install equipment so that it does not block or limit access to other equipment, access panels, etc.
- F. Install equipment so that it may be easily inspected.

### **3.03 GENERAL SUPPORTS**

- A. Mechanical Contractor shall provide all necessary channel, angle, brackets, vibration isolators, or supplementary steel as required for adequate support for all piping, specialties, ductwork, and equipment which is hung from the ceiling or roof, or mounted to the floor or roof. For equipment requiring welding or bolting to steel framing, or anchoring to concrete structures, the Mechanical Contractor shall require written approval from the Architect and General Contractor.
- B. Where piping or equipment is suspended from concrete construction, coordinate with the General Contractor to set approved concrete inserts, that shall receive hanger rods such as UniStrut in the concrete form-work. In metal decks, coordinate with General Contractor to use Ramset or welds as required.

### **3.04 WALL, FLOOR, CEILING, AND ROOF OPENINGS**

- A. Locate all openings and advise the General Contractor of details and templates of all openings necessary for inspection of Mechanical work.
- B. All openings including sawcuts, cores, and required lintels shall be provided by the General Contractor, and shall be approved by the Architect and Structural Engineer. Size and location are the responsibility of the Mechanical Contractor. Cracks and rough edges left following installation of equipment shall be caulked, fire-caulked if required, or filled by the Mechanical Contractor.
- C. Perform or pay for all cutting, fitting, repairing, patching and finishing of work of other sections where it is necessary to disturb such work to permit installation of mechanical work.
- D. All roof openings including sawcuts and cores through the roof deck shall be provided by the General Contractor, and shall be approved by the Architect and Structural Engineer. Size and location of the openings are the responsibility of the Mechanical Contractor.
- E. All roof curbs, Pate Curbs, or other specialty curbs shall be the responsibility of the Mechanical Contractor. Specialty roof curb flashings or curb-membranes shall be included.
- F. All roofing materials including standard flashing, and the installation of roofing systems around the Mechanical equipment shall be the responsibility of the General Contractor.
- G. All roof deck supporting materials including angles, joists, etc., shall be the responsibility of the General Contractor, and shall be approved by the Architect and Structural Engineer.

### **3.05 FIELD CHANGES**

- A. The Mechanical Contractor shall not make any field changes that affect the system design, equipment manufacturer, timing, costs, or performance without written approval from the Mechanical and Plumbing Engineer. Approval shall be in the form of a written Field Change Request or Change Order, or Supplemental Instruction. All Change Orders shall be directed through the General Contractor and Architect.
- B. The Contractor assumes liability for any additional costs for changes requested. Should any unauthorized change be determined by the Engineer and Architect as lessening the value of the project, a credit will be request, and shall be issued as a change to the contract.

### **3.06 PROJECT CLOSE-OUT**

- A. Final Acceptance and payment will only be made after final Punch-List completion and receipt at the Engineer's Office of:
  - 1. Approved Operating and Maintenance Instruction Manuals
  - 2. Approved Record Drawings (As Built)
  - 3. All Guarantees/Warranties
  - 4. Certificates of Inspection
  - 5. Written and signed verification that Owner's Training has taken place
  - 6. Final Test and Balance Report (reference SECTION 23 05 93 for Report requirements)
  - 7. All extra materials specified to be provided within the Contract Documents

### **3.07 CERTIFICATES OF INSPECTION**

- A. Submit to the Engineer's Office evidence that installation has been inspected and approved by local or state mechanical inspector and/or the authority having jurisdiction.

### **3.08 GUARANTEES AND WARRANTIES**

- A. All labor, materials and equipment shall be guaranteed by Contractor and/or warranted by Manufacturer for ONE (1) year after acceptance date except where specified longer for special equipment. Contractor shall secure such warranty from all Suppliers (not one year from shipment date) or Contractor to assume warranty.
- B. Acceptance date of substantial completion shall be Owner occupancy as determined by Architect/Engineer.
- C. Contractor shall make all necessary alterations, repairs, adjustments, replacements during guarantee periods as directed by Architect/Engineer to comply with Drawings and Specifications at no cost to Owner.
- D. Repair or replacements made under guarantee bear further ONE (1) year guarantee from date of acceptance of repair or replacement.
- E. At the end of a one year period of continuous operation, make a complete inspection of all systems, fixtures, equipment, safety devices and controls to insure equipment is operating properly, and report to Engineer in writing.

### **3.09 PLACING EQUIPMENT INTO OPERATION**

- A. Mechanical Contractor shall be responsible for all startup procedures, system checks and balancing associated with his equipment.
- B. All equipment shall be installed, tested and operated in accordance with manufacturer's recommendations at normal operating conditions.
- C. All permanent mechanical equipment operated during construction periods shall be cleaned and damaged equipment replaced.

### **3.10 OWNER'S TRAINING**

- A. The option of video taping any and all training sessions shall be given to the Owner at no additional cost, with the Contractor conducting the video taping and with TWO (2) copies of all tapes being turned over to the Owner for future use.
- B. The Mechanical Contractor shall conduct ONE (1) - 4-hour training session(s) on the operation and maintenance of all mechanical equipment. Schedule training with Owner at least 72 hours prior to session(s).
- C. The Mechanical Contractor or contracted Temperature Control Contractor shall conduct TWO (2) - 4-hour training session(s) on the operation & maintenance of the Temperature Control Systems. Schedule training with Owner at least 72 hours prior to session(s).

**END OF SECTION**

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**SECTION 23 00 10  
MECHANICAL EQUIPMENT AND MATERIALS**

**PART 1 GENERAL**

**1.01 INSTRUCTION:**

- A. The Mechanical Contractor is to either copy or remove this specification section from the spec book and complete as follows:
  - 1. Indicate the specific manufacturer on which the bidder's base bid price is based in the blank space provided.
  - 2. Insert the name(s) of each subcontractor used in your bid in the space provided in Part 3.
  - 3. This form shall be submitted with the bid.

**1.02 RELATED DOCUMENTS:**

- A. The other Contract Documents complement the requirements of this Section. The General Requirements apply to the work of this section.

**1.03 DEVIATIONS FROM SPECIFIED MATERIAL:**

- A. See SECTION 23 00 00, Part 2, Paragraph 2.02 - Substitutions and Changes. Base bid shall be based on manufacturers listed in this specification or on the drawings.

**PART 2 PRODUCTS**

**2.01 THE FOLLOWING IS A LIST OF APPROVED MANUFACTURERS, GROUPED ACCORDING TO TYPES OF MATERIALS OR EQUIPMENT.**

- A. Air-Handling Unit(s):
  - 1. AAON, Carrier, Daikin, Trane, and York/JCI
    - a. Voluntary alternate \_\_\_\_\_
    - b. Add \$ Deduct \$ \_\_\_\_\_
- B. Cabinet Unit Heater(s):
  - 1. Modine, Trane, Vulcan, or Sterling
    - a. Voluntary alternate \_\_\_\_\_
    - b. Add \$ Deduct \$ \_\_\_\_\_
- C. Damper(s):
  - 1. AWW, Greenheck, Pottorff, and Ruskin
    - a. Voluntary alternate \_\_\_\_\_
    - b. Add \$ Deduct \$ \_\_\_\_\_
- D. Electric Heater(s):
  - 1. Berko, Marley, Redd-I, and QMark
    - a. Voluntary alternate \_\_\_\_\_
    - b. Add \$ Deduct \$ \_\_\_\_\_
- E. Exhaust/Supply Fan(s):
  - 1. Acme, Cook, Greenheck, and PennBarry
    - a. Voluntary alternate \_\_\_\_\_
    - b. Add \$ Deduct \$ \_\_\_\_\_
- F. Hydronic Pump(s):
  - 1. Armstrong, Bell & Gossett, Grundfos, and Taco
    - a. Voluntary alternate \_\_\_\_\_
    - b. Add \$ Deduct \$ \_\_\_\_\_
- G. Louver(s):
  - 1. AWW, Greenheck, and Ruskin
    - a. Voluntary alternate \_\_\_\_\_
    - b. Add \$ Deduct \$ \_\_\_\_\_

- H. Radiant Ceiling Panel(s):  
1. Airtite, Price, and Sterling  
a. Voluntary alternate \_\_\_\_\_  
b. Add \$ Deduct \$ \_\_\_\_\_
- I. Roof Hood(s):  
1. Greenheck and Loren Cook  
a. Voluntary alternate \_\_\_\_\_  
b. Add \$ Deduct \$ \_\_\_\_\_

**PART 3 SUB-CONTRACTORS**

**3.01 INSERT THE NAME OF EACH SUB-CONTRACTOR AND WORK TO BE PERFORMED BELOW:**

- A. Subcontractor: \_\_\_\_\_ Work Performed: Temperature Controls  
B. Subcontractor \_\_\_\_\_ Work Performed: Test & Balance  
C. Subcontractor \_\_\_\_\_ Work Performed: Insulation  
D. Subcontractor \_\_\_\_\_ Work Performed: Sheet Metal Ductwork  
E. Subcontractor \_\_\_\_\_ Work Performed: \_\_\_\_\_  
F. Subcontractor \_\_\_\_\_ Work Performed: \_\_\_\_\_

**END OF SECTION**

**SECTION 23 05 10**  
**PENETRATION FIRESTOPPING FOR HVAC**

**PART 1 - GENERAL**

**1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Section, apply to work specified in this section.

**1.02 DEFINITIONS**

- A. Firestopping: Material or combination of materials used to retain integrity of fire-rated construction by maintaining an effective barrier against the spread of flame, smoke, and hot gases through penetrations in fire rated wall and floor assemblies.

**1.03 GENERAL DESCRIPTION OF THE WORK OF THIS SECTION**

- A. Only tested firestop systems shall be used in specific locations as follows:
- B. Penetrations for the passage of duct, piping, and other mechanical equipment through fire-rated vertical barriers (walls and partitions), horizontal barriers (floor/ceiling assemblies), and vertical service shaft walls and partitions.
- C. Repetitive plumbing penetrations in fire-rated floor assemblies. Penetrations exist for the installation of tubs, showers, aerators and other plumbing fixtures.

**1.04 REFERENCES**

- A. Test Requirements: ASTM E 814, "Standard Method of Fire Tests of Through Penetration Fire Stops"
- B. Test Requirements: UL 1479, "Fire Tests of Through-Penetration Firestops"
- C. Underwriters Laboratories (UL) of Northbrook, IL publishes tested systems in their "FIRE RESISTANCE DIRECTORY" that is updated annually.
  - 1. UL Fire Resistance Directory:
    - a. Firestop Devices (XHJI)
    - b. Fire Resistance Ratings (BXRH)
    - c. Through-Penetration Firestop Systems (XHEZ)
    - d. Fill, Voids, or Cavity Material (XHHW)
    - e. Forming Materials (XHKU)
- D. International Firestop Council Guidelines for Evaluating Firestop Systems Engineering Judgments
- E. Inspection Requirements: ASTM E 2174, "Standard Practice for On-site Inspection of Installed Fire Stops."
- F. ASTM E 84, "Standard Test Method for Surface Burning Characteristics of Building Materials."
  - 1. International Building Code (IBC 2009)
  - 2. NFPA 101 - Life Safety Code

**1.05 QUALITY ASSURANCE**

- A. A manufacturer's direct representative (not distributor or agent) to be on-site during initial installation of firestop systems to train appropriate contractor personnel in proper selection and installation procedures. This will be done per manufacturer's written recommendations published in their literature and drawing details.
- B. Firestop System installation must meet requirements of ASTM E 814 or UL 1479 tested assemblies that provide a fire rating equal to that of construction being penetrated.
- C. Proposed firestop materials and methods shall conform to applicable governing codes having local jurisdiction.



- D. Firestop Systems do not reestablish the structural integrity of load bearing partitions/assemblies, or support live loads and traffic. Installer shall consult the structural engineer prior to penetrating any load bearing assembly.
- E. For those firestop applications that exist for which no UL tested system is available through a manufacturer, a manufacturer's engineering judgment derived from similar UL system designs or other tests will be submitted to local authorities having jurisdiction for their review and approval prior to installation. Engineering judgment drawings must follow requirements set forth by the International Firestop Council.

#### **1.06 SUBMITTALS**

- A. Submit Product Data: Manufacturer's specifications and technical data for each material including the composition and limitations, documentation of UL firestop systems to be used and manufacturer's installation instructions to comply with Section 01 30 00.
- B. Manufacturer's engineering judgment identification number and drawing details when no UL system is available for an application. Engineering judgment must include both project name and contractor's name who will install firestop system as described in drawing.
  - 1. Submit material safety data sheets provided with product delivered to job-site.

#### **1.07 INSTALLER QUALIFICATIONS**

- A. Engage an experienced Installer who is certified, licensed, or otherwise qualified by the firestopping manufacturer as having been provided the necessary training to install manufacturer's products per specified requirements. A manufacturer's willingness to sell its firestopping products to the Contractor or to an Installer engaged by the Contractor does not in itself confer qualification on the buyer.

#### **1.08 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver materials undamaged in manufacturer's clearly labeled, unopened containers, identified with brand, type, and UL label where applicable.
- B. Coordinate delivery of materials with scheduled installation date to allow minimum storage time at job-site.
- C. Store materials under cover and protect from weather and damage in compliance with manufacturer's requirements.
- D. Comply with recommended procedures, precautions or remedies described in material safety data sheets as applicable.
  - 1. Do not use damaged or expired materials.

#### **1.09 PROJECT CONDITIONS**

- A. Do not use materials that contain flammable solvents.
- B. Scheduling
  - 1. Schedule installation of CAST IN PLACE firestop devices after completion of floor formwork, metal form deck, or composite deck but before placement of concrete.
  - 2. Schedule installation of other firestopping materials after completion of penetrating item installation but prior to covering or concealing of openings.
- C. Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.
- D. Weather conditions: Do not proceed with installation of firestop materials when temperatures exceed the manufacturer's recommended limitations for installation printed on product label and product data sheet.
- E. During installation, provide masking and drop cloths to prevent firestopping materials from contaminating any adjacent surfaces.

## **PART 2 - PRODUCTS**

### **2.01 FIRESTOPPING - GENERAL**

- A. Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by the firestopping manufacturer based on testing and field experience.
- B. Provide components for each firestopping system that are needed to install fill material. Use only components specified by the firestopping manufacturer and approved by the qualified testing agency for the designated fire-resistance-rated systems.
- C. Penetrations in Fire Resistance Rated Walls: Provide firestopping with ratings determined in accordance with UL 1479 or ASTM E 814.
  - 1. F-Rating: Not less than the fire-resistance rating of the wall construction being penetrated.
- D. Penetrations in Horizontal Assemblies: Provide firestopping with ratings determined in accordance with UL 1479 or ASTM E 814.
  - 1. F-Rating: Minimum of 1-hour rating, but not less than the fire-resistance rating of the floor construction being penetrated.
  - 2. T-Rating: when penetrant is located outside of a wall cavity, minimum of 1-hour rating, but not less than the fire-resistance rating of the floor construction being penetrated.
- E. Penetrations in Smoke Barriers: Provide firestopping with ratings determined in accordance with UL 1479 or ASTM E 814.
  - 1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at both ambient and elevated temperatures.
- F. Mold Resistance: Provide penetration firestopping with mold and mildew resistance rating of 0 as determined by ASTM G21.

### **2.02 ACCEPTABLE MANUFACTURERS**

- A. Subject to compliance with through penetration firestop systems (XHEZ) listed in Volume II of the UL Fire Resistance Directory, provide products of the following manufacturers as identified below:
  - 1. Hilti, Inc., Tulsa, Oklahoma
    - a. 800-879-8000
    - b. [www.us.hilti.com](http://www.us.hilti.com)
    - c. Provide products from the above acceptable manufacturer; no substitutions will be accepted.

### **2.03 MATERIALS**

- A. Use only firestop products that have been UL 1479 or ASTM E 814 tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire-rating involved for each separate instance.
- B. Pre-installed firestop devices for use with noncombustible and combustible pipes (closed and open systems) penetrating concrete floors and/or gypsum walls, the following products are acceptable:
  - 1. Hilti Cast-In Place Firestop Device (CP 680-P) for use with combustible penetrants.
  - 2. Hilti Cast-In Place Firestop Device (CP 680-M) for use with noncombustible penetrants.
  - 3. Hilti Speed Sleeve (CP 653) for use with cable penetrations.
  - 4. Hilti Firestop Drop-In Device (CFS-DID) for use with noncombustible and combustible penetrants.
  - 5. Hilti Firestop Block (CFS-BL)
- C. Sealants, caulking materials, or foams for use with non-combustible items including steel pipe, copper pipe, rigid steel conduit and electrical metallic tubing (EMT), the following products are acceptable:
  - 1. Hilti Intumescent Firestop Sealant (FS-ONE)

2. Hilti Self-leveling Firestop Sealant (CP 604)
  3. Hilti Fire Foam (CP 620)
  4. Hilti Flexible Firestop Sealant (CP 606)
  5. Hilti Elastomeric Firestop Sealant (CP 601S)
- D. Sealants or caulking materials for use with sheet metal ducts, the following products are acceptable:
1. Hilti Elastomeric Firestop Sealant (CP 601S)
  2. Hilti Flexible Firestop Sealant (CP 606)
  3. Hilti Intumescent Firestop Sealant (FS-ONE)
- E. Intumescent sealants, caulking materials for use with combustible items (penetrants consumed by high heat and flame) including insulated metal pipe, PVC jacketed, flexible cable or cable bundles and plastic pipe, the following products are acceptable:
1. Hilti Intumescent Firestop Sealant (FS-ONE)
- F. Foams, intumescent sealants, or caulking materials for use with flexible cable or cable bundles, the following products are acceptable:
1. Hilti Intumescent Firestop Sealant (FS-ONE)
  2. Hilti Fire Foam (CP 620)
  3. Hilti Elastomeric Firestop Sealant (CP 601S)
  4. Hilti Flexible Firestop Sealant (CP 606)
- G. Non-curing, re-penetrable, intumescent putty or foam materials for use with flexible cable or cable bundles, the following products are acceptable:
1. Hilti Firestop Putty Stick (CP 618)
  2. Hilti Firestop Plug (CFS-PL)
- H. Firestop collar or wrap devices attached to assembly around combustible plastic pipe (closed and open piping systems), the following products are acceptable:
- I. Hilti Firestop Collar (CP 643N)
1. Hilti Firestop Collar (CP 644)
  2. Hilti Wrap Strips (CP 648E/648S)
- J. Materials used for large openings and complex penetrations made to accommodate cable trays and bundles, multiple steel and copper pipes, electrical busways in raceways, the following products are acceptable:
1. Hilti Firestop Mortar (CP 637)
  2. Hilti Firestop Block (CFS-BL)
  3. Hilti Fire Foam (CP 620)
  4. Hilti Firestop Board (CP 675T)
- K. Non curing, re-penetrable materials used for large openings and complex penetrations made to accommodate cable trays and bundles, multiple steel and copper pipes, electrical busways in raceways, the following products are acceptable:
1. Hilti Firestop Block (CFS-BL)
  2. Hilti Firestop Board (CP 675T)
- L. For blank openings made in fire-rated wall or floor assemblies, where future penetration of pipes, conduits, or cables is expected, the following products are acceptable:
1. Hilti Firestop Block (CFS-BL)
  2. Hilti Firestop Plug (CFS-PL)
- M. Provide a firestop system with a "F" Rating as determined by UL 1479 or ASTM E 814 which is equal to the time rating of construction being penetrated.

## **PART 3 - EXECUTION**

### **3.01 PREPARATION**

- A. Verification of Conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.
  - 1. Verify penetrations are properly sized and in suitable condition for application of materials.
  - 2. Surfaces to which firestop materials will be applied shall be free of dirt, grease, oil, rust, laitance, release agents, water repellents, and any other substances that may affect proper adhesion.
  - 3. Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.
  - 4. Comply with manufacturer's recommendations for temperature and humidity conditions before, during and after installation of firestopping.
  - 5. Do not proceed until unsatisfactory conditions have been corrected.

### **3.02 COORDINATION**

- A. Coordinate location and proper selection of cast-in-place Firestop Devices with trade responsible for the work. Ensure device is installed before placement of concrete.
- B. Responsible trade to provide adequate spacing of field run pipes to allow for installation of cast-in-place firestop devices without interferences.

### **3.03 INSTALLATION**

- A. Regulatory Requirements: Install firestop materials in accordance with UL Fire Resistance Directory.
- B. Manufacturer's Instructions: Comply with manufacturer's instructions for installation of through-penetration joint materials.
  - 1. Seal all holes or voids made by penetrations to ensure an air and water resistant seal.
  - 2. Consult with mechanical engineer, project manager, and damper manufacturer prior to installation of UL firestop systems that might hamper the performance of fire dampers as it pertains to duct work.
  - 3. Protect materials from damage on surfaces subjected to traffic.

### **3.04 FIELD QUALITY CONTROL**

- A. Examine sealed penetration areas to ensure proper installation before concealing or enclosing areas.
- B. Keep areas of work accessible until inspection by applicable code authorities.
- C. Inspection of through-penetration firestopping shall be performed in accordance with ASTM E 2174, "Standard Practice for On-Site Inspection of Installed Fire Stops" or other recognized standard.
- D. Perform under this section patching and repairing of firestopping caused by cutting or penetrating of existing firestop systems already installed by other trades.

### **3.05 ADJUSTING AND CLEANING**

- A. Remove equipment, materials and debris, leaving area in undamaged, clean condition.
- B. Clean all surfaces adjacent to sealed holes and joints to be free of excess firestop materials and soiling as work progresses.

**END OF SECTION**

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**SECTION 23 05 53**  
**MECHANICAL IDENTIFICATION FOR 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; 2007.
- B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2013.

**1.03 SUBMITTALS**

**PART 2 PRODUCTS**

**2.01 IDENTIFICATION APPLICATIONS**

- A. Air Handling Units: Nameplates.
- B. Control Panels: Nameplates.
- C. Dampers: Ceiling tacks, where located above lay-in ceiling.
- D. Ductwork: Duct markers..
- E. Major Control Components: Nameplates.
- F. Piping: Pipe markers.
- G. Pumps: Nameplates with Design GPM and FT of Head.
- H. Small-sized Equipment: Tags.
- I. Thermostats: Nameplates.
- J. 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. Kolbi Pipe Marker Co: [www.kolbipipemarkers.com/#sle](http://www.kolbipipemarkers.com/#sle).
  - 4. Seton Identification Products, a Tricor Direct Company: [www.seton.com/#sle](http://www.seton.com/#sle).
  - 5. Letter Color: White.
  - 6. Letter Height: 1/2 inch (13 mm).
  - 7. Background Color: Black.
  - 8. Plastic: Conform to ASTM D709.

**2.03 TAGS**

- A. Manufacturers:
  - 1. Advanced Graphic Engraving: [www.advancedgraphicengraving.com/#sle](http://www.advancedgraphicengraving.com/#sle).
  - 2. Brimar Industries, Inc: [www.pipemarker.com/#sle](http://www.pipemarker.com/#sle).
  - 3. Kolbi Pipe Marker Co: [www.kolbipipemarkers.com/#sle](http://www.kolbipipemarkers.com/#sle).
  - 4. Seton Identification Products, a Tricor Company: [www.seton.com/#sle](http://www.seton.com/#sle).
- B. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch (40 mm) diameter.

- C. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch (40 mm) diameter with smooth edges.
- D. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame.

## **2.04 ADHESIVE-BACKED DUCT MARKERS**

- A. Manufacturers:
  - 1. Brimar Industries, Inc; [www.pipemarker.com/#sle](http://www.pipemarker.com/#sle).
- 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: Yellow/Black for Supply and Return Air Ducts. Blue/White for Outdoor Air Exhaust Air Ducts.
- E. Size: 16" x 2-1/4".

## **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. Kolbi Pipe Marker Co; [www.kolbipipemarkers.com/#sle](http://www.kolbipipemarkers.com/#sle).
  - 4. MIFAB, Inc; [www.mifab.com/#sle](http://www.mifab.com/#sle).
  - 5. Seton Identification Products, a Tricor Company; [www.seton.com/#sle](http://www.seton.com/#sle).
- B. Color: Conform to 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.
- E. Color code as follows:
  - 1. Heating, Cooling, and Boiler Feedwater: Green with white letters.
  - 2. Fire Suppression: Red with white letters.
  - 3. Natural Gas: Yellow with black letters.

## **2.06 CEILING TACKS**

- A. Manufacturers:
  - 1. Craftmark; [www.craftmarkid.com/#sle](http://www.craftmarkid.com/#sle).
- 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. Identify service, flow direction, and pressure.
  - 2. Install in clear view and align with axis of piping.
  - 3. 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. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

**END OF SECTION**



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**SECTION 23 05 93**  
**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. Measurement of final operating condition of HVAC systems.

**1.02 REFERENCE STANDARDS**

- A. AABC (NSTSB) - AABC National Standards for Total System Balance, 7th Edition; 2016.
- B. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems; 2008.
- C. NEBB (TAB) - Procedural Standards for Testing Adjusting and Balancing of Environmental Systems; 2015, Eighth Edition.
- D. SMACNA (TAB) - HVAC Systems Testing, Adjusting and Balancing; 2002.

**1.03 SUBMITTALS**

- A. 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 Engineer.
  - 2. Submit to the Construction Manager.
  - 3. Submit six weeks prior to starting the testing, adjusting, and balancing work.
  - 4. Include certification that the plan developer has reviewed the contract documents, the equipment and systems, and the control system with the Engineer and other installers to sufficiently understand the design intent for each system.
  - 5. 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. Expected problems and solutions.
- B. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
  - 1. Submit to the the Construction Manager within two weeks after completion of testing, adjusting, and balancing.
  - 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 Engineer and for inclusion in operating and maintenance manuals.
  - 4. Provide reports in PDF or hard-copy binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.
  - 5. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
  - 6. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
  - 7. Units of Measure: Report data in I-P (inch-pound) units only.

8. 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 Engineer.
  - g. Project Contractor.
  - h. Report date.

## **PART 3 EXECUTION**

### **2.01 GENERAL REQUIREMENTS**

- A. Perform total system balance in accordance with one of the following:
  1. AABC (NSTSB), AABC National Standards for Total System Balance.
  2. ASHRAE Std 111, Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
  3. NEBB Procedural Standards for Testing Adjusting Balancing of Environmental Systems.
  4. SMACNA (TAB).
  5. NBC, The National Building Council
- B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.
- C. TAB Agency Qualifications:
  1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
  2. Having minimum of 10 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).
    - c. TABB, The Testing, Adjusting, and Balancing Bureau of National Energy Management Institute: [www.tabbcertified.org/#sle](http://www.tabbcertified.org/#sle).
    - d. NBC, The National Building Council

### **2.02 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. Access doors are closed and duct end caps are in place.
  9. Air outlets are installed and connected.
  10. Duct system leakage is minimized.
  11. Hydronic systems are flushed, filled, and vented.
  12. Pumps are rotating correctly.
- B. Beginning of work means acceptance of existing conditions.

### **2.03 ADJUSTMENT TOLERANCES**

- A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.
- B. 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.
- C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

### **2.04 RECORDING AND ADJUSTING**

- A. Ensure recorded data represents actual measured or observed conditions.
- B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- C. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

### **2.05 SCOPE**

- A. Test, adjust, and balance the following:
  - 1. Plumbing Pumps.
  - 2. HVAC Pumps.
  - 3. Terminal Heat Transfer Units.
  - 4. Air Handling Units.
  - 5. Fans.
  - 6. Air Inlets and Outlets.

### **2.06 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.
- B. Pumps:
  - 1. Identification/number.
  - 2. Manufacturer.
  - 3. Size/model.
  - 4. Impeller.
  - 5. Service.
  - 6. Design flow rate, pressure drop, BHP.
  - 7. Actual flow rate, pressure drop, BHP.
  - 8. Discharge pressure.
  - 9. Suction pressure.
  - 10. Total operating head pressure.
- 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. Air Moving Equipment:
1. Location.
  2. Manufacturer.
  3. Model number.
  4. Serial number.
  5. Arrangement/Class/Discharge.
  6. Air flow, specified and actual.
  7. Return air flow, specified and actual.
  8. Outside air flow, specified and actual.
  9. Total static pressure (total external), specified and actual.
  10. Inlet pressure.
  11. Discharge pressure.
  12. Sheave Make/Size/Bore.
  13. Number of Belts/Make/Size.
  14. Fan RPM.
- E. 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.
- F. Air Distribution Tests:
1. Air terminal number.
  2. Room number/location.
  3. Terminal type.
  4. Terminal size.
  5. Area factor.
  6. Design velocity.
  7. Design air flow.
  8. Test (final) air flow.

**END OF SECTION**

## **SECTION 23 07 13 DUCT INSULATION**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Duct insulation.
- B. Duct liner.

#### **1.02 REFERENCE STANDARDS**

- A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- B. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2010.
- C. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013.
- D. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014.
- E. ASTM C916 - Standard Specification for Adhesives for Duct Thermal Insulation; 2014.
- F. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material); 2012.
- G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- H. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2014.
- I. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005.
- J. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

#### **1.03 SUBMITTALS**

- A. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

#### **1.04 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type 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, with minimum 5 years of experience and approved by manufacturer.

#### **1.05 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.

#### **1.06 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, UL 723, ASTM E84, or UL 723.

## **2.02 GLASS FIBER, FLEXIBLE**

- A. Manufacturer:
  - 1. Knauf Insulation: [www.knaufinsulation.com](http://www.knaufinsulation.com).
  - 2. Johns Manville: [www.jm.com/#sle](http://www.jm.com/#sle).
  - 3. Owens Corning Corporation: [www.ocbuildingspec.com/#sle](http://www.ocbuildingspec.com/#sle).
  - 4. CertainTeed Corporation: [www.certainteed.com/#sle](http://www.certainteed.com/#sle).
- B. Insulation: ASTM C553; flexible, noncombustible blanket.
  - 1. Maximum '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: 250 degrees F (121 degrees C).
  - 3. Maximum Water Vapor Absorption: per ASTM C1104.
- C. Vapor Barrier Jacket:
  - 1. Kraft paper with glass fiber yarn and bonded to aluminized film.
  - 2. Moisture Vapor Permeability: Maximum 0.02 perm when tested in accordance with ASTM E96/E96M.
  - 3. Secure with pressure sensitive ASJ tape on longitudinal seams with staples at 6"-8" O.C. on lap. Mechanical fasteners or bands on round ducts. Include mastic at penetrations in shower areas.

## **2.03 DUCT LINER**

- A. Manufacturers:
  - 1. Armacell LLC; AP Coilflex: [www.armacell.us/#sle](http://www.armacell.us/#sle).
  - 2. Knauf Insulation: [www.knaufinsulation.com](http://www.knaufinsulation.com).
  - 3. Johns Manville: [www.jm.com/#sle](http://www.jm.com/#sle).
  - 4. Owens Corning Corporation: [www.ocbuildingspec.com/#sle](http://www.ocbuildingspec.com/#sle).
  - 5. CertainTeed Corporation: [www.certainteed.com/#sle](http://www.certainteed.com/#sle).
- B. Insulation: Non-corrosive, noncombustible glass fiber complying with ASTM C1071; flexible blanket; impregnated surface and edges coated with poly vinyl acetate polymer, acrylic polymer, or black composite.
  - 1. Maximum flame spread index of 25 and smoke developed index of 50 when tested per ASTM E84.
  - 2. Fungal Resistance: No growth when tested according to ASTM G21.
  - 3. Service Temperature: Up to 250 degrees F (121 degrees C).
  - 4. Rated Velocity on Coated Air Side for Air Erosion: 5,000 fpm (25.4 m/s), minimum.
  - 5. Minimum Noise Reduction Coefficients, when tested in accordance with ASTM C423:
    - a. 1/2 inch (13 mm) Thickness: 0.30.
    - b. 1 inch (25 mm) Thickness: 0.45.
    - c. 1-1/2 inches (40 mm) Thickness: 0.60.
- C. Liner Fasteners: Galvanized steel, impact applied or welded with integral head.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that ducts have been tested before 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. Install in accordance with NAIMA National Insulation Standards.
- C. 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.
- D. Insulated ducts conveying air above ambient temperature:
  1. Provide with or without standard vapor barrier jacket.
  2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.

### **3.03 SCHEDULES**

- A. Exhaust Ducts Within 10 ft (3 m) of Exterior Openings: 1-1/2 inches Flexible Fiberglass.
- B. Outside Air Intake Ducts: Flexible Fiberglass, 2" Thick
- C. Supply Air Duct: Minimum R-6 for ducts in mechanical rooms, above ceilings, and below ambient temperature.
- D. Supply Air Duct: Exposed in locker room and multipurpose room - not required.
- E. Return Air Duct: Minimum R-2 for ducts in mechanical rooms, above ceilings, and below ambient temperature.
- F. Supply and Return Duct within 10 ft of any Fan:
  1. Flexible Glass Fiber Duct Liner Insulation: 1 inch thick

**END OF SECTION**



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## **SECTION 23 07 19 PIPING INSULATION**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Piping insulation.
- B. Jackets and accessories.

#### **1.02 REFERENCE STANDARDS**

- A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2014.
- C. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2013.
- D. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2014.
- E. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2015.
- F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- G. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2014.
- H. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

#### **1.03 SUBMITTALS**

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

#### **1.04 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.

#### **1.05 DELIVERY, STORAGE, AND HANDLING**

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

### **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, UL 723, ASTM E84, or UL 723.

#### **2.02 GLASS FIBER**

- 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: [www.knaufinsulation.com](http://www.knaufinsulation.com).
  - 4. Owens Corning Corporation: [www.ocbuildingspec.com/#sle](http://www.ocbuildingspec.com/#sle).
- 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-inches (0.029 ng/Pa s m).
- D. Vapor Barrier Lap Adhesive: Compatible with insulation.

### **2.03 JACKETS**

- A. PVC Plastic.
  - 1. Jacket: One piece molded type fitting covers and sheet material, off-white color.A
    - a. Minimum Service Temperature: 0 degrees F (minus 18 degrees C).
    - b. Maximum Service Temperature: 150 degrees F (66 degrees C).
    - c. Moisture Vapor Permeability: 0.002 perm inch (0.0029 ng/Pa s m), maximum, when tested in accordance with ASTM E96/E96M.
    - d. Thickness: 10 mil (0.25 mm).
    - e. Connections: Brush on welding adhesive.

## **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 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. 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.
- F. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, refer to Section 07 84 00.
- G. 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 SCHEDULE**

- A. Confrom with current ASHRAE Standard 90.1 for minimum thickness
- B. Heating Systems:
  - 1. Heating Water Supply and Return:
    - a. Pipe sizes less than 2": 1" thick fiberglass.
    - b. Pipe sizes 2" and greater: 2" thick fiberglass
    - c. All piping - include PVC jacketing on all exposed piping.

C. Cooling Systems:

1. Chilled Water:

- a. Pipe sizes less than 1": 1/2" thick fiberglass.
- b. Pipe sizes 1" and greater: 2" thick fiberglass.
- c. All piping - include PVC jacketing on all exposed piping.

**END OF SECTION**

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## **SECTION 23 09 23**

### **FACTORY INSTALLED UNIT CONTROLS – BAS READY**

#### **PART 1 – GENERAL**

##### **1.01 SUMMARY**

- A. Provide factory-installed, unit-mounted DDC controls for air handling units.
- B. Controls shall operate units in standalone mode.
- C. Controls shall be fully open-protocol and capable of integration into a future Building Automation System (BAS) without replacement of installed hardware.
- D. Provide all sensors, actuators, safeties, and end devices required for full standalone operation.

#### **PART 2 – PRODUCTS**

##### **2.01 GENERAL**

- A. Provide dedicated, field-programmable DDC controller for each air handling unit.
- B. Controller shall be factory mounted and wired.
- C. Controller shall be fully programmable and not application-specific or locked firmware.
- D. Provide minimum 10 percent spare I/O capacity and 10 percent spare processing capacity.

##### **2.02 COMMUNICATION**

- A. Controller shall support native BACnet MS/TP and/or BACnet/IP, complying with ASHRAE 135.
- B. No proprietary gateways shall be required.
- C. All points shall be exposed as standard BACnet objects.
- D. All writable setpoints shall be commandable via BACnet.
- E. No recurring licensing fees shall be required to access points or modify setpoints.
- F. Loss of network communication shall not impair standalone operation.
- G. Controller shall retain programming and schedules for minimum 72 hours upon loss of power.

##### **2.03 STANDALONE OPERATION**

- A. Controller shall provide:
  - 1. Supply fan control via VFD.
  - 2. Economizer control.
  - 3. Coil valve modulation.
  - 4. Freeze protection.
  - 5. Condensate overflow shutdown.
  - 6. Filter status monitoring.

7. Local scheduling capability.
8. Alarm generation for critical faults

#### 2.04 INPUTS AND OUTPUTS

- A. Provide sufficient I/O capacity for all installed devices plus 10% spare, including:
  1. Supply air temperature sensor.
  2. Outdoor air temperature sensor.
  3. Mixed air temperature sensor.
  4. Low limit freeze protection.
  5. Filter differential pressure switch.
  6. Condensate overflow switch.
  7. Damper actuators.
  8. Valve actuators.
  9. Fan status proof.
- B. All sensors and actuators shall be factory wired.
- C. Provide terminal strip for future BAS tie-in if required.

#### 2.05 LOCAL INTERFACE

- A. Provide onboard display or local interface.
- B. Allow setpoint adjustment and alarm viewing without external workstation.
- C. Interface shall not require proprietary software unavailable to Owner.

#### 2.06 FUTURE BAS INTEGRATION

- A. Provide complete BACnet point list with submittal.
- B. Provide wiring diagrams showing all I/O points.
- C. Provide network port accessible for future connection.
- D. Coordinate addressing scheme with Owner.

### PART 3 – EXECUTION

#### 3.01 STARTUP

- A. Verify standalone operation.
- B. Verify all BACnet points are visible via test connection.
- C. Provide startup report documenting operational testing.

**END OF SECTION**

## **SECTION 23 21 13 HYDRONIC PIPING**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Hydronic system requirements.
- B. Heating water piping, above grade.
- C. Chilled water piping, above grade.
- D. Pipe hangers and supports.
- E. Unions, flanges, mechanical couplings, and dielectric connections.
- F. Valves:
  - 1. Ball valves.
  - 2. Butterfly valves.
  - 3. Check valves.
- G. Flow controls.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 07 84 00 - Firestopping.
- B. Section 22 05 16 - Expansion Fittings and Loops.
- C. Section 22 05 53 - Identification for Plumbing Piping and Equipment.
- D. Section 22 07 19 - Plumbing Piping Insulation.
- E. Section 22 05 16 - Expansion Fittings and Loops for Plumbing Piping.
- F. Section 23 05 16 - Expansion Compensation.
- G. Section 23 05 48 - Vibration Controls for Mechanical Piping and Equipment.
- H. Section 23 05 53 - Mechanical Identification for Piping and Equipment.
- I. Section 23 07 19 - Piping Insulation.
- J. Section 23 21 14 - Hydronic Specialties.
- K. Section 23 25 00 - HVAC Water Treatment: Pipe cleaning.

#### **1.03 REFERENCE STANDARDS**

- A. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2011.
- B. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2012.
- C. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2013.
- D. ASME B31.9 - Building Services Piping; 2014.
- E. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.
- F. ASTM A106/A106M - Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service; 2014.
- G. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2015.
- H. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984 (Reapproved 2014).
- I. ASTM B32 - Standard Specification for Solder Metal; 2008 (Reapproved 2014).
- J. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2014.
- K. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2013.
- L. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2015.



- M. ASTM D2000 - Standard Classification System for Rubber Products in Automotive Applications; 2012.
- N. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40; 2013.
- O. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers; 1992 (Reapproved 2008).
- P. ASTM F876 - Standard Specification for Crosslinked Polyethylene (PEX) Tubing; 2013a.
- Q. ASTM F877 - Standard Specification for Crosslinked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems; 2011.
- R. ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications; 2007 (Reapproved 2013).
- S. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2011-AMD 1.
- T. AWS A5.8/A5.8M - Specification for Filler Metals for Brazing and Braze Welding; American Welding Society.

#### **1.04 SYSTEM DESCRIPTION**

- A. Where more than one piping system material is specified, ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.
- B. Use grooved mechanical couplings and fasteners in accessible locations.
- C. Use unions, flanges, and couplings downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus.
- D. Non-conducting dielectric connections/fittings are NOT approved for use on this project.
- E. Provide pipe hangers and supports in accordance with ASME B31.9 unless indicated otherwise.
- F. Use ball or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- G. Use globe valves for throttling, bypass, or manual flow control services.
- H. Use 3/4 inch (20 mm) ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment. Pipe to nearest floor drain.

#### **1.05 SUBMITTALS**

- A. Product Data:
  - 1. Include data on pipe materials, pipe fittings, valves, and accessories.
  - 2. Provide manufacturers catalogue information.
  - 3. Indicate valve data and ratings.
  - 4. Show grooved joint couplings, fittings, valves, and specialties on drawings and product submittals, specifically identified with the manufacturer's style or series designation.
- B. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.
- C. Project Record Documents: Record actual locations of valves.
- D. Project Record Documents: Record and submit as-built drawings

#### **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. Provide all grooved joint couplings, fittings, valves, specialties, and grooving tools from a single manufacturer.

- C. Date stamp all castings used for coupling housings, fittings, valve bodies, etc. for quality assurance and traceability.

#### **1.07 REGULATORY REQUIREMENTS**

- A. Conform to ASME B31.9 code for installation of piping system.

#### **1.08 DELIVERY, STORAGE, AND HANDLING**

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- 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.

#### **1.09 FIELD CONDITIONS**

- A. Do not install underground piping when bedding is wet or frozen.

### **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. Do NOT use non-conducting dielectric connections. These are not approved on this project.
  - 3. Grooved mechanical joints may be used in any location.
    - a. Accessible locations include those exposed on interior of building, in pipe chases, and in mechanical rooms, aboveground outdoors, and as approved by Engineer.
    - b. Grooved mechanical connections and joints comply with AWWA C606.
      - 1) Ductile Iron: Comply with ASTM A536, Grade 65-45-12.
      - 2) Steel: Comply with ASTM A106/A106M, Grade B or ASTM A53/A53M.
    - c. Depending on pipe size, three or four flexible joints may be used in lieu of a flexible connector.
    - 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).
  - 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.
  - 1. Where grooved joints are used in piping, provide grooved valve/equipment connections if available; if not available, provide flanged ends and grooved flange adapters.
- 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.

## **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.
  - 4. Fittings: ASTM B 16.3, malleable iron or ASTM A 234/A 234M, wrought steel welding type fittings.
  - 5. Joints: Threaded, or AWS D1.1 welded.
- 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. Grooved Joints: AWWA C606 grooved tube, fittings of same material, and copper-tube-dimension mechanical couplings.
  - 3. Grooved Joints: AWWA C606 grooved tube, fittings of same material, and copper-tube-dimension mechanical couplings.
  - 4. Tee Connections: Mechanically extracted collars with notched and dimpled branch tube.
  - 5. Mechanical Press Sealed Fittings: Double pressed type complying with ASME B16.22, utilizing EPDM, nontoxic synthetic rubber sealing elements.

## **2.03 CHILLED WATER PIPING, ABOVE GRADE**

- A. Steel Pipe: ASTM A53/A53M, Schedule 40, black; using one of the following joint types:
  - 1. Threaded Joints: ASME B16.3, malleable iron fittings.
  - 2. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.
  - 3. Fittings: ASME B16.3, malleable iron or ASTM A 234/A 234M, wrought steel welding type.
- B. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), hard drawn; using one of the following joint types:
  - 1. Grooved Joints: AWWA C606 grooved tube, fittings of same material, and copper-tube-dimension mechanical couplings.
  - 2. Mechanical Press Sealed Fittings: Double pressed type complying with ASME B16.22, utilizing EPDM, nontoxic synthetic rubber sealing elements.

## **2.04 EQUIPMENT DRAINS AND OVERFLOWS**

- A. 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; ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
  - 2. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.

## **2.05 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.
- B. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch (13 to 38 mm): Malleable iron, adjustable swivel, split ring.
- C. Hangers for Cold Pipe Sizes 2 Inches (50 mm) and Greater: Carbon steel, adjustable, clevis.

- D. Hangers for Hot Pipe Sizes 2 to 4 Inches (50 to 100 mm): Carbon steel, adjustable, clevis.
- E. Hangers for Hot Pipe Sizes 6 Inches (150 mm) and Greater: Adjustable steel yoke, cast iron roll, double hanger.
- F. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
- G. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 Inches (150 mm) and Greater: Steel channels with welded spacers and hanger rods, cast iron roll.
- H. Wall Support for Pipe Sizes to 3 Inches (76 mm): Cast iron hook.
- I. Wall Support for Pipe Sizes 4 Inches (100 mm) and Greater: Welded steel bracket and wrought steel clamp.
- J. Wall Support for Hot Pipe Sizes 6 Inches (150 mm) and Greater: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.
- K. Vertical Support: Steel riser clamp.
- L. Floor Support for Hot Pipe Sizes to 4 Inches (100 mm): Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- M. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
- N. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
- O. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.
- P. 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.

## **2.06 UNIONS, FLANGES, MECHANICAL COUPLINGS, AND DIELECTRIC CONNECTIONS**

- A. Unions for Pipe 2 Inches (50 mm) and Less:
  - 1. Ferrous Piping: 150 psig (1034 kPa) malleable iron, threaded.
  - 2. Copper Pipe: Bronze, soldered joints.
- B. Flanges for Pipe 2 Inches (50 mm) and Greater:
  - 1. Ferrous Piping: 150 psig (1034 kPa) forged steel, slip-on.
  - 2. Copper Piping: Bronze.
- 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. Mechanical Couplings: Comply with ASTM F1476.
  - 3. Housing Material: Malleable iron or ductile iron, galvanized.
  - 4. Housing Clamps: Malleable iron galvanized to engage and lock, designed to permit some angular deflection, contraction, and expansion.
  - 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.
  - 7. When pipe is field grooved, provide coupling manufacturer's grooving tools.
  - 8. Manufacturers:
    - a. Victaulic Company; \_\_\_\_\_: [www.victaulic.com/#sle](http://www.victaulic.com/#sle).

## **2.07 BALL VALVES**

- A. Up To and Including 2 Inches (50 mm):
  - 1. Bronze one piece body, chrome plated brass ball, teflon seats and stuffing box ring, lever handle with balancing stops, solder ends with union.

- B. Over 2 Inches (50 mm):
  - 1. Ductile iron body, chrome plated stainless steel ball, teflon, Virgin TFE, or \_\_\_\_\_ seat and stuffing box seals, lever handle or gear operated, flanged ends, rated to 800 psi (5515 kPa).

## **2.08 BUTTERFLY VALVES**

- A. Body: Cast or ductile iron with resilient replaceable EPDM seat, wafer, lug, grooved, or \_\_\_\_\_ ends, extended neck.
- B. Disc: Construct of aluminum bronze, chrome plated ductile iron, stainless steel, ductile iron with EPDM encapsulation, Buna-N encapsulation, or \_\_\_\_\_.
- C. Stem: Stainless steel with stem offset from the centerline to provide full 360 degree circumferential setting.
- D. Operator: 10 position lever handle.

## **2.09 SWING CHECK VALVES**

- A. Up To and Including 2 Inches (50 mm):
  - 1. Bronze body, bronze trim, bronze rotating swing disc, with composition disc, solder ends.
- B. Over 2 Inches (50 mm):
  - 1. Iron body, bronze or \_\_\_\_\_ trim, stainless steel, bronze, bronze faced rotating, or \_\_\_\_\_ swing disc, renewable disc and seat, flanged, grooved, or \_\_\_\_\_ ends.

## **2.10 SPRING LOADED CHECK VALVES**

- A. Iron body, bronze trim, split plate, hinged with stainless steel spring, resilient seal bonded to body, wafer or threaded lug ends.

## **2.11 FLOW CONTROLS**

- A. Manufacturers:
  - 1. Griswold Controls; \_\_\_\_\_: [www.griswoldcontrols.com/#sle](http://www.griswoldcontrols.com/#sle).
  - 2. ITT Bell & Gossett; \_\_\_\_\_: [www.bellgossett.com/#sle](http://www.bellgossett.com/#sle).
  - 3. Taco, Inc; \_\_\_\_\_: [www.taco-hvac.com/#sle](http://www.taco-hvac.com/#sle).
  - 4. Victaulic Company; \_\_\_\_\_: [www.victaulic.com/#sle](http://www.victaulic.com/#sle).
- 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 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 3.5 psi (24 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. Refer to Section 23 25 00 for additional requirements.

### **3.02 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.
- C. Route piping in orderly manner, parallel to building structure, and maintain gradient.

- D. Install piping to conserve building space and to avoid interfere 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. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 22 05 16.
- J. Grooved Joints:
  - 1. Install in accordance with the manufacturer's latest published installation instructions.
  - 2. Gaskets to be suitable for the intended service, molded, and produced by the coupling manufacturer.
- K. Pipe Hangers and Supports:
  - 1. Install in accordance with ASME B31.9, ASTM F708, or MSS SP-58.

### **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 inch (40 mm) and 2 inch (50 mm): Maximum span, 8 feet (2400 mm); minimum rod size, 3/8 inch (9 mm).
  - 4. 2-1/2 inch (65 mm): Maximum span, 9 feet (2700 mm); minimum rod size, 3/8 inch (9 mm).
  - 5. 3 inch (80 mm): Maximum span, 10 feet (3.0 m); minimum rod size, 3/8 inch (9 mm).
  - 6. 4 inch (100 mm): Maximum span, 12 feet (3.6 m); minimum rod size, 1/2 inch (13 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).
  - 4. 2 inches (50 mm): Maximum span, 10 feet (3.0 m); minimum rod size, 3/8 inch (9 mm).
  - 5. 2-1/2 inches (65 mm): Maximum span, 11 feet (3.4 m); minimum rod size, 3/8 inch (9 mm).
  - 6. 3 inches (80 mm): Maximum span, 12 feet (3.6 m); minimum rod size, 3/8 inch (9 mm).
  - 7. 4 inches (100 mm): Maximum span, 14 feet (4.3 m); minimum rod size, 1/2 inch (13 mm).

**END OF SECTION**

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## **SECTION 23 21 14 HYDRONIC SPECIALTIES**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Air vents.
- B. Strainers.
- C. Suction diffusers.
- D. Combination flow controls.
- E. Relief valves.
- F. Pressure reducing valves.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 23 21 13 - Hydronic Piping.

#### **1.03 REFERENCE STANDARDS**

- A. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1 - Rules for Construction of Pressure Vessels; 2015.

#### **1.04 SUBMITTALS**

- A. 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.
- B. Project Record Documents: Record actual locations of flow controls.

#### **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.

#### **1.06 MAINTENANCE SERVICE**

- A. Furnish service and maintenance of glycol system for one year from date of substantial completion.

### **PART 2 PRODUCTS**

#### **2.01 AIR VENTS**

- A. Manufacturers:
  - 1. Armstrong International, Inc; \_\_\_\_\_: [www.armstronginternational.com/#sle](http://www.armstronginternational.com/#sle).
  - 2. ITT Bell & Gossett; \_\_\_\_\_: [www.bellgossett.com/#sle](http://www.bellgossett.com/#sle).
  - 3. Taco, Inc; \_\_\_\_\_: [www.taco-hvac.com/#sle](http://www.taco-hvac.com/#sle).
- B. Manual Type: Short vertical sections of 2 inch (50 mm) diameter pipe to form air chamber, with 1/8 inch (3 mm) brass needle valve at top of chamber.

#### **2.02 STRAINERS**

- A. Size 2 inch (50 mm) and Under:
  - 1. Screwed brass or iron body for 175 psi (1200 kPa) working pressure, Y pattern with 1/32 inch (0.8 mm) stainless steel perforated screen.
- B. Size 2-1/2 inch (65 mm) to 4 inch (100 mm):
  - 1. Provide flanged or grooved iron body for 175 psi (1200 kPa) working pressure, Y pattern with 1/16 inch (1.6 mm) stainless steel perforated screen.

#### **2.03 PRESSURE-TEMPERATURE TEST PLUGS**

- A. 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).



- B. Application: Use extended length plugs to clear insulated piping.

#### **2.04 COMBINATION FLOW CONTROLS**

- A. Construction: Brass or bronze body with union on inlet and outlet, temperature and pressure test plug on inlet and outlet with blowdown/backflush drain.
- B. Calibration: Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 3.5 psi (24 kPa).
- C. Control Mechanism: Stainless steel or nickel plated brass piston or regulator cup, operating against stainless steel helical or wave formed spring.
- D. Accessories: In-line strainer on inlet and ball valve on outlet.

#### **2.05 RELIEF VALVES**

- A. Manufacturers:
  - 1. Armstrong International, Inc; \_\_\_\_\_: [www.armstronginternational.com/#sle](http://www.armstronginternational.com/#sle).
  - 2. ITT Bell & Gossett; \_\_\_\_\_: [www.bellgossett.com/#sle](http://www.bellgossett.com/#sle).
- B. Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labelled.

#### **2.06 PRESSURE REDUCING VALVES**

- A. Manufacturers:
  - 1. Armstrong International, Inc; \_\_\_\_\_: [www.armstronginternational.com/#sle](http://www.armstronginternational.com/#sle).
  - 2. ITT Bell & Gossett; \_\_\_\_\_: [www.bellgossett.com/#sle](http://www.bellgossett.com/#sle).
  - 3. Taco, Inc; \_\_\_\_\_: [www.taco-hvac.com/#sle](http://www.taco-hvac.com/#sle).
- B. Operation: Automatically feeds make-up water to the hydronic system whenever pressure in the system drops below the pressure setting of the valve. Refer to Section 23 21 13.
- C. Materials of Construction:
  - 1. Valve Body: Constructed of bronze, cast iron, brass, iron, or \_\_\_\_\_.
  - 2. Internal Components: Construct of stainless steel, brass, or \_\_\_\_\_ and engineered plastics, composition material, or \_\_\_\_\_.
- D. Connections:
  - 1. NPT threaded: 0.50 inch (15 mm), 0.75 inch (20 mm), or \_\_\_\_ inch (\_\_\_\_ mm).
  - 2. Soldered: 0.50 inch (15 mm) or \_\_\_\_ inch (\_\_\_\_ mm).
- E. Provide integral check valve and strainer.
- F. Maximum Inlet Pressure: 100 psi (689 kPa).
- G. Maximum Fluid Temperature: 180 degrees F (82 degrees C).
- H. Operating Pressure Range: Between 10 psi (69 kPa) and 25 psi (172 kPa).

### **PART 3 EXECUTION**

#### **3.01 INSTALLATION**

- A. Install specialties in accordance with manufacturer's instructions.
- B. Where large air quantities can accumulate, provide enlarged air collection standpipes.
- C. Provide manual air vents at system high points and as indicated.
- D. Provide air separator on suction side of system circulation pump and connect to expansion tank.
- E. Provide radiator balancing valves on water outlet from terminal heating units such as radiation, unit heaters, and fan coil units.
- F. Perform tests determining strength of glycol and water solution and submit written test results.

**END OF SECTION**

## **SECTION 23 21 23 HYDRONIC PUMPS**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. System lubricated circulators.

#### **1.02 REFERENCE STANDARDS**

- A. UL 778 - Standard for Motor-Operated Water Pumps; Current Edition, Including All Revisions.

#### **1.03 SUBMITTALS**

- A. Product Data: Provide certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.
- B. Operation and Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

#### **1.04 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacture, assembly, and field performance of pumps, with minimum three years of documented experience.

### **PART 2 PRODUCTS**

#### **2.01 HVAC PUMPS - GENERAL**

- A. Provide pumps that operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.
- B. Minimum Quality Standard: UL 778.
- C. Base Mounted Pumps: Aligned by qualified millwright.
- D. Products Requiring Electrical Connection: Listed and classified by UL or testing agency acceptable to Authority Having Jurisdiction as suitable for the purpose specified and indicated.

#### **2.02 SYSTEM LUBRICATED CIRCULATORS**

- A. Type: Horizontal shaft, single stage, direct connected with multiple speed wet rotor motor for in-line mounting, for 140 psi (965 kPa) maximum working pressure, 230 degrees F (110 degrees C) maximum water temperature.
- B. Casing: Cast iron with flanged pump connections.
- C. Impeller, Shaft, Rotor: Stainless Steel.
- D. Bearings: Metal Impregnated carbon (graphite) and ceramic.
- E. Motor: Impedance protected, multiple speed, with external speed selector.

### **PART 3 EXECUTION**

#### **3.01 PREPARATION**

- A. Verify that electric power is available and of the correct characteristics.

#### **3.02 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Provide access space around pumps for service. Provide no less than minimum space recommended by manufacturer.
- C. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. For close-coupled or base-mounted pumps, provide supports under elbows on pump suction and discharge line sizes 4 inches (102 mm) and over.

- D. Provide line sized shut-off valve and strainer on pump suction, and line sized soft seat check valve and balancing valve on pump discharge.
- E. Check, align, and certify alignment of base-mounted pumps prior to start-up.
- F. Provide side-stream filtration system for closed loop systems. Install across pump with flow from pump discharge to pump suction from pump tapplings.

**END OF SECTION**

**SECTION 23 25 00  
HVAC WATER TREATMENT**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Materials.
  - 1. System cleaner.
  - 2. Closed system treatment (water).

**1.02 RELATED REQUIREMENTS**

- A. Section 23 21 13 - Hydronic Piping.
- B. Section 23 21 14 - Hydronic Specialties.

**1.03 SUBMITTALS**

- A. Product Data: Provide chemical treatment materials, chemicals, and equipment including electrical characteristics and connection requirements.
- B. Project Record Documents: Record actual locations of equipment and piping, including sampling points and location of chemical injectors.
- C. Operation and Maintenance Data: Include data on chemical feed pumps, agitators, and other equipment including spare parts lists, procedures, and treatment programs. Include step by step instructions on test procedures including target concentrations.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Enerco.
- B. KML. Inc..

**2.02 MATERIALS**

- A. System Cleaner:
  - 1. Non-foaming alkaline cleaner.
  - 2. Compatible with piping and system metals.
  - 3. Suitable for hydronic systems.
- B. Closed System Treatment (Water):
  - 1. Nitrite/borate or molybdate-based
  - 2. Azole for copper protection
  - 3. pH buffering

**PART 3 EXECUTION**

**3.01 PREPARATION**

- A. Systems shall be operational, filled, started, and vented prior to cleaning. Use water meter to record capacity in each system.
- B. Place terminal control valves in open position during cleaning.
- C. Verify that electric power is available and of the correct characteristics.

**3.02 CLEANING SEQUENCE**

- A. Concentration:
  - 1. As recommended by manufacturer.
- B. Hot Water Heating Systems:
  - 1. Apply heat while circulating, slowly raising temperature to 160 degrees F (71 degrees C) and maintain for 12 hours minimum.
  - 2. Remove heat and circulate to 100 degrees F (37.8 degrees C) or less; drain systems as quickly as possible and refill with clean water.

3. Circulate for 6 hours at design temperatures, then drain.
  4. Refill with clean water and repeat until system cleaner is removed.
- C. Use neutralizer agents on recommendation of system cleaner supplier and approval of Engineer.
  - D. Flush open systems and glycol filled closed systems with clean water for one hour minimum. Drain completely and refill.
  - E. Remove, clean, and replace strainer screens.
  - F. Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required.

### **3.03 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.

### **3.04 CLOSEOUT ACTIVITIES**

- A. Training: Train Owner's personnel on operation and maintenance of chemical treatment system.
  1. Provide minimum of two hours of instruction for two people.
  2. Have operation and maintenance data prepared and available for review during training.
  3. Conduct training using actual equipment after treated system has been put into full operation.

**END OF SECTION**

**SECTION 23 31 00  
HVAC DUCTS AND CASINGS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Metal ductwork.

**1.02 RELATED REQUIREMENTS**

- A. Section 23 07 13 - Duct Insulation: External insulation and duct liner.

**1.03 REFERENCE STANDARDS**

- A. ASHRAE (FUND) - ASHRAE Handbook - Fundamentals; 2013.
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- E. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2015.
- F. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005.
- G. SMACNA (LEAK) - HVAC Air Duct Leakage Test Manual; 2012, 2nd Edition.

**1.04 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.

**PART 2 PRODUCTS**

**2.01 DUCT ASSEMBLIES**

- A. Regulatory Requirements: Construct ductwork to NFPA 90A standards.

**2.02 MATERIALS**

- A. Galvanized Steel for Ducts: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G90/Z275 coating.
- B. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
  - 1. 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.
  - 2. Surface Burning Characteristics: Flame spread index of 25 and smoke developed index of 50, when tested in accordance with ASTM E84.
- C. Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.
- D. All Ducts: Galvanized steel, unless otherwise indicated.
- E. Exposed ducts in locker room: G90 Galvanized steel with shop prime coat and field epoxy paint finish. Coat all seams and fasteners.

**2.03 DUCTWORK FABRICATION**

- A. Fabricate and support in accordance with SMACNA (DCS) and as indicated.
- B. No variation of duct configuration or size permitted except by written permission. Size round duct installed in place of rectangular ducts in accordance with ASHRAE (FUND) Handbook - Fundamentals.
- C. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

- D. Construct T's, 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 air foil turning vanes of perforated metal with glass fiber insulation.
- 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. Fabricate continuously welded round and oval duct fittings in accordance with SMACNA (DCS).

## **2.04 MANUFACTURED DUCTWORK AND FITTINGS**

- A. Flat Oval Ducts: Machine made from round spiral lockseam duct.
  - 1. Manufacture in accordance with SMACNA (DCS).
  - 2. Fittings: Manufacture at least two gages heavier metal than duct.
  - 3. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- B. Spiral Ducts: Round spiral lockseam duct with galvanized steel outer wall.
  - 1. Manufacture in accordance with SMACNA (DCS).

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install, support, and seal ducts in accordance with SMACNA (DCS).
- B. Flexible Ducts: Connect to metal ducts with mechanical fastener.
- C. Duct sizes indicated are inside clear dimensions.
- D. Install and seal metal and flexible ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- E. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- F. Use crimp joints with or without bead for joining round duct sizes 8 inch (200 mm) and smaller with crimp in direction of air flow.
- G. Connect diffusers or light troffer boots to low pressure ducts with 6 foot maximum length of flexible duct held in place with strap or clamp.
- H. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- I.

**END OF SECTION**

**SECTION 23 33 00  
AIR DUCT ACCESSORIES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Air turning devices/extractors.
- B. Backdraft dampers - metal.
- C. Duct access doors.
- D. Duct test holes.
- E. Fire dampers.
- F. Flexible duct connections.
- G. Volume control dampers.

**1.02 RELATED REQUIREMENTS**

- A. Section 07 84 00 - Firestopping.
- B. Section 23 31 00 - HVAC Ducts and Casings.

**1.03 REFERENCE STANDARDS**

- A. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2015.
- B. NFPA 92 - Standard for Smoke Control Systems; 2015.
- C. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; 2014.
- D. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005.
- E. UL 33 - Safety Heat Responsive Links for Fire-Protection Service; Current Edition, Including All Revisions.
- F. UL 555 - Standard for Fire Dampers; Current Edition, Including All Revisions.
- G. UL 555S - Standard for Smoke Dampers; Current Edition, Including All Revisions.

**1.04 SUBMITTALS**

- A. Product Data: Provide for shop fabricated assemblies including volume control dampers. Include electrical characteristics and connection requirements.
- B. Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers.
- C. Manufacturer's Installation Instructions: Provide instructions for fire dampers.
- D. Project Record Drawings: Record actual locations of access doors and test holes.

**1.05 PROJECT RECORD DOCUMENTS**

- A. Record actual locations of access doors.

**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.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

**1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Protect dampers from damage to operating linkages and blades.



## **PART 2 PRODUCTS**

### **2.01 AIR TURNING DEVICES/EXTRACTORS**

- A. Multi-blade device with blades aligned in short dimension; steel construction; with individually adjustable blades, mounting straps.

### **2.02 BACKDRAFT DAMPERS - METAL**

- A. Multi-Blade, Parallel Action Gravity Balanced Backdraft Dampers: Extruded aluminum, with center pivoted blades of maximum 6 inch (150 mm) width, with neoprene sealed edges, linked together in rattle-free manner with 90 degree stop, stainless steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

### **2.03 DUCT ACCESS DOORS**

- A. Fabricate in accordance with SMACNA (DCS) and as indicated.
- B. Minimum 8x8 for hand access. 12x12 standard unless duct dimensions prevent install.

### **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.

### **2.05 FIRE DAMPERS**

- A. Fabricate in accordance with NFPA 90A and UL 555, and as indicated.
- B. Fusible Links: UL 33, separate at 165 deg F rating with adjustable link straps for combination fire/balancing dampers.

### **2.06 FLEXIBLE DUCT CONNECTIONS**

- A. Fabricate in accordance with SMACNA (DCS) and as indicated.
- B. Flexible Duct Connections: Fabric crimped into metal edging strip.

### **2.07 VOLUME CONTROL DAMPERS**

- A. Fabricate in accordance with SMACNA (DCS) and as indicated.
- B. Single Blade Dampers:
  - 1. Fabricate for duct sizes up to 6 by 30 inch (150 by 760 mm).
  - 2. Blade: 24 gage, 0.0239 inch (0.61 mm), minimum.
- C. Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 8 by 72 inch (200 by 1825 mm). Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
  - 1. Blade: 18 gage, 0.0478 inch (1.21 mm), minimum.
- D. 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.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA (DCS). Refer to Section 23 31 00 for duct construction and pressure class.
- B. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.
- C. 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 for hand access, size for

shoulder access, and as indicated. Provide 4 by 4 inch (100 by 100 mm) for balancing dampers only. Review locations prior to fabrication.

- D. Provide duct test holes where indicated and required for testing and balancing purposes.
- E. Provide fire dampers, combination fire and smoke dampers, and smoke 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.
- F. Install smoke dampers and combination smoke and fire dampers in accordance with NFPA 92.
- G. Demonstrate re-setting of fire dampers to Owner's representative.

**END OF SECTION**

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**SECTION 23 34 23**  
**HVAC POWER VENTILATORS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Roof ventilators.
- B. Cabinet exhaust fans.
- C. Inline centrifugal fans.

**1.02 RELATED REQUIREMENTS**

- A. Section 22 05 48 - Vibration and Seismic Controls for Plumbing Piping and Equipment.
- B. Section 23 33 00 - Air Duct Accessories: Backdraft dampers.

**1.03 REFERENCE STANDARDS**

- A. AMCA (DIR) - (Directory of) Products Licensed Under AMCA International Certified Ratings Program; <http://www.amca.org/certified/search/company.aspx>.
- B. AMCA 99 - Standards Handbook; 2025.
- C. AMCA 204 - Balance Quality and Vibration Levels for Fans; 2020.
- D. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating; 2025.
- E. AMCA 300 - Reverberation Room Methods of Sound Testing of Fans; 2024.
- F. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data; 2022.

**1.04 SUBMITTALS**

- A. Product Data: Provide data on fans and accessories including fan curves with specified operating point clearly plotted, power, RPM, sound power levels at rated capacity, and electrical characteristics and connection requirements.
- B. Manufacturer's Instructions: Indicate installation instructions.
- C. Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

**1.05 EXTRA MATERIALS**

- A. Supply two sets of belts for each fan.

**PART 2 PRODUCTS**

**2.01 POWER VENTILATORS - GENERAL**

- A. Static and Dynamically Balanced: AMCA 204 - Balance Quality and Vibration Levels for Fans.
- B. Performance Ratings: Determined in accordance with AMCA 210 and bearing the AMCA Certified Rating Seal.
- C. Sound Ratings: AMCA 301, tested to AMCA 300 and bearing AMCA Certified Sound Rating Seal.
- D. Fabrication: Conform to AMCA 99.
- E. Electrical Components: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

**2.02 ROOF VENTILATORS**

- A. Product Requirements:
  - 1. Performance Ratings: Determined in accordance with AMCA 210 .
  - 2. Fabrication: Conform to AMCA 99.
  - 3. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705.

- B. Performance Ratings: Refer to Equipment Schedules
- C. Roof Curb: 24 inch (600 mm) high self-flashing of galvanized steel with continuously welded seams, built-in cant strips.
- D. Backdraft Damper: aluminum multiple blade construction, felt edged with offset hinge pin, nylon bearings, blades linked, and line voltage motor drive, power open, spring return.
- E. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheave selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

### **2.03 CABINET EXHAUST FANS**

- A. Centrifugal Fan Unit: V-belt or direct driven with galvanized steel housing lined with acoustic insulation, resilient mounted motor, gravity backdraft damper in discharge.
- B. Grille: Molded white plastic.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Secure roof exhausters with stainless steel lag screws to roof curb.
- C. Extend ducts to roof exhausters into roof curb. Counterflash duct to roof opening.
- D. Install backdraft dampers on inlet to roof and wall exhausters.
- E. Provide backdraft dampers on outlet from cabinet and ceiling exhauster fans and as indicated.

**END OF SECTION**

**SECTION 23 37 00  
AIR OUTLETS AND INLETS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Diffusers.
- B. Registers/grilles.
- C. Louvers.

**1.02 REFERENCE STANDARDS**

- A. AMCA 511 - Certified Ratings Program for Air Control Devices; 2010.
- B. AMCA 550 - Test Method for High Velocity Wind Driven Rain Resistant Louvers; 2015.
- C. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
- D. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2013.
- E. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005.

**1.03 SUBMITTALS**

- A. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.

**PART 2 PRODUCTS**

**2.01 RECTANGULAR CEILING DIFFUSERS**

- A. Specifications: As indicated on the drawings.

**2.02 CEILING EXHAUST AND RETURN REGISTERS/GRILLES**

- A. Specifications: As indicated on the drawings.

**2.03 CEILING GRID CORE EXHAUST AND RETURN REGISTERS/GRILLES**

- A. Specifications: As indicated on the drawings.

**2.04 WALL SUPPLY REGISTERS/GRILLES**

- A. Specifications: As indicated on the drawings.

**2.05 WALL EXHAUST AND RETURN REGISTERS/GRILLES**

- A. Specifications: As indicated on the drawings.

**2.06 LOUVERS**

- A. Specifications: As indicated on the drawings.

**2.07 GRAVITY VENTILATORS**

- A. Hood Relief Gravity Ventilator:
  - 1. General:
    - a. Performance ratings and factory testing to be in accordance with AMCA 511 and AMCA 550.
    - b. Suitable for non-ducted applications.
    - c. Equipment to bear permanently affixed manufacturer's nameplate listing model and serial number.
  - 2. Hood and Base:
    - a. Material: Aluminum.
    - b. Hood Construction: Precision formed, arched panels with interlocking seams.
    - c. Vertical End Panels: Fully locked into hood end panels.

- d. Curb Cap: Pre-punched mounting holes for installation.
- 3. Birdscreen:
  - a. Fabricate in accordance with ASTM B221 (ASTM B221M).
  - b. Horizontally mounted across hood intake area.
- 4. Hood Support: Galvanized steel construction and fastened so hood can be removed completely from the base or hinged open.
- 5. Options/Accessories:
  - a. Roof Curbs:
    - 1) Flat Roofs:
      - (a) Welded, straight side curb with flashing flange and wood nailer.
  - b. Curb Seal: Rubber seal between fan and roof curb.
  - c. Dampers:
    - 1) Type: Motorized.
    - 2) Factory designed to prevent outside air from entering back into building when fan is off.
    - 3) Balanced for minimal resistance to flow.
    - 4) Galvanized frames with pre-punched mounting holes.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.
- C. Install diffusers to ductwork with air tight connection.
- D. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, despite whether dampers are specified as part of the diffuser, or grille and register assembly.
- E. Paint ductwork visible behind air outlets and inlets matte black. Refer to Section 09 91 23.

**END OF SECTION**

**SECTION 23 73 13**  
**MODULAR INDOOR CENTRAL-STATION AIR-HANDLING UNITS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Casing construction.
- B. Filter and air cleaner section.
- C. Damper section.
- D. Total energy recovery wheel section.
- E. Access section.
- F. Controls.
- G. Packaged air handling units.

**1.02 REFERENCE STANDARDS**

- A. AHRI 410 - Standard for Forced-Circulation Air-Cooling and Air-Heating Coils; 2001 (R2011).
- B. AMCA 300 - Reverberation Room Methods of Sound Testing of Fans; 2024.
- C. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data; 2022.
- D. AMCA 500-D - Laboratory Methods of Testing Dampers for Rating; 2012.
- E. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size; 2012, with 2015 amendments.
- F. ASHRAE Std 62.1 - Laboratory Method of Testing to Determine the Sound Power in a Duct; 2013.
- G. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2015.
- I. UL 1812 - Ducted Heat Recovery Ventilators; Current Edition, Including All Revisions.

**1.03 SUBMITTALS**

- A. Product Data:
  - 1. Published Literature: Indicate dimensions, weights, capacities, ratings, gauges and finishes of materials, and electrical characteristics and connection requirements.
  - 2. Filters: Data for filter media, filter performance data, filter assembly, and filter frames.
  - 3. Fans: Performance and fan curves with specified operating point clearly plotted, power, RPM.
  - 4. Sound Power Level Data: Fan outlet and casing radiation at rated capacity.
  - 5. Electrical Requirements: Power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.
- B. Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.
- C. Maintenance Data: Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.
- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. Extra Filters: One set for each unit.



## **PART 2 PRODUCTS**

### **2.01 CASING CONSTRUCTION**

- A. Casing:
  - 1. Construct of one piece, insulated, double wall panels.
  - 2. Provide mid-span, no through metal, internal thermal break.
  - 3. Construct outer panels of galvanized steel and inner panels of galvanized steel.
  - 4. Casing Air Pressure Performance Requirements:
    - a. Able to withstand up to 8 inches w.g. (2 kPa) positive or negative static pressure.
    - b. Not to exceed 0.0042 inches per inch (0.0042 mm/mm) deflection at 1.5 times design static pressure up to a maximum of plus 8 inches w.g. (2 kPa) in positive pressure sections and minus 8 inches w.g. (2 kPa) in negative pressure sections.
- B. Access Doors:
  - 1. Construction, thermal and air pressure performance same as casing.
  - 2. Provide surface mounted handles on hinged, swing doors.
- C. Insulation:
  - 1. Minimum 1" expanded foam, minimum R-4 per inch.
  - 2. Completely fill panel cavities in each direction to prevent voids and settling.
  - 3. Comply with NFPA 90A.
- D. Drain Pan Construction:
  - 1. Provide cooling coil sections with an insulated, double wall, galvanized steel drain pan complying with ASHRAE Std 62.1 for indoor air quality and sufficiently sized to collect all condensate.
  - 2. Slope in two planes to promote positive drainage and eliminate stagnate water conditions.
  - 3. Locate outlet of sufficient diameter at lowest point of pan to prevent overflow at normal operating conditions.
  - 4. Provide threaded drain connections constructed of drain pan material, extended sufficient distance beyond the base to accommodate field installed, condensate drain trapping.

### **2.02 CASING**

- A. Finish:
  - 1. Indoor Units:
    - a. Provide exterior, galvanized steel panels without paint.
- B. Left-Hand or Right-Hand coil and access panels. See Air Handler Schedule for required orientation.

### **2.03 FANS**

- A. Fan Type
  - 1. Single-width, single-inlet, direct-drive plenum fan.
  - 2. Selected for stable operation and optimum energy efficiency.
- B. Bearings
  - 1. Minimum L-10 bearing life of 250,000 hours.
- C. Balancing and Resonance
  - 1. Fans shall be dynamically balanced at design RPM.
  - 2. Fans shall be factory tested from 25% to 100% of design RPM.
  - 3. Fans shall operate within manufacturer vibration tolerances throughout full speed range.
  - 4. Systems requiring programmed VFD skip frequencies to avoid resonant conditions shall not be acceptable.
- D. Shaft Grounding
  - 1. Provide maintenance-free shaft grounding device to prevent bearing damage from induced shaft currents.

- E. Sound
  - 1. Provide AMCA 301 certified sound ratings.

#### **2.04 COILS**

- A. Casing: Provide access to both sides of coils. Enclose coils with headers and return bends exposed outside casing. Slide coils into casing through removable access panel .
- B. Water Heating Coils:
  - 1. Headers: Cast iron, seamless copper tube, or prime coated steel pipe with brazed joints.
  - 2. Configuration: Drainable, with threaded plugs for drain and vent; serpentine type with return bends on smaller sizes and return headers on larger sizes.
- C. Factory Testing
  - 1. Coils shall be factory proof-tested at minimum 300 psig.
  - 2. Coils shall be leak-tested under water at minimum 200 psig.
  - 3. Provide AHRI 410 certified ratings for capacity and pressure drop.
- D. Connections
  - 1. Provide steel pipe male connections.
  - 2. Connections shall be stubbed within the unit casing or coil tunnel unless otherwise indicated.
  - 3. Piping contractor shall extend connections beyond unit.

#### **2.05 FILTER AND AIR CLEANER SECTION**

- A. General: Provide filter sections with filter racks, minimum of one access door for filter removal, and filter block-offs to prevent air bypass.
- B. Throwaway Filters:
  - 1. Media: 2 inch (50 mm) fiberglass with rigid supporting mesh across the leaving face, capable of operating up to a maximum of 500 fpm (2.54 m/s) without loss of efficiency and holding capacity.
  - 2. Frame: Rigid.
  - 3. Minimum Efficiency Reporting Value: MERV 13 when tested in accordance with ASHRAE Std 52.2.
- C. Differential Pressure Gauge:
  - 1. Provide factory installed dial type differential pressure gauge, flush mounted with casing outer wall, and fully piped to both sides of each filter to indicate status.
  - 2. Maintain plus/minus 5 percent accuracy within operating limits of 20 degrees F (minus 6.7 degrees C) to 120 degrees F (48.9 degrees C).

#### **2.06 DAMPER SECTION**

- A. Mixing Section: Provide a functional section to support the damper assembly for modulating the volume of outdoor, return, and exhaust air.
- B. Outdoor air damper, 100% fresh air.
- C. Damper Blades:
  - 1. Double-skin airfoil design with metal, compressible jamb seals and extruded-vinyl blade-edge seals on each blade.
  - 2. Self-lubricating stainless steel or synthetic sleeve bearings.
  - 3. Comply with ASHRAE Std 90.1 I-P for rated maximum leakage rate.
  - 4. Provide leakage testing and pressure ratings in compliance with AMCA 500-D test methods.
  - 5. Arrange in parallel or opposed-blade configuration.

#### **2.07 TOTAL ENERGY RECOVERY WHEEL SECTION**

- A. Certified in accordance with AHRI 1060 (I-P) and UL 1812 for mechanical, electrical, and fire safety.

- B. Wheel Construction:
  - 1. Dessicant Properties:
    - a. Factory coated.
    - b. Washable using standard detergent or alkaline based coil cleaner.
    - c. Resistant to high levels of humidity.
  - 2. Factory set adjustable diameter seals and self-adjusting perimeter seals.
  - 3. Permanently sealed and lubricated wheel bearings.
  - 4. Motor:
    - a. Thermally protected.
    - b. Factory mounted.
- C. Maintenance and Access Features:
  - 1. Access doors upstream and downstream of the wheel cassette.
  - 2. Removable wheel segments to facilitate maintenance and cleaning.
  - 3. Adequate space for cleaning, service, and maintenance.
- D. Controls:
  - 1. Wheel Control: Damper control of recovery capacity to 40 percent of initial total recovery capacity.

## **2.08 ACCESS SECTION**

- A. Provide where indicated on drawings to allow for inspection, cleaning, and maintenance of field-installed components.
- B. Construct access doors same as previously specified within this Section.

## **2.09 CONTROLS**

- A. Combination VFD - Disconnects:
  - 1. Provide factory mounted, combination VFD - disconnect for each fan motor.
  - 2. Single VFD shall serve fan array unless otherwise indicated.
  - 3. Compliance
    - a. VFD assembly shall comply with UL 508A.
    - b. Provide minimum SCCR rating equal to or greater than available fault current at installation location.
    - c. Installation shall comply with NEC.
  - 4. Enclosure
    - a. NEMA Type 1 unless otherwise indicated.
    - b. Externally mounted on fan section.
  - 5. Disconnect
    - a. Circuit breaker type with through-the-door interlocking handle.
    - b. Lockable in OFF position.
  - 6. VFD Functional Requirements
    - a. Electronic manual speed control.
    - b. Hand-Off-Auto selector.
    - c. Inlet short circuit protection.
    - d. Current limited stall prevention.
    - e. Automatic restart after momentary power loss.
    - f. Speed search for starting into rotating motor.
    - g. Manual motor protection.
  - 7. Operation
    - a. VFD programming shall not rely on skip-frequency lockout to correct system resonance.
    - b. Single-width, single-inlet, direct-drive plenum fan.
    - c. Selected for stable operation and optimum energy efficiency.
- 8. B. Bearings
  - a. Minimum L-10 bearing life of 250,000 hours.

- B. Factory Installed Direct Digital Control (DDC) System:
1. Factory engineer and test each component.
  2. General
    - a. Provide factory-installed, unit-mounted DDC controls capable of standalone operation.
    - b. System shall be fully functional for safe and reliable unit operation without connection to a building automation system.
    - c. All sensors, actuators, safeties, and end devices shall be factory mounted and wired to unit controller.
  3. Controller
    - a. Provide dedicated, field-programmable DDC controller.
  4. Controller shall have sufficient I/O capacity for all unit devices plus minimum 10 percent spare capacity.
    - a. Provide open communication protocol:
      - 1) a. Native BACnet MS/TP or BACnet/IP.
      - 2) b. No proprietary gateways required.
      - 3) c. No recurring license fees for point access.
    - b. All points shall be available to future BAS including:
      - 1) a. Monitoring points.
      - 2) b. Alarm points.
      - 3) c. Commandable setpoints.
  5. Local Interface
    - a. Provide local user interface via onboard display or portable interface device.
    - b. Allow monitoring, troubleshooting, and setpoint adjustment.
    - c. Interface shall not require proprietary software unavailable to Owner.
  6. End Devices (BAS-Ready)
    - a. Provide the following factory-installed and wired:
      - 1) Mixing dampers with spring return actuators:
        - (a) a. Outdoor air damper – normally closed.
        - (b) b. Return air damper – normally open.
    - b. Airflow measurement station:
      - 1) a. 2–10 VDC output proportional to airflow.
    - c. Supply air temperature sensor and averaging sensors as required.
    - d. Low limit freeze protection switches:
      - 1) a. Manual reset.
      - 2) b. Separate device for each coil bank.
    - e. Differential pressure switches:
      - 1) a. Across filters for dirty filter indication.
      - 2) b. Across fan or airflow proving device for fan status.
    - f. Condensate overflow switch:
      - 1) a. UL 508 compliant.
      - 2) b. Factory installed float switch.
      - 3) c. Shut down unit upon high water detection.
  7. Future BAS Integration
    - a. Provide isolated dry contacts for:
      - 1) a. Fan start/stop command.
      - 2) b. General alarm.
    - b. Provide BACnet point list during submittal.
    - c. Provide wiring diagrams identifying all control points.
  8. Field-Installed Devices
    - a. Factory provide and ship loose for field installation:
      - 1) Control valves.
      - 2) Space temperature sensors.

- 3) Outdoor air temperature sensors.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. If provided in section, bolt sections together with gaskets.
- C. Install flexible duct connections between fan inlet and discharge ductwork and air handling unit sections. Ensure that metal bands of connectors are parallel with minimum one inch (25 mm) flex between ductwork and fan while running.
- D. Make connections to coils with unions or flanges.
- E. Hydronic Coils:
  - 1. Hydronic Coils: Connect water supply to leaving air side of coil (counterflow arrangement).
  - 2. Provide shut-off valve on supply line and lockshield balancing valve with memory stop on return line.
  - 3. Locate water supply at bottom of supply header and return water connection at top.
  - 4. Provide manual air vents at high points complete with stop valve.
  - 5. Ensure water coils are drainable and provide drain connection at low points.
- F. Provide field wiring between unit-mounted controller and field-installed devices in accordance with manufacturer wiring diagrams.

### **3.02 SYSTEM STARTUP**

- A. Provide manufacturer's field representative to perform systems startup.
- B. Prepare and start equipment and systems in accordance with manufacturers' instructions and recommendations.
- C. Adjust for proper operation within manufacturer's published tolerances.

### **3.03 CLOSEOUT ACTIVITIES**

- A. Demonstrate proper operation of equipment to Owner's designated representative.
- B. Demonstration: Demonstrate operation of system to Owner's personnel.
  - 1. Use operation and maintenance data as reference during demonstration.
  - 2. Briefly describe function, operation, and maintenance of each component.
- C. Training: Train Owner's personnel on operation and maintenance of system.
  - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
  - 2. Provide minimum of two hours of training.
  - 3. Location: At project site.

**END OF SECTION**

**SECTION 26 00 00**  
**ELECTRICAL GENERAL PROVISIONS**

**PART 1 GENERAL**

**1.01 DESCRIPTION OF WORK:**

- A. Work included in this Division consists of providing all demolition, labor, materials, equipment, tools, supervision, start-up services, Owner's instructions, including all incidental and related items necessary to complete installation, and successfully test, start up and operate building in a practical and efficient manner. Electrical Systems indicated on Drawings and described in each Section of Division 26 Specification and conforming with all Contract Documents.
- B. Work not included under this Division:
  - 1. Low voltage temperature control wiring. Refer to Part 2, Paragraph 2.03 of this Section.
  - 2. Field painting of equipment, except for repair to damaged factory finishes.
- C. The General Provisions of this Contract, including General and Supplementary Conditions and other General Requirements Sections, apply to the Work specified in this Section.
- D. This Section is not intended to supersede, but to clarify, the definitions in Division 1, General Requirements and Supplementary Conditions.
- E. The Contractor shall coordinate directly with the Owner and the General Contractor to complete the necessary documentation for eligible energy rebates from Cloverland Electric Cooperative as a result of this project.

**1.02 DRAWINGS AND SPECIFICATIONS:**

- A. Drawings are diagrammatic and indicate general arrangement of systems and work included in Contract, and shall serve only as design drawings, and not as working drawings, for general layout of various equipment and systems.
- B. Drawings and Specifications are intended to supplement each other, and all work specified or indicated in either shall be provided. Should drawings disagree in themselves or with Specifications, the better quality or greater quantity of work shall be provided.
- C. Drawings and Specifications are intended to include all work and materials necessary for completion of the work. Any incidental item of material, labor or detail required for the proper execution and completion of the work and omitted from either the drawings and specifications or both, but required by governing codes local regulations, trade practices, operational functions, and good workmanship, shall be provided as part of the Contract Work without extra charge, even though not specifically detailed or specified.

**1.03 SITE AND PROJECT DOCUMENT EXAMINATION:**

- A. Submission of a proposal is considered evidence the Contractor has visited site, examined Drawings and Specifications of all trades including Architectural, Structural and Mechanical, and fully informed himself with all project and site conditions, and is proficient, experienced and knowledgeable of all standards, codes, ordinances, permits and regulations which affect his respective trade, and that all costs are included in his proposal.
- B. The Electrical Contractor and/or Sub-Contractor shall insure all required permits, and assessments have been obtained prior to any work beginning. Contractor shall verify requirement to include privilege fees, plan review fees, and permits as part of his formal bid.

**1.04 STANDARDS, CODES AND PERMITS:**

- A. Refer to Division 1, General Requirements and Supplementary Conditions.
- B. All work under Electrical Sections shall comply with latest edition of applicable standards and codes of the following, including local codes and variances:
  - 1. NECA - Standards for Installation
  - 2. NFPA - National Fire Protection Association
  - 3. NEC - Latest edition of NFPA 70
  - 4. UL - Underwriter's Laboratories

5. NEMA - National Electric Manufacturers Association
  6. NESC - National Electric Safety Code (H13)
  7. OSHA - Occupational Safety and Health Act
  8. IEEE - Institute of Electrical and Electronics Engineers
- C. All work shall be provided and tested in accordance with all applicable local, county, state laws, ordinances, code rules and regulations, including Michigan Department of Labor, General Rules, Part 8-Electrical Code Rules.
- D. No work shall be covered or enclosed until work is tested in accordance with applicable codes and regulations, and successful tests witnessed and approved by authorized inspection authority. Written approvals shall be secured by Contractor and submitted to Engineer before final acceptance of work.

#### **1.05 SUBMITTALS:**

- A. Proposal Supplement:
1. Contractor to submit one (1) copy of Proposal Supplement - SECTION 26 00 10 - ELECTRICAL EQUIPMENT AND MATERIALS, at the time of Bid opening, listing the manufacturers upon which his bid was based, including all items being provided by Sub-Contractors.
  2. After Proposal Supplement and Sub-Contractors are approved, no deviation shall be permitted without written approval of Engineer.
- B. Shop Drawings:
1. Submit nine (9) hard copies or one (1) electronic set of shop drawings on all equipment and materials indicated in the specifications or on drawings.
  2. At the time of submittal for review by the Engineer, shop drawings shall include signatures or stamps indicating that the Contractor and/or the Sub-Contractor has reviewed the submittals and has coordinated the required space, quantities required, services and work of other trades for the equipment or system being submitted.
  3. Submittals shall be in the form of bound folders with the name of the Project, Architect, Engineer and the submitting Contractor indicated on the cover. Submittals requiring drawings too large to be bound into the folder shall be folded and inserted in pockets bound into the folder.
  4. Submit complete manufacturer's shop drawings of all equipment, accessories and controls, including dimensions, weights, capacities, construction details, installation, controls, wiring diagrams, and motor data.
  5. Engineer's approval of show drawings is for general application only and is a service only and not considered as a guarantee of total compliance with or as relieving Contractor of basic responsibilities under all Contract Documents, and does not approve changes in quantities, time or cost.
  6. After approval, each Contractor is responsible to provide information to all other trades involved in, or affected by, installation of his equipment and work.
- C. Operating and Maintenance Instructions and Manuals:
1. Electrical Contractor shall provide for all items of equipment three (3) bound and indexed sets of operating/installation and maintenance instructions to Engineer for approval. After approval, manuals will be given to Owner by the Engineer.
  2. Manuals shall include a complete set of shop drawings submitted, indexed with tabs for each section.

#### **1.06 ELECTRICAL SERVICE REQUIREMENTS:**

- A. Permanent Electrical Service:
1. The Electrical Contractor is to verify with the Electric Utility Company the electrical system amperage, voltage and phase and report any variations from what is indicated on the drawings to the Engineer. Electrical Contractor is to obtain written varification of the available symmetrical and asymmetrical RMS fault current from the Electrical Utility Company.

2. The Electrical Contractor shall select the over current protection devices and coordinate with the existing fault current.
3. The existing electrical service(s) are to remain.

## **PART 2 PRODUCTS**

### **2.01 STANDARDS:**

- A. All products shall be of established manufacturers regularly engaged in making type of materials to be provided and complete with all parts, accessories, trimmings, connections, etc. as specified in detail or as described in manufacturer's catalog.
- B. All material shall be labeled or listed by Underwriter's Laboratories, Inc. Assembled electrical equipment supplied to the job site shall be listed or labeled and/or approved by the authority having jurisdiction.

### **2.02 SUBSTITUTION AND CHANGES:**

- A. Contractor and/or Equipment Supplier may propose alternate equipment or materials of EQUAL or better quality, function, performance, durability and appearance. This information is to be submitted to the Engineer's Office ten (10) working days prior to bid due date to allow for proper review time and to issue an addendum incorporating the acceptable substitution(s). It is the submitter's responsibility to provide sufficient material for review as required by Engineer's Office. Acceptance and approval is the responsibility of the Engineer.
- B. Contractor and/or Equipment Supplier is liable for any added costs to himself or others and is responsible for verifying dimensions, clearance and roughing-in requirements, when product not named as the basis of design are used and is responsible for advising other Contractors of variations and submit revised drawing layout for approval of Engineer.
- C. See Section 26 00 10 for voluntary alternates.
  1. No substitutions will be accepted after bids are received. The lighting or electrical equipment specified herein has been carefully chosen for it's ability to meet the luminous performance and/or design criteria of this project. Substitutions in all likelihood will be unable to meet all of the same requirements as the specified equipment.
  2. When only one manufacturer is listed within the description of the luminaire or electrical equipment, the design engineering or architectural aesthetics will not allow substitution of other manufacturer.
  3. When two or more manufacturers are listed within the description of the luminaire or electrical equipment, the Contractor may elect to submit to the Engineer a substitute fixture for review. All submittals must follow paragraph 2.02.A of this section.
  4. Substitution submittals shall consist of a physical description, dimensioned drawing and complete photometric and electric data of the proposed lamp, luminaire or electrical equipment. Working samples may be requested and shall be supplied to the Engineer for a visual check of finish and operating characteristics.
  5. Contractor will be responsible for ALL costs (engineering time, manufacturer's costs, distributor costs, etc.) incurred to replace equipment not approved if substitutions are made by the distributor, manufacturer's rep., contractor or subcontractor.

### **2.03 EQUIPMENT REQUIREMENTS AND CONNECTIONS:**

- A. Motor Starters and Controls:
  1. Electrical Contractor shall provide all manual or magnetic motor starters and combination motor starter disconnects as required for all motors as indicated on all Electrical Drawings.
  2. Mechanical Contractor shall provide factory installed motor starters integral with packaged equipment containing thermal overcurrent protection in all underground conductors with heater coils selected for specific motor usage for all motors.
- B. Electrical Wiring and Controls:
  1. Mechanical Contractor shall furnish and install all motors, drives, and controllers integral to equipment and factory-mounted controls for all mechanical equipment.



2. Mechanical Contractor or Temperature Control Contractor shall furnish and install all electrical devices requiring mechanical connections, and/or electrical connections, such as pressure switches, limit switches, float switches, solenoid valves, motor operated valves, motor operated dampers, fire stats, freeze stats, thermostats, override timers, E.P.'s, P.E.'s, temperature control cabinet, air compressor with starter, etc.
3. Temperature Control Contractor or Mechanical Contractor shall furnish and install all power and Class 2 and 3 wiring, conduit, boxes for their association equipment in 2.03, B, 2.
4. Electrical Contractor shall install all power wiring, conduit to motors and/or factory mounted control panels as indicated on Electrical Drawings or as indicated in Specifications.
5. All electrical wiring work by Mechanical Contractor and Temperature Control Contractor shall be in accordance with Division 26 requirements.

## **PART 3 EXECUTION**

### **3.01 COORDINATION OF ELECTRICAL WORK:**

- A. The Electrical Contractor shall be responsible for all Sub-Contractors and Suppliers, and include in his bid all materials, labor and equipment involved in accordance with all local customs, rules, regulations, jurisdictional awards, decisions and secure compliance of all parts of the Specifications and Drawings regardless of Sectional inclusion in these Specifications.
- B. The Electrical Contractor and Sub-Contractor shall be responsible for all parts applicable to his trade in accordance with the Specifications and Drawings, and shall be responsible for coordinating locations and arrangements of his work with all other relevant Mechanical, Architectural, Structural and Electrical Contractor's Specifications, Drawings and Shop Drawings.

### **3.02 EQUIPMENT CLEARANCE:**

- A. Electrical Contractor to coordinate with the Mechanical Contractor's equipment location to insure adequate clearance is maintained as required by the National Electrical Code and applicable state and local codes, as well as accessibility for future maintenance and operation.
- B. Electrical work shall be arranged with building construction to provide minimum 6'-8" overhead clearance where possible.

### **3.03 WALL, FLOOR AND CEILING OPENINGS:**

- A. Locate all openings and advise the General Contractor of details and templates of all openings necessary for inspection of electrical work.
- B. In general, openings and required lintels shall be provided through the General Contractor. Size and location is the responsibility of this Contractor. Cracks and rough edges left following installation of equipment shall be caulked or covered by Electrical Contractor.
- C. Perform or pay for all cutting, fitting, repairing, patching and finishing of work of other sections where it is necessary to disturb such work to permit installation of electrical work.
  1. Repair or replace existing or new work disturbed.

### **3.04 FIELD CHANGES:**

- A. The Contractor shall not make any field changes that affect timing, costs or performance without written approval from the Architect/Engineer in the form of a Change Order, Field Change Order or a Supplemental Instruction. The Contractor assumes liability for any additional costs for changes made without such instruction or approval. Should any unauthorized change be determined by the Architect/Engineer as lessening the value of the project, a credit will be determined and issued as a change to the Contract.

### **3.05 PROJECT CLOSEOUT:**

- A. Final Acceptance and payment will only be made after final punchlist completion and receipt at the Engineer's Office of:
  1. All Guarantees/Warranties

2. Operating and Maintenance Instruction Manuals
3. Record Drawings (As Built)
4. Certificates of Inspection
5. Test Reports
6. Lamps and ballasts.

**3.06 CERTIFICATES OF INSPECTION AND TEST REPORTS:**

- A. Submit to the Engineer's Office evidence that installation has been inspected and approved by local or state electrical inspector and/or the authority having jurisdiction.

**3.07 GUARANTEES AND WARRANTIES:**

- A. At the end of a one year period of continuous operation, make a complete inspection of all systems, fixtures, equipment, safety devices and controls to insure equipment is operating properly, and report to Engineer in writing.

**3.08 RECORD DRAWINGS:**

- A. Maintain a white-print set of Electrical Contract Drawings in clean, undamaged condition for markup of actual installation on Electrical Contract Drawings which vary substantially from the work as shown. These drawings are to be available for inspection by the Engineer on a weekly basis. Drawings shall indicate at a minimum the routing of all conduits over 2" on size, revised circuiting, revised panel schedules, emergency lighting controller (EPCs, BLTCs, etc.) locations, and addendum, bulletin and field changes.

**3.09 OPERATING AND MAINTENANCE INSTRUCTIONS:**

- A. Provide instruction of Owner's personnel in operation and maintenance procedures for all systems equipment.
- B. Provide 3 - bound & tabbed sets of operating & maintenance instruction manuals for all electrical equipment

**3.10 PLACING SYSTEMS INTO OPERATION:**

- A. Electrical Contractor shall be responsible for all startup procedures, system checks and balancing associated with his equipment.
- B. All equipment shall be installed, tested and operated in accordance with manufacturer's recommendations at normal operating conditions.
- C. When reconnecting existing circuits to new panels, individually turn on each circuit while using a current indicating meter on the equipment grounding conductor. This is to check the individual branch circuits' current flow on the E.G.C.. If current flow is found on the E.G.C., investigate the circuit to find why this current flow exists (parallel neutral path, conduit with no E.G.C., etc.), and notify the Owner/Architect/Engineer of this problem to be properly addressed in a bulletin.
- D. All permanent electrical equipment operated during construction periods shall be cleaned and damaged equipment replaced.

**3.11 ADJUSTMENTS AND BALANCING:**

- A. Contractor shall make all necessary adjustments to equipment installed or connected by him under this contract so as to insure proper operation of the same.

**3.12 GUARANTEES AND WARRANTIES:**

- A. All labor, materials and equipment shall be guaranteed by Contractor and/or warranted by Manufacturer for one year after acceptance date and/or one normal continuous complete seasons operation applicable to equipment or system except where specified longer for special equipment. Contractor shall secure such warranty from all Suppliers (not one year from shipment date), or Contractor to assume warranty.
- B. Acceptance date of substantial completion shall be Owner occupancy as determined by Architect/Engineer.

- C. Contractor shall make all necessary alterations, repairs, adjustments, replacements during guarantee periods as directed by Architect/Engineer to comply with Drawings and Specifications at no cost to Owner.
- D. Repair or replacements made under guarantee bear further one year guarantee from date of acceptance of repair or replacement.

**3.13 IDENTIFICATION:**

- A. All service switches, motor disconnects, controllers, etc., whether or not furnished under this Division shall be marked to identify the equipment served and the origin of the power source. Distribution panels, branch panels and switchboards shall be identified as to the designation indication on the Contract Drawings and voltage characteristics. Individual switches in Distribution Panels and Switchboards shall be identified as to equipment being fed.
- B. All identification shall be done with engraved 2-ply lamacoid plates with ¼" white lettering on a black background. "Dymo" or tape markers ARE NOT acceptable.
- C. Concisely and clearly type out all branch panel schedules indicating room or area served along with the item(s) connected to each circuit.
- D. See Electrical Drawing Detail for additional identification requirements.

**3.14 TRAINING:**

- A. The option of video taping any and all training sessions shall be given to the Owner at no additional cost, with the Contractor conducting the video taping and with two (2) copies of all tapes being turned over to the Owner for future use.
- B. E.C. shall conduct 1 - 4 hour training session on the operation and controls of all electrical equipment. Notify owner 72 hours prior to session.
- C. E.C. shall conduct 1 - 2 hr training sessions on the operation & control of the Fire Alarm System. Notify owner 72 hours prior to session.
- D. E. C. shall conduct 1 - 2 hr. training session on the operation & control of the lighting control systems, which includes the occupancy sensors, the over-ride switches, and the lighting control panels. Notify owner 72 hours prior to session.

**END OF SECTION**

**SECTION 26 00 10  
ELECTRICAL EQUIPMENT AND MATERIALS**

**PART 1 GENERAL**

**1.01 INSTRUCTION:**

- A. The Electrical Contractor is to either copy or remove this specification section from the spec book and complete as follows:
  - 1. Indicate the specific manufacturer on which the bidder's base bid price is based in the blank space provided.
  - 2. All equipment is to be bid as specified. Material or equipment from another manufacturer may be bid as a Voluntary Alternate, but the dollar amount must be shown as an "Add" or "Deduct" to the base bid. Provide the name of the alternate manufacturer in the space provided.
  - 3. Insert the name(s) of each subcontractor used in your bid in the space provided in Part 3.
  - 4. This form shall be submitted with the bid.

**1.02 RELATED DOCUMENTS:**

- A. The other Contract Documents complement the requirements of this Section. The General Requirements apply to the work of this section.

**1.03 DEVIATIONS FROM SPECIFIED MATERIAL:**

- A. See Section 26 00 00, Part 2, Paragraph 2.02 - Substitutions and Changes. Base bid shall be based on manufacturers listed in this specification or on the drawings.

**PART 2 PRODUCTS**

**2.01 THE FOLLOWING IS A LIST OF APPROVED MANUFACTURERS, GROUPED ACCORDING TO TYPES OF MATERIALS OR EQUIPMENT.**

- A. Wiring Devices:
  - 1. Legrand, Pass & Seymour, Hubbell, Leviton, and Cooper
    - a. Voluntary alternate \_\_\_\_\_
    - b. Add \$ \_\_\_\_\_ Deduct \$ \_\_\_\_\_
- B. Distribution and Branch Panelboards and Circuit Breakers:
  - 1. Square D, EATON/Cutler-Hammer (BASIS OF DESIGN), and ABB/General Electric
    - a. Voluntary alternate \_\_\_\_\_
    - b. Add \$ \_\_\_\_\_ Deduct \$ \_\_\_\_\_
- C. Safety Switches and Circuit Breakers:
  - 1. Square D, EATON/Cutler-Hammer (BASIS OF DESIGN), and ABB/General Electric
    - a. Voluntary alternate \_\_\_\_\_
    - b. Add \$ \_\_\_\_\_ Deduct \$ \_\_\_\_\_
- D. Motor Controls & Motor Control Center:
  - 1. Square D, EATON/Cutler-Hammer (BASIS OF DESIGN), Rockwell Automation/Allen-Bradley, and ABB/General Electric
    - a. Voluntary alternate \_\_\_\_\_
    - b. Add \$ \_\_\_\_\_ Deduct \$ \_\_\_\_\_
- E. Dry Type and/or Buck/Boost Transformers:
  - 1. Square D, EATON/Cutler-Hammer (BASIS OF DESIGN), and ABB/General Electric
    - a. Voluntary alternate \_\_\_\_\_
    - b. Add \$ \_\_\_\_\_ Deduct \$ \_\_\_\_\_
- F. Fire Alarm System
  - 1. Edwards
    - a. Voluntary alternate \_\_\_\_\_
    - b. Add \$ \_\_\_\_\_ Deduct \$ \_\_\_\_\_

- G. Emergency Lighting Inverter (INV-1)
1. Myers (Basis of Design) and Evenlite
    - a. Voluntary alternate \_\_\_\_\_
    - b. Add \$ \_\_\_\_\_ Deduct \$ \_\_\_\_\_
- H. Lighting Controls Systems
1. Cooper Lighting Controls Wavelinx Wireless (Basis of Design) and nLightAir
    - a. Voluntary alternate \_\_\_\_\_
    - b. Add \$ \_\_\_\_\_ Deduct \$ \_\_\_\_\_
- I. Lighting Fixtures:
1. Tag A series: Lithonia and Cooper (Basis of Design)
    - a. Voluntary alternate \_\_\_\_\_ Add \$ \_\_\_\_\_ Deduct \$ \_\_\_\_\_
  2. Tag B series: Not Used
    - a. Voluntary alternate \_\_\_\_\_ Add \$ \_\_\_\_\_ Deduct \$ \_\_\_\_\_
  3. Tag C series: Cooper-Fail-Safe (Basis of Design) and Kenall
    - a. Voluntary alternate \_\_\_\_\_ Add \$ \_\_\_\_\_ Deduct \$ \_\_\_\_\_
  4. Tag D series: Not Used
    - a. Voluntary alternate \_\_\_\_\_ Add \$ \_\_\_\_\_ Deduct \$ \_\_\_\_\_
  5. Tag EX series: Isolite (Basis of Design) and Evenlite
    - a. Voluntary alternate \_\_\_\_\_ Add \$ \_\_\_\_\_ Deduct \$ \_\_\_\_\_
  6. Tag F series: Cooper (Basis of Design)
    - a. Voluntary alternate \_\_\_\_\_ Add \$ \_\_\_\_\_ Deduct \$ \_\_\_\_\_
  7. Tag G series: Lithonia and Cooper (Basis of Design)
  8. Tag J series: LUXdynamics (Basis of Design)
    - a. Voluntary alternate \_\_\_\_\_ Add \$ \_\_\_\_\_ Deduct \$ \_\_\_\_\_

### **PART 3 SUBCONTRACTORS**

#### **3.01 INSERT THE NAME OF EACH SUBCONTRACTOR AND WORK TO BE PERFORMED BELOW:**

- A. Subcontractor \_\_\_\_\_  
Work Performed \_\_\_\_\_
- B. Subcontractor \_\_\_\_\_  
Work Performed \_\_\_\_\_
- C. Subcontractor \_\_\_\_\_  
Work Performed \_\_\_\_\_

**END OF SECTION**

**SECTION 26 00 50**  
**BASIC MATERIALS AND METHODS**

**PART 1 GENERAL**

**1.01 MATERIALS:**

- A. All materials and equipment furnished for installation on this project shall be new and in strict accordance with Contract Documents. All packaged materials shall be delivered in their original containers which shall show the manufacturer's name and the identifying designations as to size, quality, etc. Materials delivered to the project unmarked or mutilated packages will be ordered to be removed from the site at once. Materials or equipment judged as "damaged" by the Architect/Engineer shall be removed from the project and site.
- B. Should any dispute arise to the quality of any material, the decision shall rest entirely with the Architect/Engineer and shall be based on the requirement that all materials furnished shall be first class in every respect, and what is usual or customary in erecting other buildings shall in no way enter into the consideration or decision whatever as it pertains to the project under consideration.
- C. All materials and equipment furnished under work of all Division 26 sections shall be UL approved and listed, and shall bear the Underwriter's Label.

**1.02 SUBMITTALS:**

- A. Submit shop drawings for the following: (See 26 00 00 1.05 B 1 thru 6)
  - 1. Wiring devices.
  - 2. Motor starters/contactors.
  - 3. Branch circuit panelboards & circuit breakers.
  - 4. Distribution panelboards & circuit breakers.
  - 5. Safety switches / breakers.
  - 6. Motor Control Center.
  - 7. Dry-type transformers.
  - 8. Indoor and outdoor light fixtures (See 26 51 00 1.03 A thru D).
  - 9. Lighting Controls.
  - 10. Emergency Lighting Inverters.
  - 11. Fire Alarm System.

**PART 2 PRODUCTS**

**2.01 RACEWAYS:**

- A. Aluminum conduit is not acceptable in this Contract.
- B. Rigid Metal Conduit:
  - 1. Rigid metal conduit shall be hot dipped galvanized steel, meeting Federal Standard WW-C-581.
  - 2. Threaded fittings shall be used on rigid metal conduit.
- C. Electric Metallic Tubing:
  - 1. Electrical metallic tubing shall be standard weight, meeting Federal Standard WW-C-563 and bear the manufacturer's name and Underwriter's Label on each length. Maximum permissible size tubing shall be 4".
  - 2. Provide compression-type steel fittings or set screw-type steel fittings. Crimp-type connectors are not acceptable.
- D. Flexible Metal Conduit:
  - 1. Flexible metallic conduit shall meet Federal Standard WW-C-566 and is to have separate grounding conductor. Minimum permissible size shall be 1/2".
  - 2. Fittings shall be malleable iron, threaded type.

- E. Liquid-Tight Flexible Metal Conduit:
  - 1. Liquid-tight flexible metal conduit shall be single strip, flexible, continuous, interlocked, and double-wrapped steel. It shall be galvanized inside and outside, with a liquid-tight jacket of flexible polyvinyl chloride (PVC). Minimum permissible size shall be 1/2".
  - 2. Connectors shall be insulated throat, malleable iron.
- F. Liquid-Tight Flexible Non-Metallic Conduit:
  - 1. Liquid-tight flexible non-metallic conduit shall be single strip, flexible polyvinyl chloride (PVC). Minimum permissible size shall be 1/2".
  - 2. Connectors shall be non-metallic (PVC) compression type UL labeled and listed to be used on liquid-tight flexible non-metallic conduit.
- G. Rigid Non-Metallic Conduit:
  - 1. Rigid non-metallic conduit (PVC) shall be Schedule 40, rigid heavy wall polyvinyl chloride, 90 degrees C., UL rated.
  - 2. Fittings shall be solvent weld type of the same material as the conduit.
  - 3. All 45 degree bends or greater shall be made with rigid metal conduit fittings.
- H. Surface Metal Raceways:
  - 1. Exposed raceways noted on drawings as "Wiremold" shall be equal to Wiremold Series 700 or 4000 as required or as shown on drawings. Provide required anchors, fittings and outlet boxes as required. Outlet boxes shall be Wiremold #5748 or as shown on drawings.
- I. Metal-Clad Cable:
  - 1. Metal-clad cable shall be U.L. labeled and have a smooth, weld or corrugated metallic sheath. Type MC cable shall provide an adequate path for equipment grounding as required by N.E.C.
  - 2. All fitting shall be of the same metallic composition as cable and U.L. labeled for use on cable.

## **2.02 WIRE AND CABLE:**

- A. All wiring shall be copper and shall be installed in conduit or tubing unless specified otherwise.
- B. All wire shall be new and in the original cartons or on manufacturer's shipping reels.
- C. No wire smaller than #14 may be used unless specified under descriptions of special systems. Wire #14 and larger shall be stranded.
- D. All branch circuit wiring shall be color coded black, red, blue, phases and white neutral for 120/208v, 3 phase, 4 wire system and brown, orange, yellow and white stripped neutral for 277/480v, 3 phase, 4 wire system. All grounding / bonding conductors shall be green or bare. Phase color consistent throughout the entire branch circuit system.
- E. All neutral runs including feeders shall be white full length of conductor or identified per NEC.
- F. Select from the following wire types to comply with the project's installation requirements and NEC standards.
  - 1. Type THHN/THWN rated installation. 600 volt, 90 degrees C., in conduit, stranded copper, size No. 14 AWG up to and including No. 10 AWG.
  - 2. Type THWN-2 rated insulation, 600 volt, 90 degrees C., in conduit, stranded copper, size No. 8 AWG up to No. 750 MCM AWG.
- G. Select from the following cable types to comply with the project's installation requirements and NEC standards.
  - 1. Metal-Clad Cable: Type MC. Use in existing concealed locations only. (above ceilings, in walls etc.) Not to be used in new construction. Maximum length of six (6) feet.
  - 2. Armored Cable: Type AC. Use in existing concealed location only. (above ceilings, in walls etc.) Not to be used in new construction. Maximum length of six (6) feet.

### **2.03 WIRE CONNECTORS AND JOINTS:**

- A. All conductors #8 AWG and smaller shall be joined with electrical spring connectors with vinyl insulating cap. Conductors larger than #8 shall be joined by compression type connectors.

### **2.04 OUTLET BOXES:**

- A. Ceiling outlet boxes shall be 4" octagon, 2 1/8" deep, with fixture hickey, and supported to withstand 50 pounds.
- B. Convenience outlet and switch boxes shall be a minimum 4"sq. x 2 1/8" deep with 1 or 2 gang, 2" deep plaster ring. When installed in poured walls, 3 1/8" minimum deep masonry box shall be used; when installed in masonry blocks, minimum 4"sq. x 2 1/8" deep with 1 or 2 gang, 2" deep plaster ring shall be used.
- C. Ceiling paddle fans outlet boxes shall U.L. labeled and listed for paddle fans use and be capable of supporting paddle fan.

### **2.05 JUNCTION BOXES AND PULL BOXES:**

- A. When used, pull boxes and junction boxes shall be galvanized and have flat steel covers fastened with screws and set flush with the finished surface and located in an accessible area. When installed in damp locations, gaskets and seals shall be provided. Junction boxes shall be sized to meet N.E.C. Standards based on conduit and conductors. Provide identifying labels on each box.

### **2.06 WIRING DEVICES:**

- A. Receptacles:
  - 1. Receptacles shall be commercial specification grade and TAMPER RESISTANT.
    - a. 20 Amp, 125 Volt, duplex, ground fault, tamper resistant, weatherproof (NEMA 5-20R).
    - b. 20 Amp, 125 Volt, duplex, ground fault, tamper resistant (NEMA 5-20R).
    - c. 20 Amp, 125 Volt, duplex, tamper resistant (NEMA 5-20R).
    - d. 30 Amp, 125/250 Volt (NEMA 14-30R).
- B. Wall Switches (Snap Switches):
  - 1. Switches shall be specification grade, totally enclosed molded composition, silent type, spring action silver contacts, and rated 120/277 volts A.C. All switches shall be binding screw type.
  - 2. Switches shall be rated at 20 Amp.
- C. Device Plates:
  - 1. Plates shall be brushed smooth stainless steel, except plates used on surface mounted boxes. Surface mounted outlets plates shall be raised, pressed metal type. Mounting screws shall be metal with same finish as plate and with countersunk head. Plates shall be single ganged, or combination, to accommodate arrangement indicated on drawings.

### **2.07 MOTOR CONTROLLERS:**

- A. 120 volt, less than 1/4hp:
  - 1. Provide motor toggle switch with heater, pilot light and lockout guard. Mount adjacent to motor. Size heater per NEC and manufacturer's recommendations. Based on Sq-D #FG1P (surface mount) or # FF1P (flush mount) or similar by Eaton/Cutler Hammer or ABB/GE.
- B. 120 volt, 1/3hp to 1hp:
  - 1. Provide NEMA rated combination magnetic motor starter and disconnect in appropriate enclosure with H.O.A. selector switch, red pilot light, 1 - N.O. & 1 - N.C. Aux. coil. Combination motor starter disconnect shall be Sq-D Class 8539 or similar by Eaton/Cutler Hammer or ABB/GE with breaker sized for respective motor load or two speed starters as shown on plans. Mount within sight and within 50' of motor. Size heaters per NEC and manufacturer's recommendations.



- C. 208v, 1ph; 208v, 3ph; 480v, 1ph; and 480v, 3ph; 1/2hp or larger:
  - 1. Provide NEMA rated combination magnetic motor starter and disconnect in appropriate enclosure with H.O.A. selector switch, red pilot light, 120 volt control transformer, 1 - N.O. & 1 - N.C. Aux. coil. Combination motor starter disconnect shall be based on Sq-D Class 8539 or similar by Eaton/Cutler Hammer or ABB/GE with breaker sized for respective motor load or two speed starters as shown on plans. Mount within sight and within 50' of motor. Size heaters per NEC and manufacturer's recommendations.

## **2.08 DISTRIBUTION PANELBOARDS:**

- A. Distribution and metering equipment shall be of the circuit breaker type with main lugs or main switch as indicated on drawings rated at 250 volts or 600 volt maximum, 3 phase, 4 wire AC, respectively, capable of withstanding available fault current and be U.L.S.E. labeled and listed, surface mount, bottom fed. Circuit breakers shall be system series rated.
- B. Distribution and power panelboards shall be based on Square "D" breaker type I-Line or similar by Eaton/Cutler Hammer or ABB/GE meeting Federal Specification W-P-115A. Switches shall be Sq-D breaker type to fit panelboard.

## **2.09 BRANCH CIRCUIT PANELBOARDS:**

- A. Branch circuit panelboards shall be of the circuit breaker type with main lugs or main switch as indicated on drawings rated at 120/208 volts maximum, 3 phase, 4 wire AC capable of withstanding available fault current and be U.L. labeled and listed, surface or flush mounted, bottom or top fed with ground bar kits. Circuit breakers shall be system series rated. Panelboards shall be based on Square "D" type NQ or similar by Eaton/Cutler Hammer or ABB/GE.
- B. Branch circuit panelboards shall be of the circuit breaker type with main lugs or main switch as indicated on drawings rated at 277/480 volts maximum, 3 phase, 4 wire AC capable of withstanding available fault current and be U.L. labeled and listed, surface or flush mounted, bottom or top fed with ground bar kits. Circuit breakers shall be system series rated. Panelboards shall be Square "D" type NF or I-Line or similar by Eaton/Cutler Hammer or ABB/GE, as indicated.

## **2.10 FUSES:**

- A. Fuses 600 Amperes and Less: Dual element, current limiting, time delay, one-time fuse, 250 or 600 volt, UL Class J. Supply Owner with 3 - spare fuses of each size if applicable.
- B. Fuses 601 Amperes and Larger: Current limiting, fast-acting, one time fuse, 600 volt, UL Class L. Supply Owner with 1 - spare fuse of each size if applicable.
- C. Interrupting Rating: 200,000 rms amperes.

## **2.11 SAFETY SWITCHES:**

- A. Furnish and install all required safety switches.
- B. Safety switches shall be NEMA heavy duty type "HD", fusible or non-fusible as shown on drawings and be U.L. labeled and listed. Switches shall be furnished in NEMA-1 general purpose dry location enclosures unless otherwise shown on drawings. Weatherproof switches shall be NEMA-3R (raintight).
- C. Switches shall be horsepower rated with interlocking provisions to prevent unauthorized opening of the switch covers in the "ON" position. Switches shall be capable of being physically locked in the open (off) position.
- D. Switches shall be Sq-D type "HD" 250v or 600v, respectively.

## **PART 3 EXECUTION**

### **3.01 RACEWAYS:**

- A. Conduit or tubing shall be installed in a manner which complies with all applicable provisions of the National Electrical Code and at least six inches from parallel runs of steam pipes, flues, or hot water pipes.

- B. Ends of all conduit or tubing shall terminate in a bushing or fitting having factory installed insulating liners. Provide plastic bushings on all conduit or tubing with wire larger than #4 AWG. Exposed runs shall be supported by hangers, clamps, or straps secured by toggle bolts in hollow construction or expansion bolts or inserts in poured or brick walls. No lead anchors shall be allowed
- C. Every precaution shall be taken to protect the conduit from damage and from water, dirt, concrete, etc., getting into the system during construction. Capped bushings shall be used on all conduit terminations until wire is installed. If, in the opinion of the Engineer, conduit or tubing has become damaged or contains unremovable foreign matter, it shall be replaced at the Contractor's expense.
- D. Rigid metal conduit shall be used in all poured construction, fill, outside masonry walls, areas exposed to weather, under drives and walks, and in areas where tubing may become damaged..
- E. Rigid non-metallic conduit (PVC) may be used in lieu of rigid metal conduit below grade or where concealed in concrete. Provide a separate bare stranded copper grounding conductor in the raceway sized in accordance with Table 250.122 of the NEC.
- F. Electrical metallic conduit (EMT) shall be used for feeders and branch circuits above ground & above suspended accessible ceilings; for switch and receptacle legs which terminate above suspended accessible ceilings; for exposed feeders and branch circuits; for switch legs in moveable partitions.
- G. Flexible metal conduit shall be used for connections to the following equipment: lighting fixtures only. Maximum length of flexible metallic conduit shall be 6'-0". Longer length may be permitted at the discretion of the Owner or as indicated on the plans. Minimum size shall be 1/2". Flexible metal conduit used for lighting fixture connections shall be "Greenfield" type. Fittings shall be insulated throat, flex-steel connectors.
- H. Use liquid-tight flexible steel conduit and liquid-tight flexible non-metallic conduit for final connections to all indoor and outdoor motors and mechanical equipment with a length not to exceed 36".
- I. After exhausting all resources to recess new feeds to new power, and low voltage devices within the existing walls, surface mounted raceways may be used, unless otherwise noted on the drawings. Permission to use surface mounted raceways must be obtained by the Owner and Architect. The Owner and Architect will also approve the routing of the Wiremold prior to installation. Any new surface mounted raceway shall be painted to match the existing surface it is installed on, or be the closest standard color to match.
  - 1. Exposed raceways noted on drawings as "Wiremold" shall be equal to Wiremold Series 700 or 4000 series or as shown on drawings. Provide required anchors, fittings and outlet boxes as required. Outlet boxes shall be Wiremold #5748 or as shown on drawings
- J. At all wall penetrations, space around circuits shall be filled with mortar or other approved filler. Penetrations through walls, floors or ceilings must not alter the fire rating of the assembly.
- K. Install from each recessed branch panel, four (4) 1" conduits to the nearest accessible ceiling space for future branch wiring. Identify such conduits above the ceiling.
- L. All conduit and boxes shall be flush mounted and concealed. No exposed conduit will be allowed, except in electrical and mechanical spaces, and where specifically noted.

### **3.02 WIRE AND CABLE:**

- A. All wiring shall be installed in approved raceways. Conductors shall be continuous between outlets or junction boxes with splice made only within such boxes.
- B. Any branch circuits over 50 feet in length shall be installed with one wire size larger than the circuit rating. Example: 1P/20amp breaker with #12 THHN wire run 50'+ shall be increased to a #10 THHN wire.

### **3.03 OUTLET BOXES:**

- A. Set boxes squarely with faces flush to finished surfaces. The exact location of all outlets shall be approved by the Architect/Engineer before same are place and Contractor shall consult Architect/Engineer at all times relative to the location of outlets. No outlets shall be placed behind plumbing or heating pipes or where they will interfere with ducts, pipes, equipment, or other work.
- B. Each outlet shall be rigidly supported from the building construction (independent of the raceway system).

### **3.04 WIRING DEVICES:**

- A. Receptacles shall be mounted approximately 18" above floor or at other heights indicated on drawings.
- B. E.C. shall be responsible for protection of receptacles from painting, plastering, etc.
- C. Wall switches shall be mounted approximately 4'-0" above floor unless they interfere with wainscoting or trim.
- D. E.C. shall be responsible for masking switches for protection from painting, plastering, etc.
- E. E.C. shall confirm all door swings with Building Trades Contractor before installing switches.
- F. Wall plates shall be installed plumb and level with all edges in contact with attaching surface.
- G. E.C. shall confirm all ADA and barrier free requirements are meant and install according to their regulations.

### **3.05 SUPPORTS AND HANGERS:**

- A. Provide and install necessary steel brackets, rods, clamps, etc., for support of all work under this contract. All supports shall be plated or painted and shall be secured to structural members after Architect's approval.

### **3.06 SLEEVES AND INSERTS:**

- A. This Contractor shall be responsible for the proper location of all sleeves, chases, openings and inserts for the installation of his equipment.
- B. Holes through walls, floors or structural members shall be located only where permitted by the Architect.

### **3.07 UNDERGROUND WORK:**

- A. Prior to any underground excavating, trenching, pole base augering, etc. call MISS DIG at 1-800-482-7171 no less than 72 hours in advance of any earthwork.

**END OF SECTION**

**SECTION 26 05 05  
ELECTRICAL DEMOLITION**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Electrical demolition.

**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 that abandoned wiring and equipment serve only abandoned facilities.
- B. Demolition drawings are based on casual field observation and existing record documents.
- C. Report discrepancies to Architect/Engineer before disturbing existing installation.
- D. 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. 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.
- E. Existing Fire Alarm System: Maintain existing system in service. 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.

**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. PCB-containing electrical equipment, including transformers, capacitors, and switches.
  - 2. PCB- and DEHP-containing lighting ballasts.
  - 3. Mercury-containing lamps and tubes, including fluorescent lamps, high intensity discharge (HID), arc lamps, ultra-violet, high pressure sodium, mercury vapor, ignitron tubes, neon, and incandescent.
- B. Remove, relocate, and extend existing installations to accommodate new construction.
- C. Remove abandoned wiring to source of supply.
- D. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes, unless reuseable. 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 01 74 19 - Construction Waste Management and Disposal for additional requirements.
- B. Clean and repair existing materials and equipment that remain or that are to be reused.
- 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**

**SECTION 26 05 19**  
**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. Wiring connectors.
- E. Electrical tape.
- F. Oxide inhibiting compound.
- G. Wire pulling lubricant.
- H. Cable ties.

**1.02 RELATED REQUIREMENTS**

- A. Section 07 84 00 - Firestopping.
- B. Section 26 05 05 - Electrical Demolition: Disconnection, removal, and/or extension of existing electrical conductors and cables.
- C. Section 26 05 26 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.
- D. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

**1.03 REFERENCE STANDARDS**

- A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire; 2013.
- B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft; 2011.
- C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes; 2010 (Reapproved 2014).
- D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation; 2004 (Reapproved 2014).
- E. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape; 2010.
- F. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- G. NECA 120 - Standard for Installing Armored Cable (AC) and Metal-Clad Cable (MC); 2012.
- H. NEMA WC 70 - Nonshielded Power Cable 2000 V or Less for the Distribution of Electrical Energy; 2009.
- I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- J. UL 4 - Armored Cable; Current Edition, Including All Revisions.
- K. UL 44 - Thermoset-Insulated Wires and Cables; Current Edition, Including All Revisions.
- L. UL 83 - Thermoplastic-Insulated Wires and Cables; Current Edition, Including All Revisions.
- M. UL 267 - Outline of Investigation for Wire-Pulling Compounds; Most Recent Edition, Including All Revisions.
- N. UL 486A-486B - Wire Connectors; Current Edition, Including All Revisions.
- O. UL 486C - Splicing Wire Connectors; Current Edition, Including All Revisions.
- P. UL 486D - Sealed Wire Connector Systems; Current Edition, Including All Revisions.

- Q. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape; Current Edition, Including All Revisions.
- R. 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 with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.

#### **1.05 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 not permitted.
- E. Service entrance cable is not permitted.
- F. 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 and in existing constructed locations only for branch circuits up to 20 A. Not to be used in new construction.
      - 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. Where not approved for use by the authority having jurisdiction.
    - b. Where exposed to view.
    - c. Where exposed to damage.
    - d. For damp, wet, or corrosive locations.
- G. 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 junctions boxes to luminaires.
      - 1) Maximum Length: 6 feet (1.8m)
    - b. From mechanical/plumbing/utilization equipment connections to associated disconnects in mechanical type spaces.
    - c. Where concealed within existing block walls.
      - 1) Maximum Length: 6 feet (1.8 m).
    - d. Where concealed in hollow stud walls and in existing constructed locations only for branch circuits up to 20 A. Not to be used in new construction.
      - 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. Where not approved for use by the authority having jurisdiction.
  - b. Where exposed to view, except in dedicated electrical, communications, and mechanical rooms where not subject to damage.
  - c. Where exposed to damage.
  - d. For damp, wet, or corrosive locations.

## **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. Conductor Material:
  1. Provide copper conductors only. Aluminum conductors are not acceptable for this project. Conductor sizes indicated are based on copper.
  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.
- H. 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.
  3. Color Code:
    - a. 480Y/277 V, 3 Phase, 4 Wire System:
      - 1) Phase A: Brown.
      - 2) Phase B: Orange.
      - 3) Phase C: Yellow.
      - 4) Neutral/Grounded: Gray.
    - b. 208Y/120 V, 3 Phase, 4 Wire System:
      - 1) Phase A: Black.
      - 2) Phase B: Red.
      - 3) Phase C: Blue.
      - 4) Neutral/Grounded: White.
    - c. Equipment Ground, All Systems: Green.
    - d. 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.

## **2.03 SINGLE CONDUCTOR BUILDING WIRE**

- A. Description: Single conductor insulated wire.
- B. Insulation Voltage Rating: 600 V.
- C. Insulation:
  1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2, except as indicated below.
    - a. Installed Underground: Type XHHW-2.

## **2.04 ARMORED CABLE**

- A. 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.



- B. Conductor Stranding:
  - 1. Size 10 AWG and Smaller: Solid.
  - 2. Size 8 AWG and Larger: Stranded.
- C. Insulation Voltage Rating: 600 V.
- D. Insulation: Type THHN.
- E. Grounding: Combination of interlocking armor and integral bare 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.
- F. Armor: Steel, interlocked tape.

## **2.05 METAL-CLAD CABLE**

- A. 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.
- B. Conductor Stranding:
  - 1. Size 10 AWG and Smaller: Solid.
  - 2. Size 8 AWG and Larger: Stranded.
- C. Insulation Voltage Rating: 600 V.
- D. Insulation: Type THHN, THHN/THWN, or THHN/THWN-2.
- E. Grounding: Full-size integral equipment grounding conductor.
- F. Armor: Steel, interlocked tape.

## **2.06 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 26 05 26.
- 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.
- 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.
- E. 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.
- F. Mechanical Connectors: Provide bolted type or set-screw type.
- G. Compression Connectors: Provide circumferential type or hex type crimp configuration.

## **2.07 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:
  - 1. Listed and labeled as complying with UL 267.
  - 2. Suitable for use with conductors/cables and associated insulation/jackets to be installed.
  - 3. Suitable for use at installation temperature.
- D. Cable Ties: Material and tensile strength rating suitable for application.

## **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. Maintain separation of wiring for emergency systems in accordance with NFPA 70.
- B. Install products in accordance with manufacturer's instructions.
- C. Perform work in accordance with NECA 1 (general workmanship).
- D. Install armored cable (Type AC) in accordance with NECA 120.
- E. Install metal-clad cable (Type MC) in accordance with NECA 120.
- F. 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.
- G. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.

- H. 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.
- I. 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.
- J. Install conductors with a minimum of 12 inches (300 mm) of slack at each outlet.
- K. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.
- L. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.
- M. 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. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
  - 6. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- N. 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.
- O. Insulate ends of spare conductors using vinyl insulating electrical tape.
- P. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.
- Q. 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.

**END OF SECTION**

**SECTION 26 05 26**  
**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.
- D. Ground bars.

**1.02 RELATED REQUIREMENTS**

- A. Section 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Additional requirements for conductors for grounding and bonding, including conductor color coding.
- B. Section 26 05 53 - 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; 2010.
- C. NEMA GR 1 - Grounding Rod Electrodes and Grounding Rod Electrode Couplings; 2007.
- D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. UL 467 - Grounding and Bonding Equipment; Current Edition, Including All Revisions.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Verify exact locations of underground metal water service pipe entrances to building.
  - 2. Coordinate the work with other trades to provide steel reinforcement complying with specified requirements for concrete-encased electrode.

**1.05 PERFORMANCE REQUIREMENTS**

- A. Grounding System Resistance: 5 ohms or less.

**1.06 SUBMITTALS**

- A. Product Data: Provide for grounding electrodes and connections.
- B. Test Reports: Indicate overall resistance to ground and resistance of each electrode.
- C. Project Record Documents: Record actual locations of components and grounding electrodes.
- D. Certificate of Compliance: Indicate approval of installation by authority having jurisdiction.

**1.07 QUALITY ASSURANCE**

- A. Conform to requirements of NFPA 70.

**PART 2 PRODUCTS**

**2.01 GROUNDING AND BONDING REQUIREMENTS**

- A. Do not use products for applications other than as permitted by NFPA 70 and product listing.
- B. 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.

- C. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- D. Grounding System Resistance:
  - 1. Achieve specified grounding system resistance under normally dry conditions unless otherwise approved by Engineer. 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.
- E. Grounding Electrode System:
  - 1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.
    - a. Provide continuous grounding electrode conductors without splice or joint.
    - b. Install grounding electrode conductors in raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.
  - 2. Metal In-Ground Support Structure:
    - a. Provide connection to metal in-ground support structure that is in direct contact with earth in accordance with NFPA 70.
  - 3. Concrete-Encased Electrode:
    - a. Provide connection to concrete-encased electrode consisting of not less than 20 feet (6.0 m) of either steel reinforcing bars or bare copper conductor not smaller than 4 AWG embedded within concrete foundation or footing that is in direct contact with earth in accordance with NFPA 70.
  - 4. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.
  - 5. Ground Bar: Provide ground bar, separate from service equipment enclosure, for common connection point of grounding electrode system bonding jumpers as permitted in NFPA 70. Connect grounding electrode conductor provided for service-supplied system grounding to this ground bar.
    - a. Ground Bar Size: 1/4 by 2 by 12 inches (6 by 50 by 300 mm) unless otherwise indicated or required.
    - b. Where ground bar location is not indicated, locate in an accessible location as close to the service entrance as possible, as well as one as close as possible to the Communications Rack.
    - c. Ground Bar Mounting Height: 18 inches (450 mm) above finished floor unless otherwise indicated.
- F. Separately Derived System Grounding:
  - 1. Separately derived systems include, but are not limited to:
    - a. Transformers (except autotransformers such as buck-boost transformers).
  - 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.
  7. Provide bonding for interior metal piping systems in accordance with NFPA 70. This includes, but is not limited to:
    - a. Metal water piping where not already effectively bonded to metal underground water pipe used as grounding electrode.
  8. Provide bonding for metal building frame.
- H. Communications Systems Grounding and Bonding:
1. Provide intersystem bonding termination at service equipment or metering equipment enclosure and at disconnecting means for any additional buildings or structures in accordance with NFPA 70.
  2. Provide bonding jumper in raceway from intersystem bonding termination to each new communications rack, cabinet, or backboard location and provide ground bar for termination.
    - a. Bonding Jumper Size: 6 AWG, unless otherwise indicated or required.
    - b. Raceway Size: 3/4 inch (21 mm) trade size unless otherwise indicated or required.
    - c. Ground Bar Size: 1/4 by 2 by 12 inches (6 by 50 by 300 mm) unless otherwise indicated or required.
    - d. Ground Bar Mounting Height: 18 inches (450 mm) above finished floor unless otherwise indicated.

## **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 26 05 26:
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 or UL Listed irreversible connectors for underground, concealed and other inaccessible connections.
  3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.

- D. Ground Bars:
  - 1. Description: Copper rectangular ground bars with mounting brackets and insulators.
  - 2. Size: As indicated.
  - 3. Holes for Connections: As indicated or as required for connections to be made.

## **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 26 05 53.
- E. Provide bonding to meet requirements described in Quality Assurance.
- F. Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.

### **3.03 FIELD QUALITY CONTROL**

- A. See Section 01 40 00 - 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.

**END OF SECTION**

**SECTION 26 05 29**  
**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 26 05 33.13 - Conduit for Electrical Systems: Additional support and attachment requirements for conduits.
- B. Section 26 05 33.16 - Boxes for Electrical Systems: Additional support and attachment requirements for boxes.
- C. Section 26 51 00 - Interior Lighting: Additional support and attachment requirements for interior luminaires.
- D. Conduit and equipment supports.
- E. Anchors and fasteners.

**1.03 REFERENCE STANDARDS**

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2013.
- D. MFMA-4 - Metal Framing Standards Publication; 2004.
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

**1.04 QUALITY ASSURANCE**

**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. NFPA 70.
    - b. Requirements of authorities having jurisdiction.
  - 2. Provide required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for complete installation of electrical 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 the load to be supported. 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 and Cable Supports: Straps and clamps suitable for 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 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. Nonpenetrating Rooftop Supports for Low-Slope Roofs:
  - 1. Description: Steel pedestals with thermoplastic or rubber bases that rest on top of roofing membrane, not requiring attachment to roof structure and not penetrating roofing assembly, with support fixtures as specified.
  - 2. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
  - 3. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
  - 4. Mounting Height: Provide minimum clearance of 6 inches (150 mm) under supported component to top of roofing.
- G. Anchors and Fasteners:
  - 1. Unless otherwise indicated and where not otherwise restricted, use anchor and fastener types indicated for 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. 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.
- H. Hangers, Supports, Anchors, and Fasteners - General: Corrosion-resistant materials of size and type adequate to carry the loads of equipment and conduit, including weight of wire in conduit.
- I. Supports: Fabricated of structural steel or formed steel members; galvanized.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Install hangers and supports in accordance with NECA 1.
- C. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- D. Unless specifically indicated or approved by Engineer, do not provide support from suspended ceiling support system or ceiling grid.
- E. Unless specifically indicated or approved by Engineer, do not provide support from roof deck.
- F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

- G. 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.
- H. Conduit Support and Attachment: See Section 26 05 33.13 for additional requirements.
- I. Box Support and Attachment: See Section 26 05 33.16 for additional requirements.
- J. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.
- K. Secure fasteners in accordance with manufacturer's recommended torque settings.
- L. Remove temporary supports.

**END OF SECTION**

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**SECTION 26 05 33.13**  
**CONDUIT FOR ELECTRICAL SYSTEMS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Galvanized steel rigid metal conduit (RMC).
- B. Stainless steel rigid metal conduit (RMC).
- C. PVC-coated galvanized steel rigid metal conduit (RMC).
- D. Flexible metal conduit (FMC).
- E. Liquidtight flexible metal conduit (LFMC).
- F. Galvanized steel electrical metallic tubing (EMT).
- G. Stainless steel electrical metallic tubing (EMT).
- H. Rigid polyvinyl chloride (PVC) conduit.
- I. Liquidtight flexible nonmetallic conduit (LFNC).

**1.02 RELATED REQUIREMENTS**

- A. Section 07 84 00 - Firestopping.
- B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- C. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- D. Section 26 05 33.16 - Boxes for Electrical Systems.
- E. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- F. Section 31 23 16.13 - Trenching: Excavating, bedding, and backfilling.

**1.03 REFERENCE STANDARDS**

- A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2005.
- B. ANSI C80.3 - American National Standard for Steel Electrical Metallic Tubing (EMT); 2005.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- D. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); 2013.
- E. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC); 2003.
- F. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2012.
- G. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit; 2005.
- H. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit; 2013.
- I. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing; 2015.
- J. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- K. UL 1 - Flexible Metal Conduit; Current Edition, Including All Revisions.
- L. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.
- M. UL 360 - Liquid-Tight Flexible Steel Conduit; Current Edition, Including All Revisions.
- N. UL 514B - Conduit, Tubing, and Cable Fittings; Current Edition, Including All Revisions.
- O. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings; Current Edition, Including All Revisions.

- P. UL 797 - Electrical Metallic Tubing-Steel; Current Edition, Including All Revisions.
- Q. UL 797A - Electrical Metallic Tubing - Aluminum and Stainless Steel; Current Edition, Including All Revisions.
- R. 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 actual type and quantity of conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
  - 2. Coordinate arrangement of conduits with structural members, ductwork, piping, equipment, and other potential conflicts.
  - 3. Verify exact conduit termination locations required for boxes, enclosures, and equipment.
  - 4. Coordinate work to provide roof penetrations that preserve integrity of roofing system and do not void roof warranty.

#### **1.05 SUBMITTALS**

- A. Project Record Documents: Accurately record actual routing of conduits larger than 2 inches (51 mm).

#### **1.06 QUALITY ASSURANCE**

- A. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for purpose specified and shown.

#### **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, manufacturer's 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.
- C. Concealed Within Masonry Walls: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).
- D. Concealed Within Hollow Stud Walls: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).
- E. Concealed Above Accessible Ceilings: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).
- F. Interior, Damp or Wet Locations: Use electrical metallic tubing (EMT).
- G. Exposed, Interior, Not Subject to Physical Damage: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).
- H. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit.
- I. Flexible Connections to Luminaires Above Accessible Ceilings: Use flexible metal conduit (FMC).
  - 1. Maximum Length: 6 feet (1.8 m).

- J. Flexible Connections to Vibrating Equipment:
  - 1. Dry Locations: Use flexible metal conduit (FMC).
  - 2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit (LFMC).
  - 3. Maximum Length: 6 feet (1.8 m) unless otherwise indicated.
  - 4. Vibrating equipment includes, but is not limited to:
    - a. Transformers.
    - b. Motors.

## **2.02 CONDUIT - GENERAL REQUIREMENTS**

- A. Comply with NFPA 70.
- B. Provide conduit, fittings, supports, and accessories required for complete raceway system.
- C. Provide products listed, classified, and labeled as suitable for purpose intended.
- D. 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. Underground, Interior: 3/4-inch (21 mm) trade size.
  - 5. Underground, Exterior: 3/4 inch (21 mm) trade size.
- E. 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. 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 type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

## **2.04 STAINLESS STEEL RIGID METAL CONDUIT (RMC)**

- A. Description: NFPA 70, Type RMC stainless steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6A.
- B. Fittings:
  - 1. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 6A.
  - 2. Material: Use stainless steel with corrosion resistance equivalent to conduit.
  - 3. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

## **2.05 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, 0.040 inch (1.02 mm).
- C. PVC-Coated Boxes and Fittings:
  - 1. Manufacturer: Same as manufacturer of PVC-coated conduit to be installed.
  - 2. Nonhazardous Locations: Use boxes and fittings listed and labeled as complying with UL 514A, UL 514B, or UL 6.
  - 3. Material: Use steel or malleable iron.
  - 4. Exterior Coating: Polyvinyl chloride (PVC), minimum thickness of 40 mil, 0.040 inch (1.02 mm).

- D. PVC-Coated Supports: Furnish with exterior coating of polyvinyl chloride (PVC), minimum thickness of 15 mil, 0.015 inch (0.38 mm).

## **2.06 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.
- 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.

## **2.07 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.

## **2.08 GALVANIZED STEEL ELECTRICAL METALLIC TUBING (EMT)**

- A. Description: NFPA 70, Type EMT galvanized 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.

## **2.09 STAINLESS STEEL ELECTRICAL METALLIC TUBING (EMT)**

- A. Description: NFPA 70, Type EMT stainless steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797A.
- B. Fittings:
  - 1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
  - 2. Connectors and Couplings: Use compression/gland or set-screw type.

## **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 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 type of conduit to be connected.

## **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.
- D. Verify routing and termination locations of conduit prior to rough-in.
- E. Conduit routing is shown on drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

### **3.02 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Install conduit in accordance with NECA 1.
- C. Galvanized Steel Rigid Metal Conduit (RMC): Install in accordance with NECA 101.
- D. PVC-Coated Galvanized Steel Rigid Metal Conduit (RMC): Install using only tools approved by manufacturer.
- E. Rigid Polyvinyl Chloride (PVC) Conduit: Install in accordance with NECA 111.
- F. Liquidtight Flexible Nonmetallic Conduit (LFNC): Install in accordance with NECA 111.
- G. 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 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. Unless otherwise approved, do not route exposed conduits:
    - a. Across floors.
    - b. Across roofs.
    - c. Across top of parapet walls.
    - d. Across building exterior surfaces.
  - 6. Conduits installed underground or embedded in concrete may be routed in shortest possible manner unless otherwise indicated. Route other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.
  - 7. Arrange conduit to maintain adequate headroom, clearances, and access.
  - 8. Arrange conduit to provide no more than equivalent of four 90-degree bends between pull points.
  - 9. Arrange conduit to provide no more than 150 feet (46 m) between pull points.
  - 10. Route conduits above water and drain piping where possible.
  - 11. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
  - 12. Maintain minimum clearance of 6 inches (150 mm) between conduits and piping for other systems.
  - 13. 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.
  - 14. Group parallel conduits in same area on common rack.



H. Conduit Support:

1. Secure and support conduits in accordance with NFPA 70 using suitable supports and methods approved by authorities having jurisdiction; see Section 26 05 29.
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 nonpenetrating rooftop supports to support conduits routed across rooftops, where approved.

I. 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. Provide insulating bushings, insulated throats, or listed metal fittings with smooth, rounded edges at conduit terminations to protect conductors.
7. Secure joints and connections to provide mechanical strength and electrical continuity.

J. 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. 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 07 84 00.

K. 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 conduits are subject to earth movement by settlement or frost.

- L. Conduit Sealing:
  - 1. Use foam conduit sealant to prevent entry of moisture and gases. This includes, but is not limited to:
    - a. Where conduits enter building from outside.
    - b. Where service conduits enter building from underground distribution system.
    - c. Where conduits enter building from underground.
    - d. Where conduits may transport moisture to contact live parts.
  - 2. Where conduits cross barriers between areas of potential substantial temperature differential, use foam conduit sealant at accessible point near penetration to prevent condensation. This includes, but is not limited to:
    - a. Where conduits pass from outdoors into conditioned interior spaces.
    - b. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.
- M. Provide pull string in each empty conduit and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches (300 mm) at each end.
- N. Provide grounding and bonding; see Section 26 05 26.
- O. Identify conduits; see Section 26 05 53.

### **3.03 CLEANING**

- A. Clean interior of conduits to remove moisture and foreign matter.

### **3.04 INTERFACE WITH OTHER PRODUCTS**

- A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.
- B. Route conduit through roof openings for piping and ductwork wherever possible. Where separate roofing penetration is required, coordinate location and installation method with roofing installation.

**END OF SECTION**

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**SECTION 26 05 33.16**  
**BOXES FOR ELECTRICAL SYSTEMS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Outlet and device boxes up to 100 cubic inches (1,650 cu cm), including those used as junction and pull boxes.
- B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches (1,650 cu cm).
- C. Floor boxes.
- D. Underground boxes/enclosures.

**1.02 RELATED REQUIREMENTS**

- A. Section 07 84 00 - Firestopping.
- B. Section 08 31 00 - Access Doors and Panels: Panels for maintaining access to concealed boxes.
- C. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- D. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- E. Section 26 05 33.13 - Conduit for Electrical Systems:
  - 1. Conduit bodies and other fittings.
- F. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

**1.03 REFERENCE STANDARDS**

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- B. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2010.
- C. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- D. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2012.
- E. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; 2013.
- F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. SCTE 77 - Specification for Underground Enclosure Integrity; 2013.
- H. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- I. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- J. UL 508A - Industrial Control Panels; Current Edition, Including All Revisions.
- K. UL 514A - Metallic Outlet Boxes; 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 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.

## **1.05 QUALITY ASSURANCE**

- A. Comply with requirements of NFPA 70.

## **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. Wall Plates: Comply with Section 26 27 26.
- C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches (1,650 cu cm):
  1. Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
  2. NEMA EN 10250 Environment Type, Unless Otherwise Indicated:
    - a. Indoor Clean, Dry Locations: Type 1, 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.

## **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.
- D. Verify locations of floor boxes and outlets in offices and work areas prior to rough-in.

### **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 08 31 00 as required where approved by the Architect.
  - 2. Locate boxes so that wall plates do not span different building finishes.
  - 3. Locate boxes so that wall plates do not cross masonry joints.
  - 4. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.
  - 5. 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.
  - 6. Fire Resistance Rated Walls: Install flush-mounted boxes such that the required fire resistance will not be reduced.
- I. Box Supports:
  - 1. Secure and support boxes in accordance with NFPA 70 and Section 26 05 29 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.
- 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 not set back from finished surface 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. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- N. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.
- O. Close unused box openings.
- P. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.
- Q. Provide grounding and bonding in accordance with Section 26 05 26.
- R. Identify boxes in accordance with Section 26 05 53.
- S. Adjust flush-mounting outlets to make front flush with finished wall material.
- T. Adjust flush-mounting cover plates to make front flush with finished wall material and adjust cover plate orientation such that the vertical edge of the cover plate is perpendicular to the finished floor.
- U. Install knockout closures in unused box openings.

### **3.03 CLEANING**

- A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

**END OF SECTION**

**SECTION 26 05 33.23**  
**SURFACE RACEWAYS FOR ELECTRICAL SYSTEMS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Surface metal raceways.

**1.02 RELATED REQUIREMENTS**

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- B. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- C. Section 26 05 33.13 - Conduit for Electrical Systems.
- D. Section 26 05 33.16 - Boxes for Electrical Systems.
- E. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- F. Section 26 27 26 - Wiring Devices: Receptacles.

**1.03 REFERENCE STANDARDS**

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. UL 5 - Surface Metal Raceways and Fittings; Current Edition, Including All Revisions.

**1.04 SUBMITTALS**

- A. See Section 01 30 00 - 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. 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. Conform to requirements of NFPA 70.

**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. Surface Metal Raceways: Listed and labeled as complying with UL 5.
- B. Surface Raceway System:
  - 1. Raceway Type: Single or Two channel, painted steel.
  - 2. Size: As required for the conductors.
  - 3. Length: As required and approved by the Architect/Owner.
  - 4. Color: To be selected by Architect.



### **2.03 MANUFACTURERS**

- A. Wiremold Company: [www.wiremold.com](http://www.wiremold.com).
- B. Panduit.
- C. Substitutions: See Section 16010 - Electrical Equipment and Materials

### **2.04 SURFACE RACEWAYS**

- A. Surface Metal Raceway: Sheet metal channel with fitted cover, suitable for use as surface metal raceway. Wiremold 700 series or 4000 series raceway, cover and divider with duplex receptacle and/or phone/data outlet cover as shown on drawing.
  - 1. Fittings, Boxes, and Extension Rings: Furnish manufacturer's standard accessories.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Install raceways plumb and level.
- D. Secure and support raceways in accordance with Section 26 05 29 at intervals complying with NFPA 70 and manufacturer's requirements.
- E. Use suitable insulating bushings and inserts at connections to outlets and corner fittings.
- F. Close unused raceway openings.
- G. Provide grounding and bonding in accordance with Section 26 05 26.

**END OF SECTION**

**SECTION 26 05 53**  
**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. Warning signs and labels.
- E. Field-painted identification of conduit and boxes.

**1.02 REFERENCE STANDARDS**

- A. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs; 2011.
- B. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels; 2023.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. NFPA 70E - Standard for Electrical Safety in the Workplace; 2024.
- E. UL 969 - Marking and Labeling Systems; Current Edition, Including All Revisions.

**1.03 QUALITY ASSURANCE**

- A. Comply with requirements of NFPA 70.

**PART 2 PRODUCTS**

**2.01 IDENTIFICATION REQUIREMENTS**

- A. Existing Work: Unless specifically excluded, identify existing elements to remain whose designations are changed as part of the new work.
- B. Identification for Equipment:
  - 1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
  - 2. Use identification nameplate to identify disconnect location for equipment with remote disconnecting means.
  - 3. 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.
  - 4. Use identification label or handwritten text using indelible marker on inside of door at each motor controller to identify nameplate horsepower, full load amperes, code letter, service factor, voltage, and phase of motor(s) controlled.
  - 5. 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.
  - 6. 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. 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.

- C. Identification for Conductors and Cables:
  - 1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 05 19.
  - 2. 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.
  - 3. 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. At each source and load connection.
    - b. Within boxes when more than one circuit is present.
    - c. Within equipment enclosures when conductors and cables enter or leave the enclosure.
- D. Identification for Cable Tray: Comply with Section 26 05 36.
- E. Identification for Boxes:
  - 1. Use voltage markers to identify highest voltage present.
  - 2. 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 09 91 23 and 09 91 13 per the same color code used for raceways.
    - b. For exposed boxes in public areas, do not color code.
  - 3. Use identification labels or handwritten text using indelible marker to identify circuits enclosed.
    - a. For exposed boxes in public areas, use only identification labels.
- F. Identification for Devices:
  - 1. Use identification label or engraved wallplate to identify serving branch circuit for all receptacles.
    - a. For receptacles in public areas or in areas as directed by Architect, provide identification on inside surface of wallplate.
  - 2. Use identification label or engraved wallplate to identify load controlled for wall-mounted control devices controlling loads that are not visible from the control location and for multiple wall-mounted control devices installed at one location.
  - 3. Use identification label to identify receptacles protected by upstream GFI protection, where permitted.

## **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.
  - 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".
    - 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 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 white or clear 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.
- E. Minimum Text Height: 1/8 inch (3 mm).
- F. Color: Black text on white background unless otherwise indicated.

## **2.04 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. Boxes: Outside face of cover.
  7. Conductors and Cables: Legible from the point of access.
  8. Devices: Inside 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. Install underground warning tape above buried lines with one tape per trench at 3 inches (75 mm) below finished grade.
- G. Secure rigid signs using stainless steel screws.
- H. Mark all handwritten text, where permitted, to be neat and legible.

**END OF SECTION**

**SECTION 26 05 73  
POWER SYSTEM STUDIES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Short-circuit study.
- B. Protective device coordination study.
- C. Arc flash and shock risk assessment.
  - 1. Includes arc flash hazard warning labels.
- D. Criteria for the selection and adjustment of equipment and associated protective devices not specified in this section, as determined by studies to be performed.

**1.02 RELATED REQUIREMENTS**

- A. Section 26 05 53 - Identification for Electrical Systems: Additional requirements for arc flash hazard warning labels.
- B. Section 26 24 16 - Panelboards.
- C. Section 26 24 19 - Motor-Control Centers.

**1.03 REFERENCE STANDARDS**

- A. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels; 2023.
- B. IEEE 141 - IEEE Recommended Practice for Electric Power Distribution for Industrial Plants; 1993 (Reaffirmed 1999).
- C. IEEE 242 - IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems; 2001, with Errata (2003).
- D. IEEE 399 - IEEE Recommended Practice for Industrial and Commercial Power Systems Analysis; 1997.
- E. IEEE 551 - IEEE Recommended Practice for Calculating Short-Circuit Currents in Industrial and Commercial Power Systems; 2006.
- F. IEEE 1584 - IEEE Guide for Performing Arc-Flash Hazard Calculations; 2018, with Errata (2019).
- G. NEMA MG 00001 - Motors and Generators; 2024.
- H. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.
- I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- J. NFPA 70E - Standard for Electrical Safety in the Workplace; 2024.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Coordinate the work to provide equipment and associated protective devices complying with criteria for selection and adjustment, as determined by studies to be performed.
  - 2. Notify Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
  - 1. Submit study reports prior to or concurrent with product submittals.
  - 2. Do not order equipment until matching study reports and product submittals have both been evaluated by Engineer.

**1.05 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

- B. Study reports, stamped or sealed and signed by study preparer.

## **1.06 POWER SYSTEM STUDIES**

- A. Scope of Studies:
1. Perform analysis of new electrical distribution system as indicated on drawings.
  2. Except where study descriptions below indicate exclusions, analyze system at each bus from primary protective devices of utility source down to each piece of equipment involved, including parts of system affecting calculations being performed (e.g. fault current contribution from motors).
  3. Include in analysis alternate sources and operating modes (including known future configurations) to determine worst case conditions.
- B. General Study Requirements:
1. Comply with NFPA 70.
  2. Perform studies utilizing computer software complying with specified requirements; manual calculations are not permitted.
- C. Data Collection:
1. Compile information on project-specific characteristics of actual installed equipment, protective devices, feeders, etc. as necessary to develop single-line diagram of electrical distribution system and associated input data for use in system modeling.
    - a. Utility Source Data: Include primary voltage, maximum and minimum three-phase and line-to-ground fault currents, impedance, X/R ratio, and primary protective device information.
      - 1) Obtain up-to-date information from Utility Company.
    - b. Motors: Include manufacturer/model, type (e.g. induction, synchronous), horsepower rating, voltage rating, full load amps, and locked rotor current or NEMA MG 00001 code letter designation.
    - c. Transformers: Include primary and secondary voltage ratings, kVA rating, winding configuration, percent impedance, and X/R ratio.
    - d. Protective Devices:
      - 1) Circuit Breakers: Include manufacturer/model, type (e.g. thermal magnetic, electronic trip), frame size, trip rating, voltage rating, interrupting rating, available field-adjustable trip response settings, and features (e.g. zone selective interlocking).
      - 2) Fuses: Include manufacturer/model, type/class (e.g. Class J), size/rating, and speed (e.g. time delay, fast acting).
    - e. Protective Relays: Include manufacturer/model, type, settings, current/potential transformer ratio, and associated protective device.
    - f. Conductors: Include feeder size, material (e.g. copper, aluminum), insulation type, voltage rating, number per phase, raceway type, and actual length.
- D. Short-Circuit Study:
1. Comply with IEEE 551 and applicable portions of IEEE 141, IEEE 242, and IEEE 399.
  2. For purposes of determining equipment short circuit current ratings, consider conditions that may result in maximum available fault current, including but not limited to:
    - a. Maximum utility fault currents.
    - b. Maximum motor contribution.
    - c. Known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).
  3. For each bus location, calculate the maximum available three-phase bolted symmetrical and asymmetrical fault currents. For grounded systems, also calculate the maximum available line-to-ground bolted fault currents.
- E. Protective Device Coordination Study:
1. Comply with applicable portions of IEEE 242 and IEEE 399.

2. Analyze alternate scenarios considering known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).
- F. Arc Flash and Shock Risk Assessment:
1. Comply with NFPA 70E.
  2. Perform incident energy and arc flash boundary calculations in accordance with IEEE 1584 (as referenced in NFPA 70E Annex D), where applicable.
  3. Analyze alternate scenarios considering conditions that may result in maximum incident energy, including but not limited to:
    - a. Maximum and minimum utility fault currents.
    - b. Maximum and minimum motor contribution.
    - c. Known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).
- G. Study Reports:
1. General Requirements:
    - a. Identify date of study and study preparer.
    - b. Identify study methodology and software product(s) used.
    - c. Identify scope of studies, assumptions made, implications of possible alternate scenarios, and any exclusions from studies.
    - d. Identify base used for per unit values.
    - e. Include single-line diagram and associated input data used for studies; identify buses on single-line diagram as referenced in reports, and indicate bus voltage.
    - f. Include conclusions and recommendations.
  2. Short-Circuit Study:
    - a. For each scenario, identify at each bus location:
      - 1) Calculated maximum available symmetrical and asymmetrical fault currents (both three-phase and line-to-ground where applicable).
      - 2) Fault point X/R ratio.
      - 3) Associated equipment short circuit current ratings.
    - b. Identify locations where the available fault current exceeds the equipment short circuit current rating, along with recommendations.
  3. Protective Device Coordination Study:
    - a. For each scenario, include time-current coordination curves plotted on log-log scale graphs.
    - b. For each graph include (where applicable):
      - 1) Partial single-line diagram identifying the portion of the system illustrated.
      - 2) Protective Devices: Time-current curves with applicable tolerance bands for each protective device in series back to the source, plotted up to the maximum available fault current at the associated bus.
      - 3) Conductors: Damage curves.
      - 4) Transformers: Inrush points and damage curves.
      - 5) Generators: Full load current, overload curves, decrement curves, and short circuit withstand points.
      - 6) Motors: Full load current, starting curves, and damage curves.
      - 7) Capacitors: Full load current and damage curves.
    - c. For each protective device, identify fixed and adjustable characteristics with available ranges and recommended settings.
      - 1) Circuit Breakers: Include long time pickup and delay, short time pickup and delay, and instantaneous pickup.
      - 2) Include ground fault pickup and delay.
      - 3) Include fuse ratings.
      - 4) Protective Relays: Include current/potential transformer ratios, tap, time dial, and instantaneous pickup.



- d. Identify cases where either full selective coordination or adequate protection is not achieved, along with recommendations.
- 4. Arc Flash and Shock Risk Assessment:
  - a. For the worst case for each scenario, identify at each bus location:
    - 1) Calculated incident energy and associated working distance.
    - 2) Calculated arc flash boundary.
    - 3) Bolted fault current.
    - 4) Arcing fault current.
    - 5) Clearing time.
    - 6) Arc gap distance.
  - b. For purposes of producing arc flash hazard warning labels, summarize the maximum incident energy and associated data reflecting the worst case condition of all scenarios at each bus location.

#### **1.07 QUALITY ASSURANCE**

- A. Computer Software for Study Preparation: Use the latest edition of commercially available software utilizing specified methodologies.

### **PART 2 PRODUCTS**

#### **2.01 ARC FLASH HAZARD WARNING LABELS**

- A. Provide warning labels complying with ANSI Z535.4 to identify arc flash hazards for each work location analyzed by the arc flash and shock risk assessment.
  - 1. Materials: Comply with Section 26 05 53.
  - 2. Legend: Provide custom legend in accordance with NFPA 70E based on equipment-specific data as determined by arc flash and shock risk assessment.
    - a. Include the following information:
      - 1) Arc flash boundary.
      - 2) Available incident energy and corresponding working distance.
      - 3) Nominal system voltage.

### **PART 3 EXECUTION**

#### **3.01 INSTALLATION**

- A. Install arc flash warning labels in accordance with Section 26 05 53.

#### **3.02 FIELD QUALITY CONTROL**

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Adjust equipment and protective devices for compliance with studies and recommended settings.
- D. Notify Engineer of any conflicts with or deviations from studies. Obtain direction before proceeding.

**END OF SECTION**

**SECTION 26 05 83  
WIRING CONNECTIONS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Electrical connections to equipment.

**1.02 RELATED REQUIREMENTS**

- A. Section 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES.
- B. Section 26 05 33.13 - Conduit for Electrical Systems.
- C. Section 26 05 33.16 - Boxes for Electrical Systems.
- D. Section 26 27 26 - Wiring Devices.

**1.03 REFERENCE STANDARDS**

- A. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (R 2010).
- B. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2012.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

**1.04 QUALITY ASSURANCE**

- A. Comply with requirements of NFPA 70.
- B. Products: Listed, classified, and labeled as suitable for the purpose intended.

**1.05 COORDINATION**

- A. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
- B. Determine connection locations and requirements.
- C. Sequence rough-in of electrical connections to coordinate with installation of equipment.
- D. Sequence electrical connections to coordinate with start-up of equipment.

**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 26 27 26.
- C. Flexible Conduit: As specified in Section 26 05 33.13.
- D. Wire and Cable: As specified in Section 26 05 19.
- E. Boxes: As specified in Section 26 05 33.16.

**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**

**SECTION 26 09 22**  
**DIGITAL - NETWORK LIGHTING CONTROLS**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. The following specification details the minimum compliance and related criteria for a complete and fully operational wireless digital addressable lighting control system for all interior lights.

**1.02 REFERENCES**

- A. American National Standards Institute/ (ANSI) ([www.ansi.org](http://www.ansi.org))
  - 1. C62.41-1991 - Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
- B. Institute of Electrical and Electronic Engineers (IEEE) ([www.ieee.org](http://www.ieee.org))
  - 1. 802.3af-2003 - Power over Ethernet standard
- C. International Electrotechnical Commission ([www.iec.ch](http://www.iec.ch))
  - 1. IEC/EN 61000-4-2:2009 Electrostatic Discharge Testing Standard.
- D. International Organization for Standardization (ISO) ([www.iso.ch](http://www.iso.ch))
  - 1. 9001:2000 - Quality Management Systems.
- E. National Electrical Manufacturers Association (NEMA) ([www.nema.org](http://www.nema.org))
  - 1. WD1 (R2005) - General Color Requirements for Wiring Devices.
- F. Underwriters Laboratories, Inc. (UL) ([www.ul.com](http://www.ul.com))
  - 1. 916 - Energy Management Equipment
- G. Federal Communications Commission (FCC) ([www.fcc.gov](http://www.fcc.gov))
  - 1. Title 47 CFR Part 15 Class A

**1.03 SYSTEM DESCRIPTION**

- A. The wireless lighting control system shall be capable of providing all of the following functions for all lighting:
  - 1. Continuous dimming and automatic on/off controls.
  - 2. Occupancy control.
  - 3. Vacancy control.
  - 4. Daylight harvesting.
  - 5. Load management.
  - 6. Multi-level scene control
  - 7. Scheduling
  - 8. Demand Response
  - 9. Task Tuning.
  - 10. Power measurement data reporting.
  - 11. Mobile device configuration and control
  - 12. Automatic Code Commissioning
  - 13. The wireless lighting control system shall be capable of continuous dimming and switching allowing each fixture to monitor its local environment and provide distributed control in response to environmental changes.
  - 14. The wireless lighting control system shall provide network communication of all sensor and device data for all light fixtures including power measurement, occupied/unoccupied status, scene status and daylight information.
  - 15. The wireless lighting control system shall provide out-of-the-box functionality of all light fixtures with integrated sensors providing occupancy automatic ON to 75% light level and automatic OFF after 20 minutes. Systems that do not include out-of-the-box functionality shall not be acceptable
  - 16. The wireless lighting control system shall provide a method for the installer to verify wireless communications and address all wireless devices with a single push

- button. Systems that require device addressing using a manual data entry method through software shall not be acceptable.
17. The wireless lighting control system shall provide visible indication on all wireless devices when as each wireless device joins the wireless network. Systems that do not provide a visual indicator per device to the installer shall not be acceptable.
  18. The wireless lighting control system shall provide the capabilities for the installer to create a construction group of all wireless occupancy sensors and wireless wallstations to control all installed wireless light fixtures.
  19. The wireless lighting control system shall be able to be completely programmed and configured using a mobile application. Systems that require web or PC software for configuration shall not be acceptable.
  20. The wireless lighting control system shall allow addressed wireless light fixtures with integrated sensors to be identified by shining a laser or bright flashlight into the sensor. Identified light fixtures shall provide visible indication on the mobile application. Systems that do not permit reverse identification method shall not be acceptable.
  21. The wireless lighting control system shall allow wireless wallstations, receptacles, relays and remote sensors to be identified by simple pushbutton method on each device. Identified devices shall provide visible indication on the mobile application. Systems that do not permit reverse identification method shall not be acceptable.
  22. The wireless lighting control system includes the following components:
  23. Integrated sensors shall include passive infrared sensor, digital photocell, microprocessor, a wireless radio (IEEE 802.15.4), and a load controller for ON/OFF/DIM.
  24. Relay Switchpack with 0-10V control shall contain a utility grade power meter chip and a latching relay to control 20Amp load and 120mA 0-10V sink. Device shall include LED indication and pushbutton for device override and identification.
  25. Tilemount daylight sensor shall include a digital photocell, microprocessor, a wireless radio (IEEE 802.15.4), and a load controller for ON/OFF/DIM.
  26. Wallstation shall be mains powered (120/277VAC), including the following features:
    - a. Numerous button configurations, supporting small and large engraved buttons
    - b. Individual button LED indication
    - c. Universal light icon with raise/lower buttons
    - d. Each button fully programmable for Area Scene or Zone control
    - e. Wireless radio (IEEE 802.15.4)
  27. Battery powered, wireless ceiling sensor shall include passive infrared sensor, microprocessor, a wireless radio (IEEE 802.15.4), LED indication and pushbutton for device identification.
  28. Receptacle control shall include a constant hot and controlled plug output.
    - a. The receptacle control shall provide a single input for incoming power, devices that require constant hot and switched inputs shall not be acceptable.
    - b. The receptacle control shall be clearly marked "Controlled" and with the NEMA defined controlled symbol
    - c. The receptacle control shall include a wireless radio (IEEE 802.15.4) to provide control and power measurement data.
  29. Wireless Area Controllers shall wirelessly communicate (IEEE 802.15.4) with all sensors, wallstations, relays, and receptacles to coordinate control areas, and zones. The Wireless Area Controller shall support the following features:
    - a. Multiple wireless radios
    - b. Power over Ethernet connection to building LAN
    - c. Up to 16 areas
    - d. Up to 16 zones per area
    - e. Area scene configurations
    - f. Multiple occupancy sets per area

- g. Multiple daylight sets per area
  - h. Demand Response reduction values
  - i. Scheduling configuration
  - j. Configuration backup and restore capabilities
  - k. Automatic Code Commissioning
30. Mobile application shall communicate using Wi-Fi to a single Wireless Area Controller or a building IT network with multiple Wireless Area Controllers. The Mobile application shall include the following features:
- a. Ability to connect to multiple Wireless Area Controllers
  - b. Administrative and user login credentials
  - c. Demonstration and Live mode
  - d. Automatic Code Commissioning
  - e. Drag and drop or multi select programming of wireless lighting system
31. LIGHTING CONTROL APPLICATIONS
- a. Minimum lighting control performance required, unless local Energy Code is more stringent.
  - b. Occupancy/vacancy requirements - Provide an occupancy/vacancy sensors with Manual On/ Automatic Off or Automatic On/ Automatic Off functionality in all spaces. Manual On vacancy sensors should be used for any enclosed space with a Manual On switch that does not require hands free operation. Spaces with multiple occupants or where line of sight might be obscured ceiling or corner mount sensors and Manual wallstations would be required. Automatic On of lighting via occupancy sensor cannot exceed 50% of lighting. Systems that do that allow the user to select Occupancy or Vacancy Mode shall not be acceptable.
  - c. Bi-Level switching - Provide multi-level switching and/or variable dimming for maximum energy savings. (Qualifies for EPACT tax deductions of \$0.60 per foot)
  - d. Task Lighting / Receptacle Control - Provide automatic shut off of non-essential plug loads and task lighting in all spaces. Provide Manual On or Automatic On of receptacles whenever spaces are occupied. Receptacle Control will only be shut off when no occupancy is detected within the space. Systems that do not provide receptacle control for a full 20 Amp circuit shall not be acceptable.
  - e. Daylight Zones - Primary sidelit or toplit areas within an enclosed space shall be controlled separately and automatically by individual integrated daylight sensors. Adjustments to the daylight zones must be provided by a simple to use, intuitive mobile application.
  - f. Provide smooth and continuous daylight dimming for areas marked on drawings. Daylighting control system may be designed to dim electric light to the lowest light level and OFF.
  - g. Provide the ability to adjust the high end and low end trim of the dimmers to ensure the lighting automatically provides energy saving even when daylighting calls for full illumination.
  - h. Provide the ability for the dimmers and the relays to function separately. Systems where the 0-10V dimmers and relays are tied together reduce design capabilities and shall not be acceptable.
  - i. Shall be capable of automatically responding to a Demand Response Signal and adjusting the lighting level, without the need of programming or software. Systems that require software or commissioning to provide Demand Response integration shall not be acceptable. (Required for California Title 24 2013)
  - j. Additional controls:
    - 1) Provide occupancy or vacancy sensors (Auto On or Manual On) for any enclosed office, conference, meeting or training rooms. Spaces with multiple occupants or where line of sight may be obscured require ceiling or wall/corner mounted sensors with Manual On switches.

- 2) Conference, meeting, training, auditoriums and multi-purpose rooms shall have controls that allow for scene based and independent control of each output. Rooms larger than 300 square feet shall support at least four (4) pre-set lighting scenes. Occupancy or vacancy sensors shall ensure all lighting, receptacles.
- 3) Egress lighting control shall be integral to the system. The system shall provide an automatic control of adjacent corridor and/or egress lighting based upon room occupancy. Systems that do not ensure that adjacent corridor and/or egress lighting is controlled with room occupancy shall not be acceptable.

#### **1.04 SUBMITTALS**

- A. Specification Conformance Document - Indicate whether the submitted equipment:
  1. Meets specification exactly as stated.
  2. Meets specification via an alternate means and indicate the specific methodology used.
  3. Shop Drawings; include:
    - a. Schematic (one-line diagram) will be specific to the project. Generic one-line diagrams will not be accepted. Provide drawing details for field installation that are specific to the project.
    - b. Wiring diagrams for typical application installation configurations.
    - c. Wiring diagrams for typical device installation configurations.
  4. Product Data: Catalog data sheets with performance specifications demonstrating compliance with specified requirements and are specific to the project.
  5. Sequence of Operation to describe how each component operates and how any building wide functionality is achieved to exceed local energy code (Title 24 2016, ASHRAE 90.1 2016, IECC 2015, or any newer versions of these codes).
  6. Provide a description of the system.
  7. System setup and programming to be provided by installer, certified technician or factory field service personnel.
  8. Follow-up by Field Services for "fine tuning" and additional configuration to occur approximately 90 days after system turnover.

#### **1.05 CLOSEOUT SUBMITTALS**

- A. Sustainable Design Closeout Documentation.
- B. Wireless lighting control system manufacturer to provide an Operation and Maintenance Manual that details the start-up procedure being performed including a process to follow, details on tests performed and an area that documents any test results.

#### **1.06 QUALITY ASSURANCE**

- A. Manufacturer: manufacturer shall have at least 10 years of experience in the manufacture of lighting control systems. Manufacturers that do not have at least 10 years experience shall not be acceptable.
- B. System components:
  1. Listed by UL specifically for the electronic ballast/driver loads. Provide evidence of compliance upon request.
  2. Listed by FCC specifically for the required wireless communication protocols. Provide evidence of compliance upon request.

#### **1.07 APPROVALS**

- A. 10-working days prior approval before bid date is required for alternate proposals.
- B. Complete catalog data, specifications and technical information on alternate equipment must be furnished to the Architect and Owner at least 30 business days in advance of the submission of approved Construction Documents.
- C. For wired alternatives, manufacturer shall provide wiring diagrams and architectural details of interconnecting wiring for power signal and control. Contractor shall provide a labor cost (adder or deduction) to install the wired alternative to the lighting control system.

## **1.08 DELIVERY, STORAGE AND HANDLING**

- A. The contractor is responsible for complete installation of the entire system according to strict factory standards and requirements.
- B. Packaging: All components of the lighting control system shall be packaged in a single box as a QuickKit or as individual components. The QuickKit catalog number will be marked on package label along with bill of materials. Individual component packages will be marked with product catalog number.
- C. Handling: Packaging will include clear installation instructions for all components with typical illustrations of installation locations and connections. The installing contractor can easily match each package to the layout on the design floor plans.

## **1.09 PROJECT CONDITIONS**

- A. Do not install equipment until following conditions can be maintained in spaces to receive equipment:
  - 1. Ambient temperature for indoor devices: 0 degrees to 50 degrees C (32 degrees to 122 degrees F).
  - 2. Ambient temperature for outdoor devices: -35 degrees to 85 degrees C (-31 degrees to 185 degrees F).
  - 3. Relative humidity: Maximum 90 percent, non-condensing.
  - 4. Wireless lighting control system must be protected from dust during installation.
  - 5. Ambient temperature for Lighting Management Appliance: 10 degrees C to 35 degrees C (50 degrees F - 90 degrees F).
  - 6. Coordinate layout and installation of luminaries and controls with other construction.
  - 7. Coordinate site commissioning with manufacturer no less than 21 days prior to required date.

## **1.10 WARRANTY**

- A. Provide manufacturer's Enhanced 5 Year Limited Warranty:
  - 1. 5-year limited warranty for the replacement of defective system components from the date of system shipment.
  - 2. Contractor shall provide limited workmanship warranty for one year from customer acceptance.
  - 3. Eaton wireless fixtures with standard 0-10V dimmable ballast or driver module warranty is [5] years. When purchased with the WaveLinx Wireless Lighting Control system this warranty shall also be [5] years by the lighting fixture manufacturer.

## **1.11 MAINTENANCE MATERIAL SUBMITTALS**

- A. The manufacturer shall make available to the End-User a method of ordering new equipment for expansions, replacements and spare parts through established distributor channels.
- B. The manufacturer shall make new replacement parts available for minimum of 5 years from date of manufacture.
- C. The manufacturer shall make directly available to the owner additional software apps that may be desired for a minimum of 10 years from the system's date of purchase.

# **PART 2 - PRODUCTS**

## **2.01 MANUFACTURERS**

- A. Acceptable Manufacturer: Eaton WaveLinx Wireless Connected Lighting (WCL) system
- B. Substitutions:
  - 1. All proposed substitutions (clearly delineated as such) must be submitted in writing for approval by the design professional a minimum of 10 working days prior to the bid date and must be made available to all bidders. Proposed substitutes must be accompanied by a review of the specification noting compliance on a line-by-line basis.
  - 2. By using pre-approved substitutions, the contractor accepts responsibility and associated costs for all required modifications to circuitry, devices and wiring. The contractor shall



provide complete engineered shop drawings (including power and control wiring) with deviations from the original design, highlighted in an alternate color, to the engineer for review and approval prior to rough-in.

## 2.02 CONNECTED DEVICES

### A. Load control devices.

1. Product: WaveLinx Relay Switchpack with 0-10
  - a. Plenum rated
  - b. Integrated, self-contained unit consisting internally of an isolated load switching control relay [and a power supply to provide low voltage power].
    - 1) 20amp 120/277VAC General Purpose
    - 2) 16amp 120/277VAC electronic ballast (LED load)
    - 3) Single class 2 0-10V dimming output (IEC 60929 Annex E) sinks up to 120mA per (40  $\mu$ A max per circuit leakage to line)
    - 4) 0-10V output supports up to 60 ballasts/drivers that draw a standard 2mA each
  - c. Power measurement accuracy of 5%, reporting data to the Wireless Area Controller for display on the WaveLinx Mobile Application
  - d. Shall be compatible with electronic ballast, LED, incandescent, magnetic or electronic low voltage, and magnetic or electronic fluorescent, as well as motor loads.
  - e. Shall be capable of controlling up to 20Amp receptacle or plug loads.
  - f. Controls incorporate non-volatile memory. Should power be interrupted and subsequently restored, settings and parameters saved in protected memory shall not be lost.
  - g. Relay Switchpack shall be FCC certified.
  - h. Relay Switchpack shall be a Class 1 device
2. Product: WaveLinx Receptacle [WR-20]
  - a. Integrated, self-contained unit providing a constant hot plug connection and a controlled plug connection.
    - 1) 20amp 120VAC constant hot
    - 2) 20amp 120VAC controlled load
  - b. Controlled load plug shall be labelled with "Controlled" and NEMA standard symbol for controlled plug loads.
  - c. Power measurement accuracy of 5%, reporting data to the Wireless Area Controller for display on the WaveLinx Mobile Application
  - d. Shall provide LED indication of status and wireless communication as well as override button.
  - e. Controls incorporate non-volatile memory. Should power be interrupted and subsequently restored, settings and parameters saved in protected memory shall not be lost.
  - f. WaveLinx Receptacle shall be FCC certified.
  - g. WaveLinx Receptacle shall be a Class 1 device

### B. Control devices.

1. Product: WaveLinx Wallstation
  - a. Mains powered wireless wallstation providing multi-level control of an area or zone
    - 1) 120VAC input
  - b. Shall provide individual button LED indication of status and wireless communication as well as selected button.
  - c. Controls incorporate non-volatile memory. Should power be interrupted and subsequently restored, settings and parameters saved in protected memory shall not be lost.
  - d. WaveLinx Wallstation shall be FCC certified.
  - e. WaveLinx Wallstation shall be a Class 1 device

- f. Wireless momentary pushbutton switches in 2, 3, 4, 5 and 6 button configuration; available in white, ivory, grey and black; compatible with wall plates with decorator opening. Wallstations shall include the following features:
  - 1) Multi-level scene selection
  - 2) Scene raise/lower
  - 3) Toggle ON/OFF
  - 4) Removable buttons for field replacement with engraved buttons and/or alternate color buttons. Button replacement may be completed without removing the switch from the wall.
  - 5) Intuitive button labeling to match application and load controls.
  - 6) Pre-defined digital button configurations. Each wallstation is shipped with pre-defined digital button configurations which are automatically mapped to specific area/zone controls when added to an area in the WaveLinx Mobile Application.
- g. Multiple WaveLinx wallstations may be installed in an area by simply connecting them to the WaveLinx network. No additional configuration will be required to achieve multi-way switching.
- h. WaveLinx wallstations are delivered with pre-defined functions including, raise, lower, Half Lights, Full Lights, Read, Relax, Dimmed, Night, manual and scene control.
- i. Optional custom labeling is available for application or location specific wallstation button labels.

## 2.03 CONNECTED SENSORS

- A. Ceiling mounted or fixture integrated sensors.
  - 1. Product: WaveLinx Ceiling Sensor
    - a. Sensing mechanism
      - 1) Infrared: Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.
    - b. Power failure memory
      - 1) Controls incorporate non-volatile memory. Should power be interrupted and subsequently restored, settings and parameters saved in protected memory shall not be lost.
    - c. Products tested in identical manner, complaint to NEMA WD 7 -2011 Occupancy Motion Sensors Standards
    - d. Sensor shall have time delays from 10 to 20 min
    - e. All sensors shall provide an LED as a visual means of indication at all times to verify that motion is being detected during both testing and normal operation
    - f. Sensor is battery powered by standard AA batteries
    - g. Sensor provides indication of battery life through the WaveLinx Mobile Application
    - h. Sensor battery life shall be 10 years based on approximately 30 activations and wireless signals per day.
    - i. Sensors shall monitor changes in occupancy, changes in ambient light levels and communicate digital control commands to light fixtures according to a control strategy.
    - j. Sensor shall wirelessly transmit occupancy; light level, power to the WaveLinx Wireless Area Controller which allows the data to be stored in a central location on premises and displayed via the WaveLinx Mobile Application.
    - k. Sensors shall be fully adaptive with the ability to have the sensitively and timing to be remotely adjusted to ensure optimal lighting control for any use of the space.
    - l. Sensors have remotely adjustable settings for dimming levels, occupied/unoccupied light levels, occupancy/vacancy sensing, and sensitivity to changes in motion and changes in ambient light levels.
    - m. Sensors have the ability to remotely adjust light output to reduced levels and remain at that reduced level for an adjustable time period before turning off when a space is vacant.

- n. Programming is stored in each sensor in addition to the Wireless Area Controller. Sensors operate independently of from Wireless Area Controller, so there cannot be single point failure. Systems must operate so there is no single point of failure.
- o. Responds to digital (load shed command) Demand Response signal.
- p. Sets high end trim via priority assigned in profile.
- 2. Product: WaveLinX Integrated Sensor
  - a. Sensing mechanism
    - 1) Infrared: Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.
    - 2) Daylight: Utilize integrated daylight sensor to provide closed loop daylight dimming control. Each WaveLinX Integrated Sensor provides an individual daylight dimming zone to provide highly accurate daylight levels at the work surface throughout the entire space.
  - b. Power failure memory
    - 1) Controls incorporate non-volatile memory. Should power be interrupted and subsequently restored, settings and parameters saved in protected memory shall not be lost.
  - c. Products tested in identical manner, complaint to NEMA WD 7 -2011 Occupancy Motion Sensors Standards
  - d. Sensor shall have time delays from 10 to 20 min
  - e. Sensor shall provide unique daylight calibration taking into account for light level at the sensors, work surface and integrated luminaire light output.
  - f. All sensors shall provide an LED as a visual means of indication at all times to verify that motion is being detected during both testing and normal operation
    - 1) Green LED indication when sensor is in out-of-the-box operation mode
    - 2) White LED indication when sensor has been connected to the WaveLinX wireless lighting control system
  - g. Test mode- fifteen second time delay
  - h. Walk-through mode
  - i. Sensors are RoHS compliant
  - j. Sensor shall provide out-of-the-box functionality of occupancy detection, directly controlling integrated fixture.
    - 1) Occupied default light level is 75%
    - 2) Unoccupied default light level is OFF
    - 3) Occupancy default time out is 20 minutes
  - k. Sensors shall monitor changes in occupancy, changes in ambient light levels and communicate digital control commands to light fixtures according to a control strategy.
  - l. Sensor shall wirelessly transmit occupancy; light level, power to the WaveLinX Wireless Area Controller which allows the data to be stored in a central location on premises and displayed via the WaveLinX Mobile Application.
  - m. Sensors shall be fully adaptive with the ability to have the sensitively and timing to be remotely adjusted to ensure optimal lighting control for any use of the space.
  - n. Sensors have remotely adjustable settings for dimming levels, occupied/unoccupied light levels, occupancy/vacancy sensing, and sensitivity to changes in motion and changes in ambient light levels.
  - o. Sensors have the ability to remotely adjust light output to reduced levels and remain at that reduced level for an adjustable time period before turning off when a space is vacant.
  - p. Programming is stored in each sensor in addition to the Wireless Area Controller. Sensors operate independently of from Wireless Area Controller, so there cannot be single point failure. Systems must operate so there is no single point of failure.

- q. Responds to digital (load shed command) Demand Response signal.
- r. Sets high end trim via priority assigned in profile.
- 3. Product: WaveLinx Tilemount Daylight Sensor
  - a. Sensing mechanism
    - 1) Daylight: Utilize Tilemount daylight sensor to provide closed loop daylight dimming control to a circuit of connected fixtures.
  - b. Power failure memory
    - 1) Controls incorporate non-volatile memory. Should power be interrupted and subsequently restored, settings and parameters saved in protected memory shall not be lost.
  - c. Tilemount sensor connects to a control module which supports up to 3Amps of connected fixtures.
  - d. Tilemount is designed to be installed in a 1/2" or 3/4" ceiling tile within 54" of the control module and connected fixtures.
  - e. Sensor shall provide unique daylight calibration taking into account for light level at the sensors, work surface and integrated luminaire light output.
  - f. All sensors shall provide an LED as a visual means of indication and diagnostics.
  - g. Sensors are RoHS compliant
- B. Control Module:
  - 1. Sensor shall connect to a 0-10V dimmable ballast or driver via a control module or connect to a WaveLinx enabled drivers without the use of WaveLinx control module.
  - 2. Sensor shall connect to a controller via a low voltage cable for interior applications.
  - 3. If power dropouts in the event of a brown-out or black-out, when power is restored, the lighting system should recover quickly and automatically return to the last lighting levels. A momentary interruption (1 or 2 seconds) of power should not cause extended periods (20 seconds or more) without lighting while the system reboots and all other electrical equipment is back on.
  - 4. Control Module shall be installed by luminaire manufacturer and is shipped as an integral component to the luminaire.
  - 5. Sensor shall be FCC certified.
  - 6. Sensor shall be a Class 2 device.
  - 7. System shall support user initiated manual demand response and utility or BMS initiated automatic demand response.
  - 8. Control Module Components:
    - a. Power Measurement capable of 5% power measurement accuracy.
    - b. Controller to include latching relay, to decrease power requirements of the power pack.
    - c. Operate Bounce Time: 3 ms. Max.
    - d. Max Switching Voltage 277VAC and 125VDC.
    - e. Insulation Rating: Class B and Class F.
    - f. Operations:
    - g. Control Module and Sensor shall communicate energy usage Wireless Area Controller.
    - h. Electrical/Connections:
    - i. Circuit protection:
      - 1) Listed to UL 916.
      - 2) FCC Part 15 Class A certified.
    - j. Manufacturer to pre-wire control module in fixture.
    - k. Control module shall be plenum rated.
    - l. Connection between sensors and control module shall be Class 2, 18-24 AWG, stranded or solid depending on the application U.L Classified, PVC insulated or TEFLON jacketed cable suitable for use in plenums.

## 2.04 CONNECTED SPACES

### A. WaveLinx Wireless Area Controller

1. Spaces shall be equipped with an automatic control device to shut off lighting in those areas. This automatic control device shall function on either:
  - a. a scheduled basis, using time of day, with an independent program schedule that controls the interior lighting in areas that do not exceed 5,000 square feet and are not more than one floor, or
  - b. an occupant sensor that shall turn lighting off within 20 minutes of an occupant leaving a space, or
  - c. a signal from another control or alarm system that indicates the area is occupied.
2. Provide Wireless Area Controllers in the locations and capacities as indicated on the plans and schedules. Each Wireless Area Controller shall have the following capabilities:
  - a. The Wireless Area Controller is a server class appliance that discovers, programs and manages WaveLinx connected devices, connected sensors and connected Apps.
  - b. Uses industry standard HTTPS security with AES-128 encryption safeguards the integrity of the entire system. Backups prevent data loss and restore fixtures to operational modes. It constantly monitors areas to ensure that spaces are managed according to the assigned user preferences and tasks being performed.
  - c. Powered-over-Ethernet (PoE) at 48V device, utilizes the building PoE network switches (by others) or a PoE injector (accessory by Eaton) for power and network connection.
  - d. Maximum CAT 5e cable distance between the Wireless Area Controller and a network PoE switch is 330 feet. Care shall be taken when routing the cable to not exceed the 330-foot limitation including travel distance up and down structures.
  - e. Wi-Fi access point and wireless client capabilities. Wi-Fi capabilities are automatically disabled if the Wireless Area Controller is physically connected to a building LAN and receives an IP address. Systems that allow multiple simulations methods of network connection (Wi-Fi & LAN) shall not be acceptable.
  - f. 2.4 GHz Transceiver for IEEE 802.15.4 wireless radio for communication to connected devices and sensors.
  - g. Shall support AES 128-bit encryption
  - h. LED indicators for status of various wireless radios and communications.
  - i. Shall be FCC Part 15 Class A, RoHS certified.
  - j. Wireless Area Controller connection cables shall be plenum rated.
  - k. Shall be Class 2 devices.
3. Construction Grouping
  - a. PAIR button to allow automatic creation of Construction Group allowing simplified automatic control of all connected devices and sensors.
  - b. The patent-pending Construction Grouping mode permits contractors to complete a quick system start-up to confirm that the devices have been installed correctly, instead of waiting for factory-trained technicians to get the lights on a project in working order. Contractors follow a simple process to pair the wireless devices with the appropriate WAC and initiate occupancy-based lighting control functionality. This saves lighting energy during the construction phase of the project by ensuring that the lights are turned off when the area is unoccupied.
  - c. Construction grouping provides visual indication to the installer that devices have received wireless communication from the Wireless Area Controller and received a unique individual address. Systems that do not provide visual indication of device connection to the wireless network shall not be acceptable.
  - d. Construction grouping provides automatic grouping of connected devices to provide simple occupancy-based and wallstation control of all devices, without the need of a factory trained technician. Systems that require special software or training to group wireless devices shall not be acceptable.

4. Scalability and Data Integrity
  - a. The Wireless Area Controller can be deployed as a dedicated installation managing up to 200 wireless device (connected devices, connected sensors). When deployed as a dedicated installation the Wireless Area Controller acts as a local wireless access point for Wi-Fi connection method to the WaveLinx Mobile Application.
  - b. The Wireless Area Controller can be deployed as a network installation managing up to 200 wireless devices (connected devices, connected sensors) per Wireless Area Controller. When deployed as a network installation the Wireless Area Controller connects to the building LAN or wireless network as a client using DHCP. The maximum number of Wireless Area Controllers on the building network is dependent upon the building network configuration.

## **2.05 CONNECTED APPLICATIONS**

- A. WaveLinx Mobile Application
  1. Administrative programming and editing may be conducted via an intuitive iOS or Android mobile application.
  2. WaveLinx Mobile shall support the following features:
    - a. Network discovery of multiple Wireless Area Controllers
    - b. Naming and identification of Wireless Area Controllers
    - c. Unique administrative login credentials for each Wireless Area Controller
    - d. Discovery of wireless devices per Wireless Area Controller (Find Devices)
    - e. Creation of up to 16 Areas per Wireless Area Controller
    - f. Creation of up to 16 Zones per area
    - g. Creation of multiple Occupancy Sets per area
    - h. Creation of Daylight Sets for each integrated luminaire
    - i. Creation of Demand Response values for each area
    - j. Definition of scene values for each area
    - k. Definition of schedules for each Wireless Area Controller
    - l. Blink identification and reverse identification of each connected devices and sensor
    - m. Identified connected devices and sensors will indicate on the WaveLinx Mobile Application their selection by the device icon pulsing on the screen.
    - n. Ability to utilize drag and drop, multi select and filter capabilities for easy association of connected devices and sensors to a defined area.
    - o. Automatic Code Commissioning features include:
      - 1) Automatic association of all devices added to an area to provide a California Title 24 2016 code compliant sequence of operations
      - 2) All occupancy sensors are joined together to provide an Automatic ON to 50% light level
      - 3) All occupancy sensors are joined together to provide an Automatic OFF of all luminaires and plug loads after 20 minutes of unoccupancy.
      - 4) Automatic closed loop daylighting to approximately 500lux
      - 5) Automatic wallstation button mapping providing the dominant button providing a 50% light level all other buttons provide multi-level dimming control from 30%-100%
      - 6) Automatic display of area power measurement data
      - 7) Automatic Demand Response of 20%
    - p. Additional screens if needed to adjust Automatic Code Commissioning settings.

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. The control system shall be installed and fully wired as shown on the plans by the installing contractor. The contractor shall complete all electrical connections to all control circuits.
- B. Install the work of this Section in accordance with manufacturer's printed instructions unless otherwise indicated.

- C. Provide written or computer-generated documentation on the commissioning of the system including room by room description including:
  - 1. Sensor parameters, time delays, sensitivities and daylighting setpoints.
  - 2. Sequence of operation, (e.g. manual ON, Auto OFF. etc.).
  - 3. Load parameters (e.g. blink warning, ETC.).

### **3.02 PRODUCT SUPPORT AND SERVICE**

- A. Factory telephone support shall be available at no cost to the owner. Factory assistance shall consist of solving programming or application questions concerning the control equipment.

### **3.03 FACTORY COMMISSIONING**

- A. Upon completion of the installation, the system shall be commissioned by the manufacturer's factory authorized representative who will verify a complete fully functional system.
- B. The electrical contractor shall provide both the manufacturer and the electrical engineer with twenty one working days written notice of the system startup and adjustment date.
- C. Upon completion of the system commissioning the factory-authorized technician shall provide the proper training to the owner's personnel on the adjustment and maintenance of the system.
- D. Qualifications for factory certified field service engineer:
  - 1. Certified by the equipment manufacturer on the system installed.
- E. Make first visit upon completion of installation of WaveLinX Wireless Connected Lighting system:
  - 1. Verify locations of Wireless Area Controllers
  - 2. Verify implementation of Construction Group process
  - 3. Identify connected devices and program using WaveLinX Mobile and Automatic Code Commissioning.
  - 4. Verify that system operation control based on defined sequence of operations (SOO).
  - 5. Obtain sign-off on system functions.
- F. Make second visit (optional) to demonstrate and educate Owner's representative on system capabilities, programming, fine tuning and maintenance.
  - 1. Due to building operations, start-up of WaveLinX Wireless Connected Lighting system may be required outside of normal business hours (Monday through Friday, 7 a.m. to 5 p.m.).

### **3.04 CLOSEOUT ACTIVITIES**

- A. Training Visit
  - 1. Lighting control system manufacturer to provide [1] day additional on-site system training to site personnel. This shall be a part of the second visit by field service to the site. A separate third visit will require an additional charge.
  - 2. During this visit, the manufacturer's Field Service Engineer will perform tasks, at the request of the facility representative or Commissioning Agent, such as to demonstrate wall control functions, explain or describe occupancy and/or daylight sensor functionality.
- B. On-site Walkthrough
  - 1. Lighting control system manufacturer to provide a factory certified Field Service Engineer to demonstrate system functionality to the Commissioning Agent.

### **3.05 MAINTENANCE**

- A. Capable of providing on-site service support within 48 hours anywhere in continental United States and within 72 hours worldwide except where special visas are required.
- B. Offer renewable service contract on yearly basis, to include parts, factory labor, and annual training visits. Make service contracts available up to ten years after date of system startup. Additional service contracts and warranties need to be verified as being available.
- C. Prior to bid, confirm if an on-site meeting between the Lighting Control System Manufacturer and a Facility Representative will be required to evaluate system usage after the building has been in operation for a predetermined period of time. If a field service visit is required for

Acceptance Testing or building commissioning, it shall be as an additional charge unless specifically stated in the specification and confirmed on the WaveLinx Wireless Connected Lighting bill of materials.

**END OF SECTION**



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**SECTION 26 22 00**  
**LOW-VOLTAGE TRANSFORMERS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. General purpose transformers.

**1.02 RELATED REQUIREMENTS**

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- C. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- D. Section 26 05 33.13 - Conduit for Electrical Systems: Flexible conduit connections.
- E. Section 26 05 48 - Vibration and Seismic Controls for Electrical Systems.
- F. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

**1.03 REFERENCE STANDARDS**

- A. IEEE C57.94 - IEEE Recommended Practice for Installation, Application, Operation, and Maintenance of Dry-Type General Purpose Distribution and Power Transformers; 1982 (R2006).
- B. IEEE C57.96 - Guide for Loading Dry-Type Distribution and Power Transformers; 2013.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- D. NECA 409 - Standard for Installing and Maintaining Dry-Type Transformers; 2009.
- E. NEMA ST 20 - Dry-Type Transformers for General Applications; 2014.
- F. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- G. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.
- H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. UL 506 - Standard for Specialty Transformers; Current Edition, Including All Revisions.
- J. UL 1561 - Standard for Dry-Type General Purpose and Power Transformers; Current Edition, Including All Revisions.

**1.04 SUBMITTALS**

- A. See Section 01 30 00 - 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. Source Quality Control Test Reports: Include reports for tests designated in NEMA ST 20 as design and routine tests.
- 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, and installation of product.
- E. Project Record Documents: Record actual locations of transformers.

**1.05 QUALITY ASSURANCE**

- A. Conform to requirements of NFPA 70.

- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

#### **1.06 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.

### **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. Substitutions: See Section 26 00 10 - Electrical Equipment and Materials.

#### **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. Greater than 10 kVA: Not exceeding 104 degrees F (40 degrees C).
    - b. Less than 10 kVA: Not exceeding 77 degrees F (25 degrees C).
- C. Core: High grade, non-aging silicon steel with high magnetic permeability and low hysteresis and eddy current losses. Keep magnetic flux densities substantially below saturation point, even at 10 percent primary overvoltage. Tightly clamp core laminations to prevent plate movement and maintain consistent pressure throughout core length.
- D. Impregnate core and coil assembly with non-hydroscopic thermo-setting varnish to effectively seal out moisture and other contaminants.
- E. Basic Impulse Level: 10 kV.
- F. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.
- G. Isolate core and coil from enclosure using vibration-absorbing mounts.
- H. 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: 480 volts delta, 3 phase.
- C. Secondary Voltage: 208Y/120 volts, 3 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.

2. 15 kVA and Larger: Class 220 degrees C insulation system with 150 degrees C average winding temperature rise.
- E. Winding Taps:
1. Less than 3 kVA: None.
  2. 3 kVA through 15 kVA: Two 5 percent full capacity primary taps below rated voltage.
  3. 15 kVA through 300 kVA: Two 2.5 percent full capacity primary taps above and four 2.5 percent full capacity primary taps below rated voltage.
  4. 500 kVA and Larger: Two 2.5 percent full capacity primary taps above and two 2.5 percent full capacity primary taps below rated voltage.
- F. Mounting Provisions:
1. Less than 15 kVA: Suitable for wall mounting.
  2. 15 kVA through 75 kVA: Suitable for floor mounting.
  3. Larger than 75 kVA: Suitable for floor mounting.
- G. Transformer Enclosure: Comply with NEMA ST 20.
1. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
    - a. Outdoor locations: Type 3R.
  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.
- H. Accessories:
1. Weathershield Kits: Provide for ventilated transformers installed outdoors to provide a listed NEMA EN 10250, type 3R assembly.

## **PART 3 EXECUTION**

### **3.01 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 26 05 33.13, 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 26 05 29, where not furnished by transformer manufacturer.
  2. Provide required vibration isolation and/or seismic controls in accordance with Section 26 05 48.
  3. Use integral transformer flanges, accessory brackets furnished by manufacturer, or field-fabricated supports to support wall-mounted transformers.
  4. Unless otherwise indicated, mount floor-mounted transformers on properly sized 3 inch (80 mm) high concrete pad constructed in accordance with Section 03 30 00.
- H. Mount floor-mounted transformers on properly sized 3 inch (80 mm) high concrete pad constructed in accordance with Section 03 30 00.
- I. Mount floor-mounted transformers using vibration isolators suitable for isolating the transformer noise from the building structure.

- J. Provide grounding and bonding in accordance with Section 26 05 26.
- K. 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.
- L. Where not factory-installed, install lugs sized as required for termination of conductors as indicated.

### **3.02 FIELD QUALITY CONTROL**

- A. See Section 01 40 00 - 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.

### **3.03 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.

### **3.04 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**

## **SECTION 26 24 16 PANELBOARDS**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Power distribution panelboards.
- B. Lighting and appliance panelboards.
- C. Overcurrent protective devices for panelboards.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- B. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 26 05 73 - Power System Studies: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.
- E. Section 26 22 00 - Low-Voltage Transformers: Small power centers with integral primary breaker, transformer, and panelboard.
- F. Section 26 43 00 - Surge Protective Devices.

#### **1.03 REFERENCE STANDARDS**

- A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; Federal Specification; Revision E, 2013.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- C. NECA 407 - Standard for Installing and Maintaining Panelboards; 2009.
- D. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- E. NEMA PB 1 - Panelboards; 2011.
- F. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less; 2013.
- G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- I. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- J. UL 67 - Panelboards; Current Edition, Including All Revisions.
- K. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.
- L. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.
- M. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

#### **1.04 SUBMITTALS**

- A. 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. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.

- B. 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.
- C. Project Record Documents: Record actual installed locations of panelboards and actual installed circuiting arrangements.

#### **1.05 QUALITY ASSURANCE**

- A. Comply with requirements of NFPA 70.

#### **1.06 MAINTENANCE MATERIALS**

- A. Furnish two of each panelboard key.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. ABB/GE: [www.geindustrial.com/#sle](http://www.geindustrial.com/#sle).
- B. Eaton Corporation; Type PRL1A, and PRL2A: [www.eaton.com/#sle](http://www.eaton.com/#sle).
- C. Schneider Electric; Square D Products; Type I-LINE, NF and NQ: [www.schneider-electric.us](http://www.schneider-electric.us).

#### **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 determined by short circuit study performed in accordance with Section 26 05 73.
  - 2. Listed series ratings are acceptable, except where not permitted by motor contribution according to NFPA 70.
  - 3. Label equipment utilizing series ratings as required by NFPA 70.
- D. Panelboards Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.
- E. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.
- F. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.
- G. Bussing: Sized in accordance with UL 67 temperature rise requirements.
  - 1. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
- H. Conductor Terminations: Suitable for use with the conductors to be installed.
- I. Enclosures: Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E.
  - 1. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
    - a. Indoor Clean, Dry Locations: Type 1.
    - b. Outdoor Locations: Type 3R.
  - 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.
- J. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.

### **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.
- E. Enclosures:
  - 1. Provide surface-mounted or flush-mounted enclosures as indicated.
  - 2. 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 type unless otherwise indicated.
- E. Enclosures:
  - 1. Provide surface-mounted or 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 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.



- b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
  - c. Series Rated Systems: Provide circuit breakers listed in combination with upstream devices to provide interrupting rating not less than the short circuit current rating indicated.
- 3. Conductor Terminations:
  - a. 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. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.
- 6. 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. 100 Percent Rated Circuit Breakers: Listed for application within the panelboard where installed at 100 percent of the continuous current rating.
- 7. Do not use tandem circuit breakers.
- 8. Do not use handle ties in lieu of multi-pole circuit breakers.
- 9. Provide multi-pole circuit breakers for multi-wire branch circuits as required by NFPA 70.
- 10. 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.

## **PART 3 EXECUTION**

### **3.01 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 26 05 29.
- 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 26 05 26.
- K. Install all field-installed branch devices, components, and accessories.
- L. Multi-Wire Branch Circuits: Group grounded and ungrounded conductors together in the panelboard as required by NFPA 70.
- M. Provide filler plates to cover unused spaces in panelboards.
- N. 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. Security system circuits.
- O. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads.
- P. Provide engraved plastic nameplates under the provisions of Section 26 05 53.

### **3.02 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.

### **3.03 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**

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**SECTION 26 24 19**  
**MOTOR-CONTROL CENTERS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Motor control center units:
- B. Overcurrent protective devices for motor control centers and associated units, including overload relays.
- C. Motor control accessories:
  - 1. Auxiliary contacts.
  - 2. Pilot devices.
  - 3. Control and timing relays.
  - 4. Control power transformers.
  - 5. Control terminal blocks.

**1.02 RELATED REQUIREMENTS**

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- C. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- D. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 26 05 73 - Power System Studies: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.
- F. Section 26 28 13 - Fuses: Fuses for fusible switches.

**1.03 REFERENCE STANDARDS**

- A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; Federal Specification; Revision E, 2013.
- B. IEEE C57.13 - IEEE Standard Requirements for Instrument Transformers; 2008.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- D. NECA 402 - Recommended Practice for Installing and Maintaining Motor Control Centers; 2007.
- E. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- F. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2000 (R2005), with errata, 2008.
- G. NEMA IA 10028 - Instructions for the Handling, Installation, Operation and Maintenance of Motor Control Centers Rated Not More than 600 V; 2024.
- H. NEMA IA 10039 - Control Circuit and Pilot Devices; 2025.
- I. NEMA IA 10030 - Industrial Control and Systems: Enclosures; 2024.
- J. NEMA ICS 18 - Motor Control Centers; 2001 (R2007).
- K. NEMA BS 31047 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013 (Reaffirmed 2023).
- L. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.
- M. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- N. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.

- O. UL 845 - Motor Control Centers; Current Edition, Including All Revisions.

#### **1.04 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for motor control centers, enclosures, units, overcurrent protective devices, and other installed components and accessories.
- C. Shop Drawings: Indicate dimensions, voltage, bus ampacities, unit arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
- 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, and installation of product.
- E. Field Quality Control Test Reports.
- F. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

#### **1.05 QUALITY ASSURANCE**

- A. Conform to 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.

#### **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Receive, inspect, handle, and store motor control centers in accordance with manufacturer's instructions, NECA 402, and NEMA ICS 2.3.
- B. Store in a clean, dry space having a uniform temperature to prevent condensation. Where necessary, provide temporary enclosure space heaters or temporary power for permanent factory-installed space heaters.
- C. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- D. Handle carefully to avoid damage to internal components, enclosure, and finish.

#### **1.07 FIELD CONDITIONS**

- A. Maintain field conditions within required service conditions during and after installation.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Motor Control Centers - Basis of Design: EATON/CUTLER-HAMMER.
- B. Motor Control Centers - Other Acceptable Manufacturers:
  - 1. ABB/GE; \_\_\_\_\_: [www.geindustrial.com/#sle](http://www.geindustrial.com/#sle).
  - 2. Rockwell Automation, Inc.; Allen-Bradley Products; \_\_\_\_\_: [ab.rockwellautomation.com/#sle](http://ab.rockwellautomation.com/#sle).
  - 3. Schneider Electric; Square D Products; \_\_\_\_\_: [www.schneider-electric.us/#sle](http://www.schneider-electric.us/#sle).
- C. 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.
- D. Source Limitations: Furnish motor control centers and associated components produced by a single manufacturer and obtained from a single supplier.

## 2.02 MOTOR CONTROL CENTERS

- A. Provide motor control centers consisting of all required components, control power transformers, instrumentation and control wiring, accessories, etc. as necessary for a complete operating system.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Description: Dead-front standard (non-arc-resistant) type motor control center assemblies complying with NEMA ICS 18, and listed and labeled as complying with UL 845; ratings, configurations and features as indicated on the drawings.
- D. Configuration:
  - 1. Arrangement: Front-mounted units only (no rear-mounted units or back-to-back configuration).
  - 2. NEMA Classification and Wiring Type: NEMA ICS 18, Class I, Type B (B-T for units size 3 or smaller).
- E. Short Circuit Current Rating:
  - 1. Provide motor control centers and associated units with listed short circuit current rating not less than the available fault current at the installed location as determined by short circuit study performed in accordance with Section 26 05 73.
- F. Bussing:
  - 1. Horizontal Main Bus: Size for a maximum temperature rise of 117 degrees F (65 degrees C) over an ambient temperature of 104 degrees F (40 degrees C), in compliance with NEMA ICS 18 and UL 845 requirements.
  - 2. Vertical Bus: Minimum size of 300 A, in compliance with NEMA ICS 18 requirements.
  - 3. Provide solidly bonded equipment ground bus through full length of motor control center, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
  - 4. Phase and Neutral Bus Material: Aluminum or copper.
  - 5. Ground Bus Material: Aluminum or copper.
- G. Conductor Terminations: Suitable for use with the conductors to be installed.
  - 1. Line Conductor Terminations:
    - a. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
    - b. Main and Neutral Lug Type: Mechanical.
- H. Enclosures:
  - 1. Comply with NEMA IA 10030.
  - 2. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
  - 3. Finish: Manufacturer's standard unless otherwise indicated.
- I. Future Provisions:
  - 1. Prepare designated spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.
- J. Instrument Transformers:
  - 1. Comply with IEEE C57.13.
  - 2. Select suitable ratio, burden, and accuracy as required for connected devices.
  - 3. Current Transformers: Connect secondaries to shorting terminal blocks.
  - 4. Potential Transformers: Include primary and secondary fuses with disconnecting means.

## 2.03 MOTOR CONTROL CENTER UNITS

- A. Feeder Units: Circuit breaker type.
- B. Combination Magnetic Motor Starter Units:
  - 1. Description: NEMA ICS 2, Class A combination motor controllers with magnetic contactor(s), externally operable disconnect and overload relay(s).
  - 2. Configuration: Full-voltage non-reversing type unless otherwise indicated.

3. Disconnects: Circuit breaker type.
  - a. Circuit Breakers: Motor circuit protectors (magnetic-only) unless otherwise indicated or required.
  - b. Provide externally operable handle with means for locking in the OFF position. Provide safety interlock to prevent opening the cover with the disconnect in the ON position with capability of overriding interlock for testing purposes.
  - c. Provide auxiliary interlock for disconnection of external control power sources where applicable.
4. Overload Relays: Bimetallic thermal type unless otherwise indicated.
5. Pilot Devices Required:
  - a. Furnish local pilot devices for each unit as specified below unless otherwise indicated on drawings.
  - b. Single-Speed, Non-Reversing Starters:
    - 1) Pushbuttons: START-STOP.
    - 2) Selector Switches: HAND/OFF/AUTO.
    - 3) Indicating Lights: Red ON, Green OFF.

## **2.04 OVERCURRENT PROTECTIVE DEVICES**

- A. Overload Relays:
  1. Provide overload relays and, where applicable, associated current elements/heaters, selected according to actual installed motor nameplate data, in accordance with manufacturer's recommendations and NFPA 70; include consideration for motor service factor and ambient temperature correction, where applicable.
  2. Inverse-Time Trip Class Rating: Class 20 unless otherwise indicated or required.
  3. Trip-free operation.
  4. Visible trip indication.
  5. Resettable.
    - a. Employ manual reset unless otherwise indicated.
    - b. Do not employ automatic reset with two-wire control.
  6. Bimetallic Thermal Overload Relays:
    - a. Interchangeable current elements/heaters.
    - b. Adjustable trip; plus/minus 10 percent of nominal, minimum.
    - c. Trip test function.
- B. Circuit Breakers:
  1. Interrupting Capacity (not applicable to motor circuit protectors):
    - a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than specified minimum requirements.
    - b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
  2. Motor Circuit Protectors:
    - a. Description: Instantaneous-trip circuit breakers furnished with magnetic instantaneous tripping elements for short circuit protection, but not with thermal inverse time tripping elements for overload protection; UL 489 recognized only for use as part of a listed combination motor controller with overload protection; ratings, configurations, and features as indicated on the drawings.
    - b. Provide field-adjustable magnetic instantaneous trip setting.
  3. Molded Case Circuit Breakers:
    - a. 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.

## **2.05 MOTOR CONTROL ACCESSORIES**

- A. Auxiliary Contacts:
  - 1. Comply with NEMA IA 10039.
  - 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 starter unit, minimum.
- B. Pilot Devices:
  - 1. Comply with NEMA IA 10039; heavy-duty type.
  - 2. Pushbuttons: Unless otherwise indicated, provide momentary, non-illuminated type with flush button operator; normally open or normally closed as indicated or as required.
  - 3. Selector Switches: Unless otherwise indicated, provide maintained, non-illuminated type with knob operator; number of switch positions as indicated or as required.
  - 4. Indicating Lights: Push-to-test type unless otherwise indicated.
  - 5. Provide LED lamp source for indicating lights and illuminated devices.
- C. Control and Timing Relays:
  - 1. Comply with NEMA IA 10039.
  - 2. Provide number and type of relays indicated or required to perform necessary functions.
- D. Control Power Transformers:
  - 1. Size to accommodate burden of contactor coil(s) and all connected auxiliary devices.
  - 2. Include primary and secondary fuses.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings and configurations of the motor control centers and associated components are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive motor control centers.
- 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. Install motor control centers in accordance with NECA 1 (general workmanship), NECA 402, and NEMA IA 10028.
- C. Arrange equipment to provide required clearances and maintenance access, including accommodations for any drawout devices.
- D. Install motor control centers plumb and level.
- E. Unless otherwise indicated, mount motor control centers on properly sized 4 inch (100 mm) high concrete pad constructed in accordance with Section 03 30 00.
- F. Provide grounding and bonding in accordance with Section 26 05 26.
- G. Install all field-installed devices, components, and accessories.
- H. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
- I. Set field-adjustable motor controllers and associated components according to installed motor requirements, in accordance with manufacturer's recommendations and NFPA 70.
- J. Provide filler plates to cover unused spaces.
- K. Provide engraved plastic nameplates; refer to Section 26 05 53 for product requirements and location.



- L. Motor Data: Neatly type label inside each motor starter door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating. Place label in clear plastic holder.

### **3.03 FIELD QUALITY CONTROL**

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Before energizing motor control center, perform insulation resistance testing in accordance with NECA 402 and NEMA IA 10028.
- C. Inspect and test in accordance with NETA ATS, except Section 4.
- D. Perform inspections and tests listed in NETA ATS, Section 7.16.2.1.
- E. Motor Starters: Perform inspections and tests listed in NETA ATS, Section 7.16.1.1. Tests listed as optional are not required.
- F. Correct deficiencies and replace damaged or defective motor control centers or associated components.

### **3.04 CLEANING**

- A. Clean dirt and debris from motor control center enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred surfaces to match original factory finish.

**END OF SECTION**

## **SECTION 26 27 26 WIRING DEVICES**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Wall switches.
- B. Receptacles.
- C. Wall plates and covers.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- B. Section 26 05 33.16 - Boxes for Electrical Systems.
- C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

#### **1.03 REFERENCE STANDARDS**

- A. FS W-C-596 - Connector, Electrical, Power, General Specification for; Federal Specification; Revision G, 2001.
- B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush-mounted (General Specification); Federal Specification; Revision F, 1999.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- D. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2010.
- E. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (R 2010).
- F. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2012.
- G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. UL 20 - General-Use Snap Switches; Current Edition, Including All Revisions.
- I. UL 498 - Attachment Plugs and Receptacles; Current Edition, Including All Revisions.
- J. UL 514D - Cover Plates for Flush-Mounted Wiring Devices; Current Edition, Including All Revisions.
- K. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.
- L. UL 1310 - Class 2 Power Units; Current Edition, Including All Revisions.
- M. 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.

#### **1.05 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.

## **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 WIRING DEVICES - GENERAL REQUIREMENTS**

- A. Provide wiring devices suitable for intended use with ratings adequate for load served.

### **2.02 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 weather resistant GFCI receptacles with specified weatherproof covers for receptacles installed outdoors or in damp or wet locations.
- D. Provide tamper resistant receptacles for receptacles installed in all school facilities.
- E. Provide GFCI protection for receptacles installed within 6 feet (1.8 m) of sinks.
- F. Provide GFCI protection for receptacles installed in kitchens.
- G. Provide GFCI protection for receptacles serving electric drinking fountains.
- H. Unless noted otherwise, do not use combination switch/receptacle devices.

### **2.03 ALL WIRING DEVICES**

- A. Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

### **2.04 WALL SWITCHES**

- A. Wall Switches - General Requirements: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20 and where applicable FS W-S-896; types as indicated on the drawings.
  - 1. Wiring Provisions: Terminal screws for side wiring and screw actuated binding clamp for back wiring with separate ground terminal screw.

### **2.05 RECEPTACLES**

- A. Receptacles - 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.
- B. Convenience Receptacles:
  - 1. Automatically Controlled Convenience Receptacles: Commercial specification grade, 20A, 125V, NEMA 5-20R; controlled receptacle marking on device face per NFPA 70; single or duplex as indicated on the drawings.
  - 2. Tamper Resistant Convenience Receptacles: Commercial specification grade, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as tamper resistant type; single or duplex as indicated on the drawings.
  - 3. Tamper Resistant and Weather Resistant Convenience Receptacles: Commercial specification grade, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as tamper resistant type and as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations; single or duplex as indicated on the drawings.

- C. 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.
  - 2. Tamper Resistant GFCI Receptacles: Commercial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as tamper resistant type.
  - 3. Tamper Resistant and Weather Resistant GFCI Receptacles: Commercial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as tamper resistant type and as weather resistant type complying with UL 498 Supplement SD suitable for installation in damp or wet locations.

## **2.06 WALL PLATES AND COVERS**

- 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. Stainless Steel Wall Plates: Brushed satin finish, Type 302 stainless steel.

## **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 branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.
- F. 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 26 05 33.16 as required for installation of wiring devices provided under this section.
  - 1. Mounting Heights: Unless otherwise indicated, as follows:
    - a. Wall Switches: 48 inches (1200 mm) above finished floor.
    - b. Wall Dimmers: 48 inches (1200 mm) above finished floor.
    - c. Receptacles: 18 inches (450 mm) above finished floor or 6 inches (150 mm) above counter.
  - 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 3 inches (80 mm) from edge of door frame. Where locations are indicated otherwise, notify Engineer to obtain direction prior to proceeding with work.

- 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. Install wiring devices plumb and level with mounting yoke held rigidly in place.
- J. Install wall switches with OFF position down.
- K. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.
- L. Do not share neutral conductor on branch circuits utilizing wall dimmers.
- M. Install vertically mounted receptacles with grounding pole on top and horizontally mounted receptacles with grounding pole on left.
- N. 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.
- O. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.
- P. Coordinate locations of outlet boxes provided under Section 260537 to obtain mounting heights specified.

#### **3.04 FIELD QUALITY CONTROL**

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Inspect each wiring device for damage and defects.
- C. Operate each wall switch and wall dimmer 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. Correct wiring deficiencies and replace damaged or defective wiring devices.

#### **3.05 ADJUSTING**

- A. Adjust devices and wall plates to be flush and level.

#### **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**

**SECTION 26 51 00  
INTERIOR LIGHTING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Interior luminaires.
- B. Emergency lighting units.
- C. Exit signs.
- D. Ballasts and drivers.
- E. Emergency power supply units.

**1.02 REFERENCE STANDARDS**

- A. IES LM-79 - Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products; 2008.
- B. IES LM-80 - Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays, and Modules; Illuminating Engineering Society; 2015.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- D. NECA/IESNA 500 - Standard for Installing Indoor Commercial Lighting Systems; 2006.
- E. NECA/IESNA 502 - Standard for Installing Industrial Lighting Systems; 2006.
- F. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility; 2012.
- G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. NFPA 101 - Life Safety Code; 2015.
- I. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.
- J. UL 1598 - Luminaires; Current Edition, Including All Revisions.
- K. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

**1.03 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.

**1.04 SUBMITTALS**

- A. 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.
- B. 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.
- b. Include IES LM-79 test report upon request.

- 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. Operation and Maintenance Data: Instructions for each product including information on replacement parts.

## **1.05 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.

## **PART 2 PRODUCTS**

### **2.01 LUMINAIRE TYPES**

- A. Furnish products as indicated in luminaire schedule included on the drawings. For voluntary alternates, see Section 26 00 10.

### **2.02 LUMINAIRES**

- A. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- B. Provide products that comply with requirements of NFPA 70 and NFPA 101.
- 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, drivers, power supplies, 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.
  2. Luminaires Recessed in Insulated Ceilings: Listed and labeled as IC-rated, suitable for direct contact with insulation and combustible materials.
  3. Luminaires Recessed in Sloped Ceilings: Provide suitable sloped ceiling adapters.
- H. 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.
- I. Luminaires Mounted in Continuous Rows: Provide quantity of units required for length indicated, with all accessories required for joining and aligning.

### **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.
- F. Accessories:
  - 1. Provide compatible accessory wire guards where indicated.

#### **2.04 EXIT SIGNS**

- A. Description: Exit signs and similar signs for special purpose applications such as area of refuge/rescue assistance.
- B. 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.
- C. 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.
    - a. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.
    - a. Provide low-voltage disconnect to prevent battery damage from deep discharge.
- D. Accessories:
  - 1. Provide compatible accessory wire guards where indicated.

#### **2.05 BALLASTS AND DRIVERS**

- A. Ballasts/Drivers - General Requirements:
- B. Dimmable LED Drivers:
  - 1. Dimming Range: Continuous dimming from 100 percent to 10 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.

#### **2.06 EMERGENCY POWER SUPPLY UNITS**

- A. Description: Self-contained emergency power supply units suitable for use with indicated luminaires, complying with NFPA 101 and applicable state and local codes, and listed and labeled as complying with UL 924.
- B. Compatibility:
  - 1. Drivers: Compatible standard, energy saving, and dimming AC LED drivers, including those with end of lamp life shutdown circuits.
- C. Operation: Upon interruption of normal power source, solid-state control automatically switches connected lamps to emergency power supply for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.



- D. Diagnostics: Provide accessible and visible multi-chromatic combination test switch/indicator light to display charge, test, and diagnostic status and to manually activate emergency operation.

## **PART 3 EXECUTION**

### **3.01 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.

### **3.02 INSTALLATION**

- A. Coordinate locations of outlet boxes provided under Section 26 05 33.16 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 26 05 29.
- F. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- G. Suspended Ceiling Mounted Luminaires:
  - 1. Do not use ceiling tiles to bear weight of luminaires.
  - 2. Do not use ceiling support system to bear weight of luminaires unless ceiling support system is certified as suitable to do so.
  - 3. Secure surface-mounted and recessed luminaires to ceiling support channels or framing members or to building structure.
  - 4. Secure pendant-mounted luminaires to building structure.
  - 5. Secure lay-in luminaires to ceiling support channels using listed safety clips at two corners.
  - 6. See appropriate Division 9 section where suspended grid ceiling is specified for additional requirements.
- H. 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.
  - 3. Luminaires Recessed in Fire-Rated Ceilings: Install using accessories and firestopping materials to meet regulatory requirements for fire rating.
- I. Suspended Luminaires:
  - 1. Unless otherwise indicated, specified mounting heights are to bottom of luminaire.
  - 2. Install using the suspension method indicated, with support lengths and accessories as required for specified mounting height.
  - 3. Provide minimum of two supports for each luminaire equal to or exceeding 4 feet nominal length, with no more than 4 feet (1.2 m) between supports.
  - 4. Install canopies tight to mounting surface.
  - 5. Unless otherwise indicated, support pendants from swivel hangers.
- J. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to bottom of luminaire.
- K. Lighting in equipment rooms and electric closets is diagrammatic, indicating type, quantity and general circuiting of fixtures. Modify locations and mounting to suit conditions, allowing clearances for equipment, piping and ductwork.
- L. Install accessories furnished with each luminaire.

- M. Bond products and metal accessories to branch circuit equipment grounding conductor.
- N. Interface with air handling accessories.
- O. 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.
- P. Remote Drivers: Install in concealed and accessible location as indicated or as required to complete installation, using conductors per manufacturer's recommendations not exceeding manufacturer's recommended maximum conductor length to luminaire.

### **3.03 FIELD QUALITY CONTROL**

- A. See Section 01 40 00 - 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 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 Engineer.
- F. New light fixtures SHALL NOT be used as temporary lighting. Once they are installed, test for proper installation, then leave off until ready to turn over to owner. Maintain temporary lighting throughout entire project.

### **3.04 ADJUSTING**

- A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Engineer. Secure locking fittings in place.
- B. Aim and position adjustable emergency lighting unit lamps to achieve optimum illumination of egress path as required or as directed by Engineer or authority having jurisdiction.
- C. Exit Signs with Field-Selectable Directional Arrows: Set as indicated or as required to properly designate egress path as directed by Engineer or authority having jurisdiction.

### **3.05 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.

### **3.06 PROTECTION**

- A. Protect installed luminaires from subsequent construction operations.

### **3.07 PROTECTION**

- A. Relamp luminaires that have failed lamps at Substantial Completion.

### **3.08 SCHEDULE - SEE DRAWINGS**

**END OF SECTION**

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**SECTION 26 60 50**  
**TELEPHONE, TELEVISION AND DATA SYSTEMS' RACEWAYS**

**PART 1 – GENERAL**

**1.01 DESCRIPTION OF WORK**

- A. This section of the specification indicates the scope of the work for the Sault Ste. Marie Area Public Schools High School Multi-Purpose Room Renovation Project contract.
- B. The Telephone, Television and Data Cabling raceway system shall include, but not be limited to, the following:
  - 1. Complete raceway system including conduit as indicated on the drawings.
  - 2. Provide all electrical power outlets as indicated on the drawings.
  - 3. Installation of the raceway system shall be closely coordinated with the Contractor performing the wiring and termination of the Telephone, Television and Data Cabling systems. The electrical contractor for the Sault Ste. Marie Area Public Schools High School Multi-Purpose Room Renovation Contract shall provide any miscellaneous power and raceway system work required to complete the raceway system to facilitate installation of the Telephone, Television and Data Cabling system.
- C. The Telephone, Television and Data Cabling System components will be provided under a separate contract, unless otherwise noted.

**PART 2 – PRODUCTS (NOT APPLICABLE)**

**PART 3 – EXECUTION (NOT APPLICABLE)**

**END OF SECTION**

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**SECTION 26 60 51  
SECURITY SYSTEM RACEWAYS**

**PART 1 – GENERAL**

**1.01 DESCRIPTION OF WORK**

- A. This section of the specification indicates the scope of the work for the Sault Ste. Marie Area Public Schools High School Multi-Purpose Room Renovation Project contract.
- B. The Security Cabling raceway system shall include, but not be limited to, the following:
  - 1. Complete raceway system including conduit as indicated on the drawings.
  - 2. Provide all electrical power outlets as indicated on the drawings.
  - 3. Installation of the raceway system shall be closely coordinated with the Contractor performing the wiring and termination of the Security Cabling systems. The electrical contractor for the Sault Ste. Marie Area Public Schools High School Multi-Purpose Room Renovation Contract shall provide any miscellaneous power and raceway system work required to complete the raceway system to facilitate installation of the Security Cabling system.
- C. The Security Cabling System components will be provided under a separate contract, unless otherwise noted.

**PART 2 – PRODUCTS (NOT APPLICABLE)**

**PART 3 – EXECUTION (NOT APPLICABLE)**

**END OF SECTION**

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**SECTION 28 31 00**  
**FIRE DETECTION AND ALARM SYSTEM**

**PART 1 GENERAL**

**1.01 RELATED DOCUMENTS**

- A. Work covered by this section includes the furnishing of labor, equipment, and materials for demolition, renovation, and installation of the fire alarm system devices as indicated on the schematic design drawings and related construction documents including General and Supplementary Conditions and Division 01 General Requirements, shall be included in and made part of this Section.

**1.02 RELATED SECTIONS:**

- A. Division 01 General Requirements
- B. Division 07 Thermal and Moisture Protection, Section 078413 Penetration Firestopping
- C. Division 08 Openings, Section 087100 Door Hardware
- D. Division 14 Conveying Equipment, Section 14 28 16 Elevator Controls
- E. Division 21 Fire Suppression, Section 21 13 00 Fire-Suppression Sprinkler Systems
- F. Division 21 Fire Suppression, Section 21 22 00 Clean-Agent Fire-Extinguishing Systems
- G. Division 21 Fire Suppression, Section 21 30 00 Fire pumps
- H. Division 23 Heating Ventilating and Air Conditioning, Section 23 09 93 Sequence of Operations for HVAC Controls
- I. Division 25 Integrated Automation, Section 25 98 00 Integrated Automation Control Sequences for Electronic Safety and Security Systems
- J. Division 26 Electrical, Section 26 05 00 Common Work Results for Electrical

**1.03 SUMMARY – DESCRIPTION OF WORK**

- A. This specification includes the demolition, furnishing, installation, connection, and testing of the extension, expansion, and/or renovation of the microprocessor controlled, conventional zone type fire alarm equipment required to form a complete, operative, coordinated system. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, auxiliary control devices, annunciators, and wiring as shown on the drawings and specified herein.
- B. **The fire alarm contractor is responsible for any and all plan review fees associated with the project as required by the Authority Having Jurisdiction.**
- C. Notification shall be one-way voice communications paging system with pre-recorded messages and pre-alert tones. All speaker shall be high fidelity type for intelligibility.
- D. Provide remote system access utilizing standard internet browser for systems status, and system reports.
- E. System shall have the capability to provide email and SMS text messaging over a secure network within the main control panel for transmitting all system events to Owner's designated personnel over the internal building WAN/LAN.
- F. Provide mobile application software for the end user to access the system with Apple or Google mobile device. Include (5) users in this project scope and ability to access the same information from Web Browser.
- G. All notification appliance circuit(s) shall have installed circuit spare capacity at the end of the circuit to support two (2) 115 Candela ceiling strobe visual appliances. Each floor/level shall be designed to support a minimum capacity of twenty (20) 115 Candela ceiling strobe visual appliances.

**1.04 REFERENCED STANDARDS**

- A. The fire alarm equipment and installation shall comply with the current provisions of the following latest edition standards (unless otherwise noted below) applicable to the jurisdictional



authorities, including their local adoptions and amendments and it shall be listed for its intended purpose of a Fire Alarm Detection and Notification System and be compatibility listed to insure integrity of the complete system to include all notification appliances. It shall be listed to all of the UL Standards listed below, without exception.

- B. Building Codes and National Fire Protection Association (NFPA):
  - 1. IBC - International Building Code – latest enforceable edition
  - 2. IFC - International Fire Code – latest enforceable edition
  - 3. IMC - International Mechanical Code – latest enforceable edition
  - 4. NFPA 70- National Electrical Code (NEC) – latest enforceable edition
  - 5. NFPA 72- National Fire Alarm Code – latest enforceable edition
  - 6. NFPA 101- Life Safety Code – latest enforceable edition
  - 7. Local amendments to Building Code.
  - 8. Underwriters Laboratories, Inc. (UL)
  - 9. UL 864- Control Units for Fire Protective Signaling Systems (10th Edition)
  - 10. UL 268- Smoke Detector for Fire Protective Signaling Systems (7th Edition)
  - 11. UL 217- Smoke Detectors for Single and Multiple Station (6th Edition)
  - 12. UL 521- Heat Detectors for Fire Protective Signaling Systems (7th Edition)
  - 13. UL 464- Audible Signaling Appliances (10th Edition)
  - 14. UL 1971- Visual Signaling Appliances (3rd Edition)
  - 15. UL 38- Manually Actuated Signaling Boxes (8th Edition)
  - 16. UL 1481- Power Supplies for Fire Protective Signaling Systems (5th Edition)

## **1.05 SUBMITTALS**

- A. The Contractor shall not purchase any equipment for the system specified herein until the Owner has approved the project submittals in their entirety and has returned them to the contractor with Owner's approval in writing. It is the responsibility of the contractor to meet the entire intent and functional performance detailed in these specifications. Approved submittals shall only allow the contractor to proceed with the installation and shall not be construed to mean that the contractor has satisfied the requirements of these specifications. The Contractor shall submit nine (9) hard copies or one (1) electronic copy of complete sets of documentation, or as called for elsewhere as superseded by an order of precedence, within 30 calendar days after issuance of a mutually executed agreement.
- B. Each submittal shall include a cover letter providing a list of each variation that the submittal may have from the requirements of the Contract Documents. In addition, the Contractor shall provide specific notation on each Shop Drawing, sample, catalog cut, data sheet, installation manual, etc. submitted for review and approval, of each such variation.
  - 1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to the Architect.
- C. Product Data: Product Data sheets with the printed logo or trademark of the manufacturer of all equipment. Indicated in the documentation shall be the type, size, rating, style, and catalog number for all items proposed to meet the system performance detailed in this specification. The proposed equipment shall be subject to the approval of the Owner.
- D. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Comply with all recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 as a requirement.
  - 2. Include voltage drop calculations for notification appliance circuits based on manufacturer-provided panel start voltage and point-to-point notification appliance circuit calculations. System Layout drawings prepared using the Lump Sum Method for visual strobe circuits are not acceptable.
    - a. Each notification circuit shall have installed circuit capacity at the end of the circuit to support two (2) 115 Candela ceiling strobe visual appliances.
    - b. Each floor/level shall be designed to support a minimum capacity of twenty (20) 115 Candela ceiling strobe visual appliances.

- c. Circuit loading for speakers with maximum of 1 db loss, per circuit.
  - 3. Include battery-size calculations. Batteries shall include a 25% safety factor above the minimum requirements derived from calculations, as required by NFPA 72.
  - 4. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
  - 5. Locate all detectors in accordance with the installation standards as prescribed by the applicable edition of NFPA 72.
  - 6. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
  - 7. Indicate speaker wattage tap settings for all speakers on the floor plans, calculate and show dB Line Loss calculations for all speaker circuits using the Lump sum method. dB Losses shall be no greater than 1.0 dB from amplifier start terminals to last device.
  - 8. Indicate all Acoustically Distinguishable Areas as determined by the Architect/Engineers Contract Documents on the installation shop drawings.
  - 9. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits from end-to-end. "Home Run" indicators or other non-end-to-end wire path designations are not acceptable.
  - 10. Provide the SLC – Intelligent Loop, Point-to-Point Schematic As-Built drawing, showing all Intelligent Addressable Devices (Detectors & Modules) in the exact order the devices are installed and locations of any T-Taps. Use of the electronic Map feature is acceptable equal.
- E. Operation and Maintenance Data: For fire-alarm systems and components to be included in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data, include the following:
- 1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
  - 2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
  - 3. Record copy of site-specific software database file, hardcopy printout and CD, with password for delivery to the owner. The system will also store copy of the database on the system, available for upload. Proprietary system/service companies will not be acceptable.
  - 4. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:
    - a. Frequency of testing of installed components.
    - b. Frequency of inspection of installed components.
    - c. Requirements and recommendations related to results of maintenance.
    - d. Manufacturer's user training manuals (hardcopy) and electronic on CD.
  - 5. Manufacturer's required maintenance related to system warranty requirements.
  - 6. Abbreviated operating instructions for mounting at fire-alarm control unit.
- F. Software and Firmware Operational Documentation:
- 1. Flash Memory media of site-specific software database file with password, all product data sheets and AutoCAD files. Provide hard copy printout of the software program. Proprietary system/service companies will not be acceptable.
  - 2. Provide a list of global system settings
  - 3. Provide a list of the contents of each system cabinet and their settings
  - 4. Provide a list of all addressable devices with their addresses and settings.
  - 5. All information shall be housed in the Document Storage Cabinet, see Part 2 – Products for Specification.

## 1.06 QUALITY ASSURANCE

- A. Installer Qualifications: Fire Alarm Distributor's employed personnel shall be trained and certified by manufacturer on the make and model of the fire alarm control panel specified for this Project.

- B. Additional Installer Qualifications: Installation shall be by personnel certified by NICET as a technician who has been certified at Level II in the sub-field of Fire Alarm Systems Layout.
- C. Project Manager Qualifications: Installation shall be supervised by personnel certified by NICET as Fire Alarm System Layout Level IV Technician (SET), an NFPA Certified Fire Protection Specialist (CFPS) or an NCEES accredited Licensed Fire Protection Engineer (FPE).
- D. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from authorized dealer by the product manufacturer. Single source providers shall not be acceptable. Manufacturer's components shall be compatible with and operate as a fully U.L. listed extension of a U.L. 864 listed fire alarm control system.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- F. Fire Alarm Distributor Qualifications:
  - 1. Fire Alarm Distributor shall be a full service entity qualified to provide the engineering for the technical submittal, furnishing of the equipment, commissioning, testing and inspection services outlined herein including intelligibility testing and capable of providing full repair service to any fire alarm system and/or provide fire alarm system installation and design including, but not limited to, the following minimum requirements:
    - a. Qualified Fire Alarm Service Company with employees who meet the criteria defined by NFPA 72 for the qualifications of both System Designers and System Installers to include the requirements of the Authorities Having Jurisdiction (AHJ).
    - b. Certified Fire Alarm Service Inspectors with employees of the entity who are certified in Fire Protection Engineering Technology by the National Institute for Certification in Engineering Technologies (N.I.C.E.T.) in FIRE ALARM SYSTEMS – LEVEL II, minimum.
    - c. Five (5) Years of experience with intelligibility measurement technology and testing (minimum) is required for this project and the Fire Alarm Distributor shall provide intelligibility measurement equipment capable of registering and recording Intelligibility readings in accordance with IEC 60268-16, Sound System Equipment - Part 16: Objective Rating of Speech Intelligibility by Speech Transmission Index. Equipment shall have been calibrated within one (1) year of the commencement of the intelligibility testing for this project.

## **1.07 WARRANTY AND SERVICE AGREEMENT**

- A. The contractor shall warranty all materials, installation, programming and workmanship for One (1) year from date of acceptance, and all Fire Alarm Equipment Component materials for a period of Two (2) years after that, for a Three (3) year in total manufacturer's equipment warranty. A copy of the manufacturers' Three (3) year warranty shall be provided with closeout documentation and included with the operation and installation manuals
- B. The System Supplier shall maintain a service organization with adequate spare parts stocked within 75 miles (120.7 kilometers) of the installation. Any defects that render the system inoperative shall be repaired within 24 hours of the Owner notifying the contractor. This warranty is void if the product is altered, repaired, or serviced by anyone other than the original equipment provider.
- C. Detector Sensitivity Testing: During the warranty period, each year the contractor is to perform detector sensitivity testing and provide report to the Owner. Unless, the system is UL Listed to perform automatic sensitivity testing without any manual intervention and should detector fall outside of sensitivity window, the system will automatically indicated a devices trouble. A copy of UL letter is to be provided as proof of system operation
- D. Extended Maintenance Service:
  - 1. Offer for the Owner's consideration and evaluation at the time of Product Data Submittal, a priced inspection, maintenance, testing, and repair contract in compliance with the manufacturer's recommended routine preventive maintenance program and NFPA 72 requirements necessary to maintain full ongoing listing on the complete installed system.

2. The services offered under this contract shall begin after the completion of the Initial Maintenance Service and Warranty Period.
3. The Owner shall have the option of renewing for single or multiple years, up to six years, at the price quoted upon completion of the Warranty period.
  - a. The contractor performing the contract services shall be qualified and listed to maintain ongoing certification and listing of the completed system.

#### **1.08 EXTRA MATERIALS**

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  1. Provide quantity equal to 2% percent of amount of each detector type installed, but no fewer than 1 unit of each type.
  2. Smoke Detectors, heat detectors, carbon monoxide detectors, combination detectors, manual pull stations, duct smoke detector circuit boards, relay modules, monitor modules and control modules:
  3. Interior notification appliances; horn-strobes and strobes
  4. Keys and Tools: Ten (10) extra sets for access to locked and tamper-proofed components.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Manufacturers: The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approvals agency for use as part of a protected premises protective signaling fire alarm system. The authorized representative of the manufacturer of the major equipment, such as control panels, shall be responsible for the satisfactory installation of the complete system.
- B. The Contractor shall provide, from the acceptable manufacturer's current product lines, equipment and components, which comply, with the requirements of these Specifications. Equipment or components, which do not provide the performance and features, required by these specifications are not acceptable, regardless of manufacturer.
- C. Strict conformance to this specification is required to ensure that the installed and programmed system will function as designed and will accommodate the future requirements and operations of the building Owner. All specified operational features must be met without exception.
- D. Equipment proposed to be supplied will be considered only if it meets all sections of the performance specification. Any deviations of system performance outlined in this specification will only be considered when the following requirements have been met:
  1. A complete description of proposed alternate system performance methods with three (3) copies of working drawings thereof for approval by the Owner, not less than ten (10) calendar days prior to the scheduled date for submission of bids.
  2. The supplier of alternate equipment shall furnish evidence that the proposed alternate system performance is equal to or superior than the system operation stated in the specification. Such evidence shall be submitted to the Owner, not less than ten (10) calendar days prior to the scheduled date for submission of bids.
  3. The supplier shall submit a point-by-point statement of compliance for all paragraph sections in this specification. The statement of compliance shall consist of a list of all paragraphs within these sections. Where the proposed system complies fully with the paragraph as written, placing the word "COMPLY" opposite the paragraph number shall indicate such. Where the proposed system does not comply with the paragraph as written, and the supplier feels the proposed system will accomplish the intent of the paragraph, a full description of the function as well as a full narrative description of how its proposal will meet its intent shall be provided. Any submission that does not include a point-by-point statement of compliance as described herein shall be disqualified. Where a full description is not provided, it shall be assumed that the proposed system DOES NOT COMPLY.

4. The supplier of alternate equipment shall submit a list from the alternate manufacturer on the manufacturer's letterhead indicating the names and addresses of all authorized suppliers in the area. Proprietary products from a single-source supplier will not be considered.
  5. The acceptability of any alternate proposed system shall be the sole decision of the Owner or his authorized representative.
- E. Approved Products: All panels and peripheral devices shall be of the standard product of single manufacturer and shall display the manufacturer's name of each component. The catalog numbers specified under this section are those of EDWARDS Fire Safety and shall constitute the type, product quality, material and desired operating features

## **2.02 SYSTEMS OPERATION DESCRIPTION**

- A. Fire-alarm signal initiation shall be by one or more of the following devices:
1. Manual stations.
  2. Heat detectors.
  3. Smoke detectors.
  4. Duct smoke detectors.
  5. Verified automatic alarm operation of smoke detectors.
  6. Automatic sprinkler system water flow.
  7. Heat detectors in elevator shaft and pit.
  8. Fire-extinguishing system operation.
- B. Fire-alarm signal shall initiate the following actions where applicable to this facility and jurisdiction:
1. Activate temporal 3 audible tone synchronized.
  2. Continuously operate the synchronized visual notification appliances.
  3. Identify alarm at fire-alarm control unit and remote annunciators.
  4. Transmit an alarm signal to the remote alarm receiving station.
  5. Release fire and smoke doors held open by magnetic door holders.
  6. Record events in the system memory.
- C. Carbon Monoxide activation (Supervisory) signal shall initiate the following actions:
1. Identify supervisory at fire-alarm control unit and remote annunciators.
  2. FACP shall transmit a separate and discrete alarm signal to the remote alarm receiving station distinguishing a Carbon Monoxide Alarm from that of a system Alarm, Trouble or Supervisory condition.
  3. Switch heating, ventilating, and air-conditioning equipment controls to exhaust mode.
  4. Record events in the system memory.
- D. Supervisory signal initiation shall be by one or more of the following devices and actions:
1. Identify supervisory at fire-alarm control unit and remote annunciators.
  2. FACP shall transmit a separate and discrete alarm signal to the remote alarm receiving station distinguishing a Carbon Monoxide Alarm from that of a system Alarm, Trouble or Supervisory condition.
  3. Valve supervisory switch.
  4. Low-air-pressure switch of a dry-pipe sprinkler system.
  5. Elevator shunt-trip supervision.
  6. Duct smoke detector activation.
  7. System trouble signal initiation shall be by one or more of the following devices and actions:
    8. Open circuits, shorts, and grounds in designated circuits.
    9. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
    10. Loss of primary power at fire-alarm control unit.
    11. Ground or a single break in fire-alarm control unit internal circuits.
    12. Abnormal AC voltage at fire-alarm control unit.

13. Break in standby battery circuitry.
  14. Failure of battery charging circuitry
  15. High or low battery charge.
  16. Abnormal position of any switch at fire-alarm control unit or annunciator.
  17. Fire-pump power failure, including a dead-phase or phase-reversal condition.
  18. Low-air-pressure switch operation on a dry-pipe or pre-action sprinkler system.
- E. Elevator Recall:
1. Smoke detectors at the following locations shall initiate automatic elevator recall. Alarm-initiating devices, except those listed, shall not start elevator recall.
    - a. Elevator lobby detectors except the lobby detector on the designated floor.
    - b. Smoke detector in elevator machine room.
    - c. Smoke detectors in elevator hoistway.
  2. Elevator lobby detectors located on the designated recall floors shall be programmed to move the cars to the alternate recall floor.
  3. Water-flow alarm connected to sprinkler in an elevator shaft and elevator machine room shall shut down elevators associated with the location without time delay.
    - a. Water-flow switch associated with the sprinkler in the elevator pit may have a delay to allow elevators to move to the designated floor.
- F. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke barrier walls shall be connected to fire-alarm system.

### **2.03 FIRE ALARM CONTROL UNIT**

- A. The existing fire alarm control panel is an EDWARDS model iO Series and shall be extended, expanded, and/or renovated to accommodate the building renovation.
- B. The control panel shall include the following capacities:
1. Panel shall support up to 1,000 Total Points, each loop supporting 250 analog/addressable points for total of 4 loops.
  2. Support 400 conventional zones.
  3. Support 8 fully supervised remote annunciators including graphic interface for building management systems..
  4. Support digital dialer with Contact ID format.
  5. Support 1,000 chronological events in history.
  6. Two programmable selector switches.
  7. Support global synchronization wide of audible temporal 3 and visual strobe controlling minimum of 500 Addressable NAC Power Supplies on any combination of all four SLC circuits.
- C. The control panel shall include the following features:
1. Ability to download or upload site applications and system diagnostics remotely through an Ethernet connection RS232 Serial, USB type B/A, or DACT.
  2. Provide electronic addressing of analog/addressable devices. Rotary and dip switch addressing shall not be considered equal. Device addressing shall provide a device map based on t-taps and device in series there on after t-taps
  3. Provide an operator interface display that shall include functions required to annunciate, command and control system functions.
  4. Provide an internal audible signal with different programmable patterns to distinguish between alarm, supervisory, trouble and monitor conditions.
  5. Provide system reports that provide detailed description of the status of system parameters for corrective action or for preventative maintenance programs. Reports shall be displayed by the operator interface or capable of being printed on a printer via USB type B.
  6. Provide an authorized operator with the ability to operate or modify system functions like system time, date, passwords, restart the system and clear control panel event history file.
  7. Provide an authorized operator to perform test functions within the installed system.

8. System shall provide password level clearance. Password levels to consist of level 1 as end user clearance, level 2 as technician. Level 3 as annunciator unlock ONLY.
  9. System shall maintain function of notification devices configured as horn and strobe combination to have horns silenced while maintaining the strobe synchronized flash signal until panel is reset.
  10. Onboard/Panel form C dry contact relays for alarm and trouble and form A contact relay for supervisory in order to facilitate emergency communication via a cellular or radio communicator of panel monitoring upon a digital dialer or phone line communication failure, Relay contact can be utilized for auxiliary devices per manufacturers specifications.
  11. Onboard 500mA/0.5amp auxiliary power to facilitate emergency cellular/radio communicator and/or other auxiliary devices.
  12. Panel to allow isolator modules on signaling line circuit at a maximum of 64 modules
- D. The control panel shall provide the following intelligent and intuitive diagnostic software tools.
1. Fast Ground Check
    - a. Allow quick wiring diagnostics for ground faults every 4 seconds to troubleshoot ground faults much quicker and determine if they have been fixed or not.
  2. Recalibrate Device
    - a. The control panel recalibrates any devices that have been cleaned. The Recalibrate Device feature will immediately reset the environmental compensation and dirtiness levels for faster verification of cleaned devices.
  3. Test Fire
    - a. The control panel sends a test command to a detector or input module to activate. This allows for proper operation and programming testing of the device.
  4. Flash Device LED
    - a. It shall be possible to activate any device LED from the control panel menu to help troubleshooting or locate a specific device on a loop.
  5. Walk Test
    - a. Walk test will allow the operator to test individual zones or devices without placing an alarm event on the system.
    - b. It shall be possible to perform a walk test in a silent or audible test mode. Silent test mode shall display the test results on the LCD display. Audible test confirmation shall sound a coded signal on the systems NAC circuits.
    - c. It shall be possible to activate Walk Test by zone or device to ensure the balance of the system remains in service to protect the premises.
    - d. It shall be possible to view and print a walk test report showing the activation and restoration of all walk test events.
  6. Device Maintenance
    - a. It shall be possible to view and print a report of all detectors dirtiness levels to optimize cleaning schedules. The report shall filter for all devices, devices that are 20% dirty or devices that are 80% dirty. The report shall show the device, how dirty it is by percentage and its sensitivity setting.
    - b. Detectors shall automatically send an alert message to the LCD Users Interface and illuminate the service detector LED when they reach 80% dirty and latch a trouble when they reach 100% dirty to ensure maintenance action is performed.
  7. Smoke-Detector Sensitivity Adjustment:
    - a. Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change to alternate settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and print out the final adjusted values on system printer.

- E. Main Operators Display Operations:
  - 1. Provide a discreet system control switch provided for reset, alarm silence, panel silence, remote disconnect, drill switch, and up/down/right/left switches.
  - 2. Backlit LCD display shall be 80 character display.
    - a. Each point shall have a 40 character custom message.
  - 3. Service Detector LED: Provide indication when a detector needs servicing
  - 4. Programmable Switches: Provide minimum of 2 programmable switches with corresponding LED . Switches shall be password protected at access level 2. The switches shall be programmed for disable/enable or activate restore functions as follows;
    - a. Disable NAC Circuits
      - 1) Disable Relays
  - 5. Alarm and Trouble Annunciator: Provide minimum of 32 zones of LED annunciation with red alarm and yellow trouble indicators; 8 zones may be utilized for supervisory zone annunciation. Devices on addressable loop circuits shall be identified by display or their address and by their condition (alarm, pre-alarm, monitor, supervisory, and trouble).
- F. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions
- G. Ethernet Port shall provide a standard 10/100 Base T Ethernet port for connecting to an intranet or a local network. Shall be able to support up to 8 static IP addresses of the following:
  - 1. This integrated off premise communications capability using a digital alarm communications transmitter (DACT) for sending system events to (8) different central monitoring station (CMS) receivers. The system shall provide the CMS(s) with point identification of system events using Contact ID protocol.
    - a. Digital data transmission shall include the following (Contact ID)
      - b. Address of the alarm-initiating device.
      - c. Loss of ac supply or loss of power.
      - d. Low battery.
      - e. Abnormal test signal.
      - f. Communication bus failure
  - 2. This connection shall support the downloading of configuration programming to the panel over the network and provide the capability of diagnostic information from a remote location.
  - 3. This connection shall support ethernet/IP connectivity to Fireworks graphical workstation, transmitting all system points activations and restorations.
  - 4. Shall be EDWARDS, model SA-ETH.
- H. Digital Alarm Communicator Transmitter: The system shall have an integrated off premise communications capability using a digital alarm communications transmitter (DACT) for sending system events to multiple central monitoring station (CMS) receivers. The system shall provide the CMS(s) with point identification of system events using Contact ID protocol. The dialer shall have the capability to support up to two (2) individual accounts and to send account information to two (2) different receivers, each having a primary and secondary telephone access number. System events shall be capable of being directed to one or more receivers depending on event type or location as specified by the system designed. System shall have the ability to send test times with 1 hour frequencies. In the event of a panel CPU failure during a fire alarm condition, the DACT degraded mode shall transmit a general fire alarm signal to the CMS. **CONFIRM OPERATION OF THE EXISTING DACT AND CORRECT AS REQUIRED.**
  - 1. Digital data transmission shall include the following (Contact ID)
    - a. Address of the alarm-initiating device.
    - b. Loss of ac supply or loss of power.
    - c. Low battery.
    - d. Abnormal test signal.



- e. Communication bus failure
- 2. Shall be EDWARDS, model SA-DACT.
- I. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, shall be powered by nominal 24-V dc source.
  - 1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.
- J. Secondary Power: Shall provide 24 hours supervisory and 15 minutes of alarm with batteries, automatic battery charger, and automatic transfer switch.

#### **2.04 MOBILE APPLICATION SOFTWARE**

- A. Mobile application software service shall remotely connect to the fire alarm control panel to the internet through a secure connection to remote cloud-based server. Application Dashboard shall provide a view of all Building Owner sites, buildings, and panels in one place. This service shall provide mobile device and/or email event push notifications including; Alarm, Supervisory, Trouble and Monitor.
- B. User shall be able to access the system for diagnostics, loops status, mapping, detector analog values and device faults.
- C. User shall have the ability to create reports that include; History of events, Detectors Sensitivity Status, and Walk Test.
- D. All this information shall be view on mobile application on Apple & Google devices. Must also be able to access this same information using a web browser (Chrome/Edge) without application software installed on personal computer.

#### **2.05 CONVENTIONAL ZONE BOARD**

- A. Panel shall be able to support an addressable remote zone interface module with minimum of 16 conventional zone and 2 notification appliance circuits. Each conventional zone shall be class b circuit and configurable for Alarm, Supervisory, Monitor. Zone card shall be able to be located in the main control panel and/or remotely in the field.
  - 1. Shall be EDWARDS model RZI16-2.

#### **2.06 COMMUNICATIONS BRIDGE**

- A. The communications bridge provides multi-protocol point id to building management system (BMS). Unit shall be configurable as to which points from the fire alarm system shall be transmitted to the BMS. Each communications bridge shall be able to support up 3,200 points.
- B. Unit shall have the ability to communicate the following formats:
  - 1. Modbus RTU
  - 2. Modbus TCP
  - 3. BACnet MSTP
  - 4. BACnet IP/ETH
  - 5. DNP Ethernet
- C. Shall be EDWARDS model SA-FSB

#### **2.07 AUDIO CONTROL PANEL**

- A. The audio control panel shall be microprocessor-based UL 864 10th Edition Listed, single-channel, one-way voice communications system that shall have multi-purpose audio use, supervised circuits, and emergency notification. Main audio control panel shall have integral supervised paging microphone and be able to support 8 audio selector switches. Panel shall have 20 minutes of message memory to create custom pre-recorded voice messages and/or tones.
- B. The entire audio system shall be a UL 464 Listed Audio Evacuation System, end-to-end compliance to produce a 520Hz Low Frequency Tone. This includes the audio control panel, amplifiers and high-fidelity speakers.

- C. Amplifier shall be 25 or 70 volts, available in 25 watt or 100 watts with frequency response between 400 to 400 Hz. The audio system shall be able to support up to 2,000 watts total audio amplification. Each amplifier shall provide supervised speaker circuits. Backup Amplifier card shall be added if required by AHJ. Backup switching card shall be added. Each amplifier shall be able to support Zone Splitter of up to 4 supervised circuits, each circuit with capacity of 50 watts.
- D. The system performance specified herein is based upon minimum design performance requirements utilizing high fidelity speakers with the following minimum selectable sound performance levels from 78; 81 84; and 87 dBA.
- E. Audio system shall support 8 inputs for activation pre-recorded message or tone. Audio system shall be equipped to add an 8-position switch LED Module and 8-position Output LED module
- F. Audio system shall support SIP Telco Paging interface from the building IP Phone System. Provide the necessary SIP Paging Gateway with 1 volt audio, peak-to peak.
- G. Provide battery stand- by for 24 hours of supervision and 15 mins of alarm. Panel shall have power-limited internal battery charger to support up 24 amp hour batteries.
- H. Audio system shall support up to five (5) remote audio paging microphone and All Call operations.
- I. Shall be EDWARDS model ANS Series.

## **2.08 INTELLIGENT ANALOG ADDRESSABLE SYSTEM DETECTORS**

- A. General Requirements for all Intelligent Analog Detectors:
  - 1. Each addressable detector shall contain an integral on-board microprocessor which shall determine if the device is normal, in alarm, or has an internal trouble.
  - 2. Detectors requiring switches for addressing shall not be considered as equal.
  - 3. Each addressable detector on the Signaling Line Circuit (SLC) shall transmit information regarding its location with respect to other intelligent detectors and modules on the signaling line circuit to the control panel, creating an "As-Built" circuit map.
  - 4. The circuit mapping function shall provide location supervision of all intelligent detectors and modules on the signaling line circuit.
  - 5. Detectors with addressing components in the base shall not be considered as equal.
  - 6. An intelligent detector's programmed system response functions shall be associated with the detector's actual location on the signaling line circuit and not with the detector's address.
  - 7. After system commissioning, detectors improperly installed in the wrong location shall function according to the mapped programmed response for its location on the circuit, not its detector's address.
  - 8. Microprocessor's non-volatile memory shall permanently store the detector's serial number, device type and system address. It shall be possible to address each intelligent device without the use of switches.
  - 9. Memory shall automatically be updated with the hours of operation, last maintenance date, number of alarms and troubles, time of last alarm, and analog signal patterns for each sensing element just before the last alarm.
  - 10. Detector shall be capable of identifying up to 32 diagnostic codes. This information shall be available for system maintenance. The diagnostic code shall be stored at the detector.
  - 11. A status indicator shall be provided on each detector. Flashing green shall indicate normal operation; flashing RED shall indicate the alarm state. The indicator shall be visible from any direction.
  - 12. The system shall allow for changing of detector types for service replacement purposes without the need to reprogram the system. The replacement detector type shall automatically continue to operate with the same programmed sensitivity levels and functions as the detector it replaced, without the need for reprogramming. System shall display an off-normal condition until the proper detector type is installed or a change in the device type profile has been made.

13. Detectors shall be rated for operation in the following environment unless specifically noted:
    - a. Temperature: 32°F to 120°F (0°C to 49°C)
    - b. Humidity: 0-93% RH, non-condensing
  14. Please refer to the General, System Description Section for site-specific detector operating requirements.
- B. Analog/Addressable Detectors
1. Provide analog/addressable optical smoke; heat; carbon monoxide (CO); and combination detectors as described herein at the locations shown on the drawings.
  2. Optical Smoke Detectors shall be:
    - a. Listed under UL 268 7th edition and UL 2075.
    - b. Listed as a multi criteria detector without the use of other sensing elements.
    - c. Capable of rejecting nuisance sources.
    - d. Detect smoke in the full life safety window of 0.5% to 4.36% obscuration/foot.
    - e. Detectors required to operate in a special application mode that cannot achieve the full 0.5% to 4.36% life safety window shall not be considered equal.
    - f. Individually programmable to operate at any one of five (5) sensitivity settings.
    - g. Configurable in 5% increments for Pre-Alarm Sensitivity.
    - h. Able to differentiate between a long-term drift above the pre-alarm threshold and fast rise.
    - i. Continuously monitoring the sensitivity of the smoke detector.
    - j. Able to automatically change the sensitivity of individual smoke detectors for day and night periods.
    - k. Equipped with an environmental compensation algorithm that shall automatically adjust for background environmental conditions such as dust, temperature, and pressure.
    - l. Equipped with a maintenance alert signal when a detector reaches 80% dirty.
    - m. Equipped with a dirty fault signal when 100% or greater compensation has been used.
  3. Heat Detector Elements shall:
    - a. Consist of a low mass thermistor acting as a fixed temperature 103 to 140 oF (54 to 60 oC) heat detector.
    - b. Be capable of providing separate activation when included with an Optical Smoke Detector only or with a Carbon Monoxide Detector only.
    - c. Report as Fire when included with an Optical Smoke Detector and Carbon Monoxide Detector.
    - d. Provide 135 oF (57 oC) fixed temperature alarm point and Emergency Temperature setting from 35 oF to 125 oF (1.7 oC to 51.7 oC) with the H2D detector for EST4 panels only.
  4. Analog Addressable Detector Options
    - a. SIGA-OSD Intelligent Multi-criteria Optical Smoke Detector
    - b. SIGA-OSHD Intelligent Multi-criteria Optical Smoke Detector and Heat Detector (135 oF/15 oF/Min ROR)
    - c. SIGA-OSHDB Intelligent Multi-criteria Optical Smoke Detector and Heat Detector (135 oF/15 oF/Min ROR) in Black for Black-out rooms. Use with SIGA-TSB Black Base Trim Ring
    - d. SIGA-OSCD Intelligent Multi-criteria Optical Smoke Detector and Carbon Monoxide Detector
    - e. SIGA-OSHCD Intelligent Multi-criteria Optical Smoke Detector and Heat Detector (135 oF/15 oF/Min ROR) and Carbon Monoxide Detector
    - f. SIGA-OSHCDB Intelligent Multi-criteria Optical Smoke Detector and Heat Detector (135 oF/15 oF/Min ROR) and Carbon Monoxide Detector in Black for Black-out rooms. Use with SIGA-TSB Black Base Trim Ring.
    - g. SIGA-H2D Intelligent Fixed Temperature Heat Detector with Dual Reporting

- h. SIGA-HFD Intelligent Fixed Temperature Heat Detector
  - i. SIGA-HRD Intelligent Fixed Temperature Heat Detector and Rate of Rise Heat Detector
  - j. SIGA-HCD Intelligent Fixed Temperature Heat Detector (135 oF/15 oF/Min ROR) and Carbon Monoxide Detector
  - k. SIGA-COD Intelligent Carbon Monoxide Detector
- C. Analog/Addressable Detector Bases
- 1. Provide analog/addressable detector bases as described herein at the locations shown on the drawings. All Analog/Addressable Detector Bases shall mount to either North American standard 1-gang; 3 ½ or 4 inch (101.6 mm) octagon; or 4 inch square box; utilize a twist-lock design and provide screw terminals for all field wiring connections; contain no active electronics; support all Signature Series Detectors; and allow for removal of the detector without affecting communications with other Signature detectors.
  - 2. SIGA-SB/SB4 Standard Base
    - a. Optional SIGA-LED remote LED.
  - 3. SIGA-RB/RB4 Relay Base
    - a. The relay shall be a bi-stable type and selectable for normally open or normally closed operation.
    - b. The position of the relay contact shall be supervised.
    - c. The operation of the base relay shall be configurable for control by its respective detector or for independent programmable control from the fire alarm panel.
    - d. Relay bases not configurable for detector or panel operation shall not be considered equal.
    - e. The base relay shall provide form "C" contacts with a minimum rating of 1 amp @ 30 Vdc, listed for pilot duty.
  - 4. SIGA-AB4GT Sounder Base
    - a. The audible base shall emit a temporal 3-3-3 fire alarm tone when smoke or heat has been detected.
    - b. The audible base shall emit a temporal 4-4-4-4 CO alarm tone when CO has been detected.
    - c. The outputs shall be configurable for low or high output by moving a reversible jumper. The audible bases shall provide a UL 268 reverberant room sound output of 90.8 dBA at 10ft (3m) for temporal 3-3-3 fire alarm and 84.1 dBA at 10 feet (304.8 cm)(3m) for temporal 4-4-4-4 CO alarm.
    - d. The system shall be UL 2017 listed for dual signaling for this purpose.
  - 5. SIGA-AB4G-LF Low Frequency Sounder Base
    - a. The audible base shall emit a 520 Hz tone as defined by NFPA 72 2010 edition and NFPA 720 2012 edition standards in a temporal 3-3-3 fire alarm pattern when smoke or heat has been detected or a temporal 4-4-4-4 CO alarm pattern when CO has been detected.
    - b. The sound outputs shall be configurable for low or high output by moving a reversible jumper.
    - c. The system shall be UL 2017 listed for dual signaling for this purpose.
    - d. The audible bases shall be listed to UL 268 and UL 464.
  - 6. SIGA-IB/IB4 Isolator Base
    - a. Isolator bases shall limit number of modules or detectors that may be rendered inoperative by short-circuit fault on SLC loop segment or branch. In the event the Class A signaling line circuit on which the isolator bases are installed is shorted, each base shall open the SLC. Isolator bases shall then sequentially reconnect the isolated circuit segments until only the segment with the short is left out of the circuit, leaving the balance of the circuit operational.
  - 7. SIGA-GRD Smoke Detector Guards
    - a. Smoke detector guards shall be installed at the locations shown on the drawings.

- b. The guards shall be UL tested and listed by for use with the smoke detectors they protect. Guard design shall not affect the detector operating sensitivity and shall not reduce the listed detector spacing.
  - c. The design of the guard shall provide physical protection for the detector while preventing looped items from hanging on the guard when wall mounted or being threaded through the guard.
  - d. The guards shall be constructed of 18-gauge steel with a baked white finish to match the detectors.
  - e. Provide SIGA-DGSB Detector Guard Surface Mount Accessory and SIGA-DGMF Mounting Flange as needed.
  - f. Tamperproof mounting hardware shall be provided.
- D. Analog/Addressable Duct Smoke Detector
- 1. OPTICA Intelligent Duct Smoke Detector
    - a. Provide and install Duct Smoke Detector Housings for Signature Series intelligent OPTICA technology with light scattering principal duct smoke detectors that gather analog information from their smoke sensing elements and convert it into digital signals. The detector measures and analyses these signals and compares the information to historical readings and time patterns to make an alarm decision.
    - b. Units shall contain a microprocessor capable of performing comprehensive self-diagnostics and stocking the results. Details such as hours of operations, last maintenance date and numbers of alarms and troubles are stored in nonvolatile memory.
    - c. Units shall have separate smoke sensing chamber and control wiring sections with coated circuit boards and hydrophilic coatings to keep contaminants away from sensitive electronics. Units cover shall be red in color and less than 2.5 inches (63.5 mm) in deep.
    - d. The detector shall have a smoke sensitivity range of 1.5% to 4.5% obscuration/foot. When the unit becomes "Dirty" it shall post Maintenance Alert at 80%. Operating range -20degrees F to 158 degrees Fahrenheit (70 degrees Celsius) with 100 ft/min to 4,000 ft/min air velocity rating.
    - e. Detector shall include a form "C" auxiliary alarm relay rated at 3.0A @ 30VDC, 3.0A @ 120VAC and 1.5A @ 240VAC. Relay contact position shall be supervised by control panel software. Operation of relay shall be by respective detector or under program control from the control panel.
    - f. Provide and install key operable remote test station (SD-TRK)
    - g. Provide and install sampling tubes sized per manufacturer installation guidelines. (SD-T\*)
  - 2. SIGA-SDH(R) Intelligent Duct Smoke Detector Housing
    - a. Provide and install Intelligent Duct Smoke Detector Housing for use with Signature Series Analog/Addressable Detectors. Compatible Detector heads include:
      - 1) SIGA-OSD Optica Detector
      - 2) SIGA-OSHD Optica Detector with Heat
  - 3. SIGA-SDH utilizes a SIGA-SB standard base, no relay
    - a. Provide Signature Relays as required for HVAC control.
  - 4. SIGA-SDHR utilizes a SIGA-RB relay base for HVAC Control.
    - a. Provide and install key operable remote test station (SIGA-DTS)
    - b. Provide and install sampling tubes sized per manufacturer installation guidelines. (SD-T\*)
  - 5. SIGA-DMP Detector Mounting Plate
    - a. Provide and install Intelligent Detector Mounting Plate when mounting a Signature Series Intelligent Smoke Detector in raised floor or plenum applications or in low velocity ducts with a maximum width of 36" and a maximum height of 36".

- b. The mounting plate shall be code gauge steel with corrosion resistant red enamel finish. The detector mounting plate shall support an addressable detector along with a standard, relay, or isolator detector mounting base.
- c. Utilize the SIGA-DMP with the following detectors and bases:
  - 1) SIGA-OSD Intelligent Multi-criteria Optical Smoke Detector
  - 2) SIGA-OSHD Intelligent Multi-criteria Optical Smoke Detector and Heat Detector
  - 3) SIGA-SB Standard Base
  - 4) SIGA-RB Relay Base
  - 5) SIGA-IB Isolator Base

## **2.09 MULTI-FUNCTION INTELLIGENT ADDRESSABLE INPUT/OUTPUT MODULES - GENERAL**

- A. Each addressable module shall contain an integral on-board microprocessor which shall determine if the device is normal, in alarm, or has an internal trouble.
- B. Modules requiring switches for addressing shall not be considered as equal.
- C. Each addressable module on the Signaling Line Circuit (SLC) shall transmit information regarding its location with respect to other intelligent detectors and modules on the signaling line circuit to the control panel, creating an "As-Built" circuit map.
- D. The circuit mapping function shall provide location supervision of all intelligent detectors and modules on the signaling line circuit.
- E. Each input module shall identify and report to the control panel by device address, ground faults and opens associated with its initiating device circuits.
- F. Input modules without individual ground fault detection identification capability shall not be considered as equal.

## **2.10 MANUAL PULL STATIONS**

- A. Provide intelligent analog-addressable manual pull stations as described herein at the locations shown on the drawings or as required by system operational sequence.
- B. SIGA-270 Single Action, Single Stage Manual Pull Station
  - 1. Provide addressable single action, single stage fire alarm stations at the locations shown on the drawings or as required by system operational sequence.
  - 2. The station shall be metal construction, red with silver "PULL IN CASE OF FIRE" lettering.
  - 3. Station reset - common tool
  - 4. Mounting: North American 2 ½" deep, 1-gang box or 1 ½" deep 4" square box with 1-gang cover.
  - 5. Manual pull stations that initiate an alarm condition when opening the unit are not acceptable.
- C. SIGA-270P Single Action, Two Stage Manual Pull Station
  - 1. Provide addressable single action, two stage fire alarm stations at the locations shown on the drawings or as required by system operational sequence.
  - 2. The station shall be metal construction, red with silver "PULL IN CASE OF FIRE" lettering.
  - 3. General Alarm Key with special unique key and labeled attached.
  - 4. Station reset shall be by common tool.
  - 5. Mounting: North American 2 ½" deep, 1-gang box or 1 ½" deep 4 "square box with 1-gang cover.
  - 6. Manual pull stations that initiate an alarm condition when opening the unit are not acceptable.
- D. SIGA-278 Double Action, Single Stage Manual Pull Station
  - 1. Provide addressable double action, single stage fire alarm stations at the locations shown on the drawings or as required by system operational sequence.
  - 2. The station shall be red polycarbonate construction with molded, raised-letter operating instructions.

3. Mounting: North American 2 ½" deep, 1-gang box or 1 ½" deep 4" square box with 1-gang cover.
  4. Manual pull stations that initiate an alarm condition when opening the unit are not acceptable.
- E. STI-1000 Series Guards
1. Provide manual pull station guards at the locations shown on the drawings or as required by system operational sequence.
  2. The guard shall consist of a factory-fabricated clear polycarbonate enclosure, hinged at the top. Lifting the cover shall provide access to the manual pull station and activate an integral battery powered audible horn intended to discourage false alarms.
    - a. STI-1100 Stopper II with Horn (9V) for Flush Stations
    - b. STI-1130 Stopper II with Horn (9V) for Surface Stations, includes STI-3100
    - c. STI-1200 Stopper II without Horn for Flush Stations
    - d. STI-1230 Stopper II without Horn for Surface Stations, includes STI-3100
    - e. STI-1250 Stopper II without Horn, Weatherproof for Flush Stations
    - f. STI-3002 Weatherproofing Gasket for converting STI-1200 to Weatherproof (2 gaskets required)
    - g. STI-3003 Weatherproofing Gasket for conduit entry for STI-3100
    - h. STI-3004 Conduit insert for plugging unused conduit entry into STI-3100
    - i. STI-3100 2-inch spacer for converting flush cover to surface cover
    - j. STI-3150 Stopper II without Horn, weatherproof, for surface stations

## **2.11 INTELLIGENT ANALOG ADDRESSABLE MODULES**

- A. Provide intelligent analog-addressable modules as described herein at the locations shown on the drawings or as required by system operational sequence.
- B. SIGA-CT1 / SIGA-CT1HT Single Input Module
1. Provide addressable single input multifunction modules at the locations shown on the drawings or as required by system operational sequence.
  2. Module shall provide one (1) supervised Class B input Circuit configurable as one of the following "personalities":
    - a. Normally-Open Alarm Latching (for alarm initiation applications)
    - b. Normally-Open Alarm Delayed Latching (for waterflow switch applications)
    - c. Normally-Open Active Non-Latching (for limit switch and monitor applications)
    - d. Normally-Open Active Latching (for tamper switch and supervisory applications)
- C. The SIGA-CT1HT module operates at an expanded temperature range of 32 oF to 158 oF for those applications requiring more extreme environmental temperature variations.
1. Indication: Normal – Green LED flashes; Alarm/Active – Red LED flashes
  2. Mounting: North American 2 ½" deep, 1-gang box or 1 ½" deep 4" square box with 1-gang cover.
- D. SIGA-CT 2 / SIGA-MCT2 Dual Input Module
1. Provide addressable single input multifunction modules at the locations shown on the drawings or as required by system operational sequence.
  2. Module shall provide two (2) supervised Class B input Circuit configurable as one of the following "personalities":
    - a. Normally-Open Alarm Latching (for alarm initiation applications)
    - b. Normally-Open Alarm Delayed Latching (for waterflow switch applications)
    - c. Normally-Open Active Non-Latching (for limit switch and monitor applications)
    - d. Normally-Open Active Latching (for tamper switch and supervisory applications)
    - e. Indication: Normal – Green LED flashes; Alarm/Active – Red LED flashes
  3. Mounting: North American 2 ½" deep, 1-gang box or 1 ½" deep 4" square box with 1-gang cover.

- E. SIGA-WTM Dual Input Waterflow-Tamper Module
1. Provide addressable dual input waterflow / tamper modules at the locations shown on the drawings or as required by system operational sequence.
  2. Module shall provide two (2) supervised Class B input circuits configured as:
    - a. Normally-Open Alarm Delayed Latching for waterflow switch applications.
    - b. Normally-Open Active Latching for tamper switch and supervisory applications)
  3. Indication: Normal – Green LED flashes; Alarm/Active – Red LED flashes
  4. Mounting: North American 2 ½" deep, 1-gang box or 1 ½" deep 4" square box with 1-gang cover.
- F. SIGA-CC1(S) / SIGA-MCC1(S) Notification Appliance Circuit
1. Provide addressable notification appliance circuit modules at the locations shown on the drawings or as required by system operational sequence.
  2. The addressable NAC module shall provide one (1) supervised Class B notification appliance circuit.
  3. The NAC control module shall be configurable for the following operations:
    - a. 24 VDC synchronized NAC circuit, 2 amps @ 24 VDC.
    - b. Audio notification circuit 25Vrms @ 50 watts or 70 Vrms @ 35 watts
    - c. Firefighter's Telephone control with ring tone
  4. Indication: Normal – Green LED flashes; Alarm/Active – Red LED flashes
  5. Mounting: North American 2 ½" deep, 2-gang box or 1 ½" deep 4" square box with 2-gang cover.
  6. Modules with (S) designation and programmed with a personality code 25 shall provide a supervised auto sync output for synchronizing compatible Edwards Notification Appliances.
- G. SIGA-CR / SIGA-MCR Addressable Control Relay
1. Provide addressable control relay modules at the locations shown on the drawings or as required by system operational sequence.
  2. The addressable relay module shall provide one (1) form C dry relay contacts rated at 24Vdc @ 2 amps (pilot duty) and 120Vac @ 0.5 amps to control external appliances or equipment.
  3. The position of the relay contact shall be confirmed by the system firmware.
  4. The relay coil shall be magnetically latched to reduce wiring and ensure 100% of the relays on the SLC can be energized at same time.
  5. Indication: Normal – Green LED flashes; Alarm/Active – Red LED flashes
  6. Mounting: North American 2 ½" deep, 1-gang box or 1 ½" deep 4" square box with 1-gang cover.
- H. SIGA-CRR / SIGA-MCRR Reverse Polarity Addressable Control Relay
1. Provide addressable reverse polarity control relay modules at the locations shown on the drawings or as required by system operational sequence.
  2. The addressable reverse polarity relay module shall provide one polarity reversing C dry relay contacts rated at 24Vdc @ 2 amps (pilot duty) and 120Vac @ 0.5 amps to provide activation of SIGA Sounder bases in a single power circuit.
  3. The position of the relay contact shall be confirmed by the system firmware.
  4. The relay coil shall be magnetically latched to reduce wiring and ensure 100% of the relays on the SLC can be energized at same time.
  5. Indication: Normal – Green LED flashes; Alarm/Active – Red LED flashes
  6. Mounting: North American 2 ½" deep, 1-gang box or 1 ½" deep 4" square box with 1-gang cover.
- I. SIGA-CRH High Power Addressable Control Relay
1. Provide high power addressable control relay modules at the locations shown on the drawings or as required by system operational sequence.



2. The high-power addressable control relay shall provide two (2) Form C dry relay contacts rated at 24Vdc @ 6 amps resistive, 120Vac 7 amps (PF 0.75) / 3 amps (PF 0.35); and 240Vac 7 amps (PF 0.75) / 1.5 amps (PF 0.35).
  3. The position of the relay contact shall be confirmed by the system firmware.
  4. The relay coil shall be magnetically latched to reduce wiring and ensure 100% of the relays on the SLC can be energized at same time.
  5. Indication: Normal – Green LED flashes; Alarm/Active – Red LED flashes
  6. Mounting: North American 2 1/8" deep, 2-gang box or 2 1/8" deep 4" square box.
- J. SIGA-IM2 Intelligent Addressable Isolator Module
1. Provide addressable isolator modules at the locations shown on the drawings or as required by system operational sequence or as required by system operational sequence.
  2. In the event the Class A signaling line circuit on which the intelligent isolator module is installed is shorted, each isolator module shall open the SLC. Isolator modules shall then sequentially reconnect the isolated circuit segments until only the segment with the short is left out of the circuit, leaving the balance of the circuit operational.
  3. Isolator modules shall be installed in a Class A circuit. Class B circuit segments may be installed between isolator modules.
  4. Indication: Normal – Green LED flashes; Alarm/Active – Red LED flashes
  5. Mounting: North American 2 1/2" deep, 2-gang box or 1 1/2" deep 4" square box with 2 gang cover and SIGA-MP mounting plate.
- K. SIGA-RM1 / MRM1 Intelligent Addressable Riser Monitor Module
1. Provide addressable riser monitor modules at the locations shown on the drawings or as required by system operational sequence.
  2. The intelligent addressable riser monitor module supports personality code 23, riser monitor, which configures the module to monitor 70 Vac audio, 25Vac audio, or 12Vdc and 24Vdc risers. A trouble condition is reported back to the panel whenever the voltage drops below the trouble threshold.
  3. The intelligent addressable riser module supports personality code 24, telephone rise monitor, which configures the module to monitor telephone risers.
  4. Indication: Normal – Green LED flashes; Alarm/Active – Red LED flashes
  5. Mounting: North American 2 1/2" deep, 2-gang box or 1 1/2" deep 4" square box with 2 gang cover.
- L. SIGA-UM / SIGA-MAB Intelligent Addressable Universal Input/Output Module
1. Provide addressable universal input/output modules at the locations shown on the drawings or as required by system operational sequence.
  2. Depending on their assigned personality, Universal Input/Output Modules shall provide the following modes of operations:
    - a. Personality code 1: Class B, 1 or 2 N.O. Alarm, Latching for Conventional Pull Stations and Heat Detectors
    - b. Personality code 2: Class B, 1 or 2 N.O. Alarm Delayed Latching for Waterflow Alarm Switches
    - c. Personality code 3: Class B, 1 or 2 N.O. Active Non-Latching for Fans, Dampers, Doors
    - d. Personality code 4: Class B, 1 or 2 N.O. Active Latching for Supervisory and Tamper Switches
    - e. Personality code 8: Control Relay, Form C, 2.0 amp @ 24Vdc; 0.5 amp @ 120Vac
    - f. Personality code 9: Class A, 1 or 2 N.O. Alarm, Latching for Conventional Pull Stations and Heat Detectors
    - g. Personality code 10: Class A, 1 or 2 N.O. Alarm Delayed Latching for Waterflow Alarm Switches
    - h. Personality code 11: Class A, 1 or 2 N.O. Active Non-Latching for Fans, Dampers, Doors

- i. Personality code 12: Class A, 1 or 2 N.O. Active Latching for Supervisory and Tamper Switches
- j. Personality code 13: Class B, 2-Wire Smoke, Alarm, Non-Verified for Conventional Smokes, Pulls, Heats.
- k. Personality code 14: Class B, 2-Wire Smoke, Alarm, Verified for Conventional Smokes, Pulls, Heats.
- l. Personality code 15: Class A, Signal Output, Notification Appliance Circuit, for horns and speakers
- m. Personality code 16: Class B, Signal Output, Notification Appliance Circuit, for horns and speakers
- n. Personality code 20: Class A, 2-Wire Smoke, Alarm, Non-Verified for Conventional Smokes, Pulls, Heats.
- o. Personality code 21: Class A, 2-Wire Smoke, Alarm, Verified for Conventional Smokes, Pulls, Heats.
- 3. Indication: Normal – Green LED flashes; Alarm/Active – Red LED flashes
- 4. Mounting: North American 2 ½" deep, 2-gang box or 1 ½" deep 4" square box with 1 gang cover and SIGA-MP mounting plate.
- M. SIGA-MP Series Signature Module Mounting Plates
  - 1. Provide module mounting plates at the locations shown on the drawings or as required by system operational sequence.
  - 2. SIGA-MP1 Signature Module Mounting Plate consuming 1 footprint with space for up to four (4) 2-gang Signature modules or eight (8) 1-gang Signature modules.
  - 3. SIGA-MP2 Signature Module Mounting Plate consuming ½ footprint with space for up to two (2) 2-gang Signature modules or four (4) 1-gang Signature modules.
  - 4. SIGA-MP2L Signature Module Mounting Plate consuming ½ extended footprint with space for up to three (3) 2-gang Signature modules or six (6) 1-gang Signature modules.
  - 5. SIGA-MB4 Signature Module Mounting Plate for 4" square electric box with space for up to two (2) 1-gang Signature modules into a 4" box.

## **2.12 NOTIFICATION APPLIANCES**

- A. All appliances shall be of the same manufacturer as the Fire Alarm Control Panel specified to ensure absolute compatibility between the appliances and the control panels, and to insure that the application of the appliances are done in accordance with the single manufacturers' instructions.
- B. All appliances shall be wall or ceiling mounted, white body and marking of None, and shall be UL 1971 & UL 464 listed Fire Protective Service. The appliance shall have removable body skin.

## **2.13 NOTIFICATION APPLIANCE - HIGH FIDELITY SPEAKER**

- A. High Fidelity Speakers shall have a paper cone capable of delivering audio with an STI of 0.81 for message intelligibility. With speaker frequency response of 100 to 11,000 Hz. The rear of the speakers shall be completely sealed protecting the cone.
- B. Speakers shall provide accessible selector switch for 1/4w, 1/2w, 1w, and 2w power taps for use with 70V systems access by removing device cover.
- C. Speaker shall be UL 464 listed in compliance to produce 520Hz low frequency tone signal.
- D. The actual speaker wattage setting shall be view from the device window to verify the wattage setting, without removing the device. To make any changes to the speaker wattage will only require the removal of the cover.
- E. The High Fidelity Speaker/Strobe LED strobes shall mount to Universal Mounting Plate (UMP) that has mounting holes for 1-gang, 2-gang and 4-inch square box and shall have plastic protective cover during installation. Room side screw terminal terminations and shall accommodate 12 to 18 AWG wire. UMP shall include a shorting clip bar that will allow testing the continuity of the circuits.

- F. Each appliance shall have circuit test points accessible by removal of the device cover for using meter to measure circuit voltage, circuit polarity, grounds and end of line resistor.
- G. Appliance shall have plastic protective cover during installation
- H. The actual speaker wattage setting shall be view from the device window to verify the wattage setting, without removing the device. To make any changes to the speaker wattage will only require the removal of the cover.
- I. The following selectable sound level output:
  - a. 1/4 watt - 78 dBA
  - b. 1/2 watt - 81 dBA
  - c. 1 watt - 84 dBA
  - d. 2 watt - 87 dBA
- J. Provide EDWARDS, Genesis Series, G4S & GCS model.
- K. Notification Appliance - High Fidelity Speaker/LED Visual, Wall 110 Candela
  - 1. High Fidelity Speakers shall have a paper cone capable of delivering audio with an STI of 0.81 for message intelligibility. With speaker frequency response of 100 to 11,000 Hz. The rear of the speakers shall be completely sealed protecting the cone.
  - 2. Speakers shall provide accessible selector switch for 1/4w, 1/2w, 1w, and 2w power taps for use with 70V systems access by removing device cover.
  - 3. High Fidelity Speaker shall be UL 464 listed in compliance to produce 520Hz low frequency tone signal.
  - 4. The LED strobe (15, 30, 75, & 110) candela rating shall be view from the side window to verify the setting. All LED strobes shall be synchronization to within 10 milliseconds for an indefinite period shall not require the use of separately installed remote synch modules
  - 5. The High Fidelity Speaker/Strobe LED strobes shall mount to Universal Mounting Plate (UMP) that has mounting holes for 1-gang, 2-gang and 4-inch square box and shall have plastic protective cover during installation. Room side screw terminal terminations and shall accommodate 12 to 18 AWG wire. UMP shall include a shorting clip bar that will allow testing the continuity of the circuits.
  - 6. Each appliance shall have circuit test points accessible by removal of the device cover for using meter to measure circuit voltage, circuit polarity, grounds and end of line resistor.
  - 7. Appliance shall have plastic protective cover during installation
  - 8. The actual speaker wattage & strobe candela setting shall be view from the device window to verify the wattage setting, without removing the device. To make any changes to the speaker wattage will only require the removal of the cover.
  - 9. The following selectable sound level output:
    - a. 1/4watt - 78 dBA
    - b. 1/2 watt - 81 dBA
    - c. 1 watt - 84 dBA
    - d. 2 watt - 87 dBA
  - 10. Provide EDWARDS, Genesis Series, G4SV model.
- L. Notification Appliance - High Fidelity Speaker/LED Visual, Ceiling 115 Candela or 185 Candela
  - 1. High Fidelity Speakers shall have a paper cone capable of delivering audio with an STI of 0.81 for message intelligibility. With speaker frequency response of 100 to 11,000 Hz. The rear of the speakers shall be completely sealed protecting the cone.
  - 2. Speakers shall provide accessible selector switch for 1/4w, 1/2w, 1w, and 2w power taps for use with 70V systems access by removing device cover.
  - 3. High Fidelity Speaker shall be UL 464 listed in compliance to produce 520Hz low frequency tone signal.
  - 4. The LED strobe (15, 30, 75, & 115) or (135, 150, 177, & 185) candela rating shall be view from the side window to verify the setting. All LED strobes shall be synchronization to within 10 milliseconds for an indefinite period shall not require the use of separately installed remote synch modules.

5. The High Fidelity Speaker/Strobe LED strobes shall mount to Universal Mounting Plate (UMP) that has mounting holes for 1-gang, 2-gang and 4-inch square box and shall have plastic protective cover during installation. Room side screw terminal terminations and shall accommodate 12 to 18 AWG wire. UMP shall include a shorting clip bar that will allow testing the continuity of the circuits.
  6. Each appliance shall have circuit test points accessible by removal of the device cover for using meter to measure circuit voltage, circuit polarity, grounds and end of line resistor.
  7. Appliance shall have plastic protective cover during installation
  8. The actual speaker wattage & strobe candela setting shall be view from the device window to verify the wattage setting, without removing the device. To make any changes to the speaker wattage will only require the removal of the cover.
  9. The following selectable sound level output:
    - a. 1/4watt - 78 dBA
    - b. 1/2 watt - 81 dBA
    - c. 1 watt - 84 dBA
    - d. 2 watt - 87 dBA
  10. Provide EDWARDS, Genesis Series, GCSV model
- M. Notification Appliances – LED Strobe Visual, Wall 75 Candela
1. Provide clear lens LED strobes that provide a smooth light distribution pattern field selectable candela 15 cd, 30 cd, and 75 cd flash output rating, UL 1971 listed. The current draw shall be one fixed value for all the selectable candelas.
  2. The LED strobe (15, 30, & 75) candela rating shall be view from the side window to verify the setting. All LED strobes shall be synchronization to within 10 milliseconds for an indefinite period shall not require the use of separately installed remote synch modules.
  3. The LED strobes shall mount to 1-gang box and appliance shall have plastic protective cover during installation.
  4. Provide EDWARDS, Genesis Series, G1 model.
- N. Notification Appliances – LED Visual, Ceiling 115 Candela
1. Provide clear lens LED strobes that provide a smooth light distribution pattern field selectable candela 15 cd, 30 cd, 75 cd, and 115 cd flash output rating, UL 1971 listed. The current draw shall be one fixed value for all the selectable candelas.
  2. The strobe (15, 30, 75, & 115) candela rating shall be view from the side window to verify the setting. All LED strobes shall be synchronization to within 10 milliseconds for an indefinite period shall not require the use of separately installed remote synch modules.
  3. The LED strobes shall mount to Universal Mounting Plate (UMP) that has mounting holes for 1-gang, 2-gang and 4-inch square box and shall have plastic protective cover during installation. Room side screw terminal terminations and shall accommodate 12 to 18 AWG wire. UMP shall include a shorting clip bar that will allow testing the continuity of the circuits.
  4. Each appliance shall have circuit test points accessible by removal of the device cover for using meter to measure circuit voltage, circuit polarity, grounds and end of line resistor.
  5. Appliance shall have plastic protective cover during installation.
  6. Provide EDWARDS, Genesis Series, GC model.
- O. Notification Appliances – LED Visual, Ceiling 185 Candela
1. Provide clear lens LED strobes that provide a smooth light distribution pattern field selectable candela 135 cd, 150 cd, 177 cd, and 185 cd flash output rating, UL 1971 listed. The current draw shall be one fixed value for all the selectable candelas.
  2. The strobe (135, 150, 177, & 185) candela rating shall be view from the side window to verify the setting. All LED strobes shall be synchronization to within 10 milliseconds for an indefinite period shall not require the use of separately installed remote synch modules.
  3. The LED strobes shall mount to Universal Mounting Plate (UMP) that has mounting holes for 1-gang, 2-gang and 4-inch square box and shall have plastic protective cover during installation. Room side screw terminal terminations and shall accommodate 12 to 18 AWG

wire. UMP shall include a shorting clip bar that will allow testing the continuity of the circuits.

4. Each appliance shall have circuit test points accessible by removal of the device cover for using meter to measure circuit voltage, circuit polarity, grounds and end of line resistor.
5. Appliance shall have plastic protective cover during installation.
6. Provide EDWARDS, Genesis Series, GCVH model.

#### **2.14 NAC POWER EXTENDED**

- A. NAC Power Supply: The Addressable NAC power supply shall be independent unit that will provide power to visual strobe notification appliances. It shall be possible to configure the NAC's to follow the main panel's NAC or activate from intelligent synchronized modules. The booster NAC's must be configurable to operate independently at any one of the following rates: continuous synchronized, or 3-3-3 temporal. Fault conditions on the power supply shall not impede alarm activation of host NAC circuits or other power supplies. The NAC power supply must be able to provide concurrent power for notification devices, security devices, access control equipment and auxiliary devices such as door holders. . All the NAC Power Supplies shall be synchronized. The power supply shall support up to 24 amp hour batteries.
  1. Power supply shall be minimum of 10 amps and UL 864 Listed.
  2. Four independent 3amp NAC circuits. Each being configurable as auxiliary power.
  3. All circuits shall be synchronized.
  4. Shall be EDWARDS, model BPS10A with SIGA-CC1S.

#### **2.15 MAGNETIC DOOR HOLDERS**

- A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching doorplate.
  1. Electromagnet: Requires no more than 3 W to develop 25-lbf holding force.
  2. Wall-Mounted Units: Flush mounted unless otherwise indicated.
  3. Rating: 120-V ac, 24-V ac or dc.
  4. Provide EDWARDS, model 1500 series

#### **2.16 INSPECTION BAR CODES**

- A. Inspection bar codes shall be installed on all initiating devices, annunciators, control panels and power supplies.
- B. Inspection bar codes used by the system must utilize Code 3 of 9 or other approved format, and contain a minimum of eight (8) digits that comprise a unique serial identifier within the Web-based Reporting System. There shall be no duplication of serial numbers. Serial number shall be printed below the bar code for identification purposes.
- C. Inspection bar codes shall be limited in size to no more than 2" (5cm) in width, and 3/8" 0.07 feet (2 cm), in height and shall include a Mylar® or other protective coating to protect the bar code from fading due to sunlight or exposure.
- D. Inspection bar codes shall be installed on each device in such a manner as to require that scanning of the bar code take place no further than 12" from the device during inspection.

#### **2.17 DOCUMENT STORAGE CABINET**

- A. The cabinet shall have all fire alarm documents inside the enclosure a removable steel sleeve that will accommodate standard 8 ½ x 11 manuals and loose document records that will be protected within the enclosure. A legend sheet permanently attached to the door for system passwords and critical information and inspection notes. The FAD will have permanently and securely mounted inside a minimum of 4GB's digital flash memory drive with a standard USB B connector for uploading and downloading information. The drive shall not be accessible without tools to any person whom gains access to the records. The enclosure shall also provide 2 key ring holders with a location to mount standard business type cards for key contact personnel

- B. The cabinet shall be red in color with the door cover shall be permanently screened with 1" high lettering "FIRE ALARM DOCUMENTS" with indelible ink. The access door shall be locked with a ¾" barrel lock and the hinge shall be a solid width 12" stainless steel piano hinge. The enclosure will supply 4 mounting holes.
- C. The system database program shall be stored on Digital Flash Memory Internal to the Document storage cabinet.

## **2.18 WIRE AND CABLE**

- A. Signaling Line Circuits – Intelligent Loop: Non-Twisted pair, not less than No. 16 AWG or as recommended by the manufacturer. Systems which use Shielded Wire requiring continuous foil shields and continuous drain wires are not acceptable, as they may lead to multiple ground faults and communication integrity faults
  - 1. Class B
  - 2. Class A – for circuits with more than 50 devices.
- B. Notification Appliance Circuits, Visual. Non-Twisted pair, not less than No. 14 AWG or as required by point-to-point voltage drop calculations:
  - 1. Class B
  - 2. Maximum circuit loading to 2.5 amps for notification appliance circuits.
  - 3. Each notification circuit shall have installed circuit capacity at the end of the circuit to support two (2) 115 Candela ceiling horn-strobe visual appliances.
  - 4. Each floor/level shall be designed to support a minimum capacity of twenty (20) 115 Candela ceiling horn-strobe visual appliances.

## **PART 3 EXECUTION**

### **3.01 EQUIPMENT INSTALLATION**

- A. Comply with NFPA 72 for installation of fire alarm equipment.
- B. Comply with NECA 305 "Standard for Fire Alarm System Job Practices" as published by the National Electrical Contractors Association.
- C. Fire-Alarm Control Unit: Install wall-mounted equipment cabinets, with tops of cabinets not more than 72 inches (1828.8 mm) above the finished floor.
- D. LOC/Annunciator: Install with top of panel not more than 56 inches (1422.4 mm) above the finished floor.
- E. Duct-Mounted Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes within 10' of straight duct and so they extend the full width of duct. Where installation within 10' of straight duct is not feasible, provide additional sampling tubes as required to protect ductwork branches.
- F. Heat Detectors in Elevator Shafts: Coordinate temperature rating, thermal response characteristic and location with sprinkler rating and location. Mechanical control(s): Outputs shall be installed with individual supervised output(s) with remote relay(s) to control each mechanical equipment individually.
- G. Remote Status and Alarm Indicators: Shall be installed below 72" from finished floor near each heat detector, smoke detector and duct detector that are not readily visible from normal viewing position. Remote Status and Alarm Indicators shall be marked with permanent label.
- H. Notification Devices: Install devices with appropriate back box and raceway according to room finish (i.e. flush mounted devices in recessed back boxes with concealed conduit in finished spaces; surface mounted boxes with exposed conduit in unfinished spaces).

### **3.02 WIRING INSTALLATION**

- A. Install wiring according to the following:
  - 1. NECA 1.
  - 2. TIA/EIA 568-A.

3. Cables, raceways, and support pathways, including but not limited to j-hooks and cable tray, that are used for fire alarm circuits and equipment control wiring associated with the fire alarm system shall not contain any other wire or cable.
  4. Circuits: Power-limited fire alarm cables shall not be installed in the same cable or raceway as signaling line circuits.
- B. All wiring shall be terminated on terminal blocks. No wire nuts are accepted.
  - C. Any penetrations through fire-resistance-rated wall or ceiling assembly shall use an approved fire stop system installed in accordance with ASTM E814 or UL 1479. The system shall have an F rating that is not less than the fire-resistance rating of the wall being penetrated. It is critical that the firestop system be appropriate for the penetration being protected.
  - D. Wiring Method: Install wiring in metal raceway according to NFPA 70, National Electric Code.
  - E. Wiring Method for vertical risers penetrating floor slabs: Install wiring in metal raceway according to NFPA 70, National Electric Code.
  - F. Wiring Method for circuits concealed in Walls, Partitions, and Inaccessible Ceilings: Install wiring in metal raceway according to NFPA 70, National Electric Code.
  - G. Wiring Method for surface mounted and other exposed circuits, including in Crawlspace: Install wiring in metal raceway according to NFPA 70, National Electric Code.
  - H. Wiring Method for Smoke Control Systems: Install wiring in metal raceway according to NFPA 70, National Electric Code.
    1. Circuits and equipment control wiring associated with the Smoke Control system shall be installed in a dedicated raceway system.
    2. Circuits and equipment control wiring associated with the Smoke Control system shall be 2-hour protected by an approved method according to NFPA 72.
  - I. Wiring within Enclosures:
    1. Separate power-limited and non-power-limited conductors as recommended by manufacturer.
    2. Install conductors parallel with or at right angles to sides and back of the enclosure.
    3. Bundle, lace, and train conductors to terminal points with no excess.
    4. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks.
    5. Mark each terminal according to the system's wiring diagrams.
    6. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
  - J. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.
  - K. Wiring to Remote Alarm Transmitting Device: Provide 1-inch (25-mm) conduit between the FACP and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.
  - L. Conductors: Size according to system manufacturer's written instructions, unless otherwise indicated.
  - M. General Requirements for Cabling:
    1. Comply with TIA/EIA-568-B.1.
    2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
    3. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
    4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (762 mm) and not more than 6 inches (152.4 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
    5. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.

6. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
7. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
8. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

### **3.03 OPTICAL FIBER CABLE INSTALLATION:**

- A. Comply with TIA/EIA-568-B.3.
- B. Cable shall be terminated on connecting hardware that is rack or cabinet mounted.

### **3.04 IDENTIFICATION**

- A. Identify system components, wiring, cabling, and terminals.
  1. Paint junction box cover plates using red paint. Stencil the letters "FA" in white paint over red background.
  2. For all components of the fire alarm system requiring 120VAC power, provide a permanent engraved label at the component indicating the panel and circuit number from which it is fed.
- B. Install framed Fire Alarm operating instructions in a location visible from the FACP.
- C. Color-Coding:
  1. Red jacket with Color-coded stripe to distinguish fire alarm conductors from the normal building power wiring.
  2. Use a separate color-coded stripe for SLC circuits, Power circuits, Speaker circuits, Strobe circuits, Fire-Phone circuits, and Network Data circuits.
- D. Provide a red marking on all circuit breakers feeding any fire alarm control system in accordance with NFPA 72. Provide a permanent engraved label next to the circuit breaker(s) feeding the system that reads "Fire Alarm Control Circuit".
- E. Provide a breaker lock on any circuit breaker(s) feeding any fire alarm control system in accordance with NFPA 72.

### **3.05 GROUNDING**

- A. Ground the FACP and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to the FACP and surge protectors.

### **3.06 FIELD QUALITY CONTROL**

- A. Field tests shall be witnessed by authorities having jurisdiction, as required.
  1. Provide 14 days' advance written notice of tests and opportunity for observation of tests by Engineer and Owner's representative.
- B. Manufacturer's Field Service: Engage a factory-certified service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Tests and Inspections:
  1. Visual Inspection: Conduct visual inspection prior to testing.
    - a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 and by this specification in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
    - b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
  2. Optical Fiber Cable Tests:
    - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.



- b. Link End-to-End Attenuation Tests:
    - 1) Multimode Link Measurements: Test at 850 or 1300 nm in 1 direction according to TIA-526-14-A, Method B, One Reference Jumper.
    - 2) Attenuation test results for links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.
  - 3. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
  - 4. Test audible appliances according to manufacturer's written instructions. Perform the test using a certified portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
  - 5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
  - 6. Conduct Acceptance Testing per NFPA 92A (8.4) for Firefighters' Smoke-Control Station.
  - 7. Factory-certified service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
- D. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
- E. Fire alarm system will be considered defective if it does not pass the initial test and inspection.
  - 1. Should the system require retesting after two occurrences (third test and beyond until approved by owner and owner's representative), the contractor is responsible for any and all time and expense costs and/or fees for subsequent tests incurred by the owner and/or the owner's representatives, including but not limited to the architect and the fire protection consultant.
- F. Prepare test and inspection reports.
- G. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.
- H. Annual Test and Inspection: One year after date of Substantial Completion, test fire alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

### **3.07 INTELLIGIBILITY TESTING AND ACOUSTICAL ADJUSTMENT**

- A. Installing Contractor and Fire Alarm Distributor Shall include in their bid all costs to provide two (2) full Intelligibility Tests of all Acoustically Distinguishable Spaces (ADS). Such tests shall be made and witnessed in the presence of the Owner and/or their designated representative.
- B. Intelligibility testing of the System shall be accomplished in accordance with NFPA 72 for Voice Evacuation Systems, IEC 60268-16, and ASA S3.2.
- C. Following are the specific requirements for intelligibility tests:
- D. Intelligibility Requirements: Verify intelligibility by measurement after installation.
- E. Ensure that a CIS value greater than the required minimum value is provided in each area where building occupants typically could be found. The minimum required value for CIS is 0.65.
- F. Areas of the building provided with hard wall and ceiling surfaces (such as metal or concrete) that are found to cause excessive sound reflections may be permitted to have a CIS score less than the minimum required value if approved by the AHJ installation, and if building occupants in these areas can determine that a voice signal is being broadcast and they must walk no more than 33 feet (1005.84 cm) to find a location with at least the minimum required CIS value within the same area.

- G. Areas of the building where occupants are not expected to be normally present are permitted to have a CIS score less than the minimum required value if personnel can determine that a voice signal is being broadcast and they must walk no more than 50 feet (1524 cm) to a location with at least the minimum required CIS value within the same area.
- H. Take measurements near the head level applicable for most personnel in the space under normal conditions (e.g., standing, sitting, sleeping, as appropriate).
- I. The distance the occupant must walk to the location meeting the minimum required CIS value shall be measured on the floor or other walking surface as follows:
- J. Along the centerline of the natural path of travel, starting from any point subject to occupancy with less than the minimum required CIS value.
- K. Curving around any corners or obstructions, with a 12 inches (304.8 mm) clearance there from.
- L. Terminating directly below the location where the minimum required CIS value has been obtained.
- M. Use commercially available test instrumentation to measure intelligibility as specified by ISO 7240-19 and ISO 7240-16 as applicable. Use the mean value of at least three readings to compute the intelligibility score at each test location.
- N. Record all intelligibility readings for the ADS in the web-based bar code inspection and testing software and affix barcode to the nearest audible notification appliance closest to the entrance or exit from the ADS.
- O. Provide a preliminary report to the Owner and Owner's Representative for review. Include time for a review meeting to discuss the results and any areas for adjustments.
- P. Provide one (1) full speaker tap setting adjustment to each notification appliance within the entire audible notification appliance network. Adjust speaker wattage tap settings up or down based upon the direction provided by the Owner's Representative. Do not adjust speaker tap settings for speakers or areas which are not determined to need adjustment.
- Q. Provide a second full Intelligibility Test and Final Intelligibility Report to the Owner and Owner's Representative for approval

### **3.08 ADJUSTING**

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project outside normal occupancy hours for this purpose.
- B. Follow-Up Tests and Inspections: Within one year of Substantial Completion, perform 100% annual test of the fire alarm system complying with NFPA 72. Provide the test results to the owner within 48 hours of completion

### **3.09 CLEANING**

- A. Clean components according to manufacturer's written instructions.
- B. Replace any devices that are identified as dirty or defective.
- C. On completion of device box installation but before any wiring devices are installed, inspect interior of boxes and perform the following:
- D. Vacuum dirt and debris; do not use compressed air to assist in cleaning.
- E. On completion of initiation and notification devices installation, inspect exterior surfaces and perform the following:
- F. Remove paint splatters and other spots.
- G. Remove all temporary markings and labels.
- H. Wipe down all devices with approved cleaning agent to remove fingerprints and dust.

### **3.10 DEMONSTRATION**

- A. Engage a factory-certified service representative to train Owner's management and maintenance personnel to adjust, operate, and maintain fire alarm system.

**END OF SECTION**